A Review of the Global Literature on Dental Therapists

In the Context of the Movement to Add Dental Therapists to the Oral Health Workforce in the United States

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PREPARED BY

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

PREFACE

The literature of the countries using dental therapists in their oral health workforces is extensive. Consequently, an attempt to summarize the literature is lengthy. The intention is to provide as comprehensive a review as possible in order that the existing global literature is accessible to anyone desiring to study it.

For a much more detailed and substantive summarization of the literature than is provided in this executive summary, the reader is referred to Section 17: "Summary and Conclusions."

There are 1,100 documents referenced in the bibliography. Two-thirds of these are cited and annotated in this monograph. These are identified in boldface type in the bibliography.

INTRODUCTION

"Oral Health in America: A Report of the Surgeon General" in 2000 highlighted the problems in oral health for many Americans—problems that are particularly acute for America's children. Barriers to accessing care have created significant oral health disparities among the children of the United States. In addressing this issue, efforts have focused on the inadequacy of the oral health care workforce, with calls for expanding the workforce to include the development and deployment of individuals with the skills in caring for children traditionally associated with the school dental nurse/dental therapist in New Zealand and many other countries. A dental therapist is a limited practitioner who can provide basic dental care in the same manner as a dentist. Historically, the focus of a dental therapist has been on the prevention and treatment of dental disease in children.

Worldwide, the scope of a dental therapist's practice generally includes examination, diagnosis and treatment planning; exposing radiographs; oral health education; preventive services such as prophylaxis, fluoride therapy, fissure sealants and dietary counseling; preparation of cavities in primary and permanent teeth and restoration with amalgam and composite; stainless steel crowns; pulpotomies; and the extraction of primary teeth. In some countries, dental therapists may also extract permanent teeth.

The introduction of dental therapists to the oral health care team in the United States is controversial. Some of the controversy relates to an inadequate understanding of the use of dental therapists as members of the dental team internationally. This monograph provides a literature-based review of the history and practice of dental therapists throughout the world.

The monograph reviews the literature, by country, for which documentation of the use of dental therapists could be identified. Individual sections cover the United States, New Zealand, Australia, the United Kingdom, Canada, the Netherlands, Hong Kong, Singapore, Malaysia and Thailand. Other countries are in sections by region: Africa, Caribbean and Pacific Islands. Finally, the literature of remaining countries is in a separate section, "Other Nations."

The executive summary and the final summary are organized by themes from the literature. They are: "History and Distribution of Dental Therapists"; "Education/Training"; "Legislation, Registration and Licensure"; "Scope of Practice and Practice Settings"; "Oversight, Supervision and Safety of Care"; "Access to and Effectiveness of Care"; "Quality of Technical Care"; "Perspectives of the Dental Profession"; and "Perspectives of the Public."

METHODS

A consultant was identified in each country considered to have a substantive literature on dental therapists. The monograph's 17 contributors are all academics or public health officials who are knowledgeable about dental workforce issues in their respective countries. The contributors conducted comprehensive searches for literature relating to the practice of dental therapists in their respective countries. They also focused on identifying "gray" documents—that is, reports of governmental agencies and nongovernmental organizations. In addition to obtaining copies of the documents, the consultants prepared written summaries and translated those that were in languages other than English.

One thousand one hundred (1,100) documents were identified that directly or indirectly related to the use of dental therapists in the global oral health workforce. They constitute the bibliography of the monograph. Two-thirds of these documents are cited within the monograph.

HISTORY AND DISTRIBUTION OF DENTAL THERAPISTS

The use of dental therapists in the global oral health workforce began in New Zealand in 1921. Subsequently, other countries, lacking an adequate oral health workforce, followed New Zealand's lead. The research identified 54 countries and

territories where dental therapists currently are used, most often in school-based programs for children.

This monograph reviews documents of 26 of these countries: Anguilla, Australia, Bahamas, Botswana, Brunei, Canada, Fiji, Guyana, Hong Kong, Jamaica, Malaysia, Netherlands, New Zealand, Papua New Guinea, Samoa, Seychelles, Singapore, South Africa, Sri Lanka, Suriname, Tanzania, Thailand, Trinidad and Tobago, United Kingdom, United States and Zimbabwe.

No documents could be identified for the other 28 countries or territories. However, there is reliable evidence, in the form of verbal reports from knowledgeable persons that dental therapists practice in 16 of these 28 countries and territories. They are Barbados, Cook Islands, American Samoa, Federated States of Micronesia, Grenada, Kiribati, Marshall Islands, Nepal, Palau-Belau, Solomon Islands, Tokelau, Tonga, Vanuatu, Vietnam and Northern Mariana Islands.

Suggestive evidence (from other publications) indicates that dental therapists practice in the other 12 countries: Belize, Benin, Burkina Faso, Costa Rica, Gabon, Gambia, Laos, Mali, Malawi, Myanmar, Togo and Swaziland.

Early adopters of dental therapists include Malaysia (1948), Sri Lanka (1949), Singapore (1950), Tanzania (1955) and the United Kingdom (1959). Additional countries added dental therapists to their oral health workforces later, including Australia (1966), Thailand (1968), Jamaica (1970), Canada (1972), Fiji (1973), Seychelles (1974), South Africa (1975), Trinidad and Tobago (1975), Suriname (1976) and Hong Kong (1978).

The use of dental therapists is more common in countries that were members of the British Commonwealth. Of the 54 countries and territories employing dental therapists, 33 are members of the Commonwealth of Nations.

In the United States, the Alaska Native Tribal Health Consortium introduced dental therapists to care for Alaska Natives in tribal villages in 2005. In 2009, the state of Minnesota authorized the training and practice of dental therapists to care for underserved segments of its population. The first dental therapists entered practice in Minnesota in 2011.

Dental therapists serve in both developed and developing countries. Five of the top six countries of the world on the Human Development Index employ dental therapists in their oral health workforces: Australia (2), Netherlands (3), United States (4), New Zealand (5) and Canada (6). Other countries employing dental therapists in the top 50 countries of the Index are Hong Kong (13), Singapore (26), United Kingdom (28), Brunei (33) and Barbados (47).

THE TRAINING AND EDUCATION OF DENTAL THERAPISTS

New Zealand pioneered the development of dental therapists, with the first class of 29 school dental nurses graduating from a two-year post-high school vocational training program in Wellington, New Zealand, in 1923. They were trained to provide dental care for elementary schoolchildren, and were deployed to serve in a public School Dental Service.

Vocational training in a two-year curriculum has been the tradition in the majority of countries using dental therapists, with the awarding of a certificate or diploma on completion. In some countries, the training of dental therapists has expanded to three or four years.

Gaining knowledge of the basic biomedical sciences supporting dental practice and the acquisition of perceptual motor skills tend to be the focus of the initial period of a curriculum, followed by intense clinical training. A strong emphasis on community oral health promotion and disease prevention is common.

In New Zealand, Australia and the United Kingdom the training of dental therapists and dental hygienists has been integrated into a three-year curriculum. The Netherlands has expanded its dental hygienists training to include dental therapists' skills, and extended the educational curriculum to four years. Singapore also provides opportunity for integrated training of dental therapists and dental hygienists. Continuing education modules are available in some countries, enabling dental therapists to add skills to their scope of practice.

LEGISLATION, REGISTRATION AND LICENSURE

The legislation relating to dental therapists in the United States is particularly pertinent to this review. In 1949, legislation directed the Massachusetts Department of Public Health to provide dental hygienists two years of training, after which they would be permitted to prepare and fill cavities in children's teeth under the supervision of a dentist. Under pressure from the dental associations, the law was rescinded a year later. Again in the 1970s, authorization was provided for the "Forsyth Experiment," which successfully trained dental hygienists to provide basic dental services. However, under pressure from dentists, the program was terminated before its conclusion.

In 2003, the Alaska Native Tribal Health Consortium (ANTHC) sent Alaska Natives to New Zealand to train as dental therapists. They returned to be employed as Dental Health Aide Therapists (DHATs). The American and Alaska dental associations sued the ANTHC and the individual DHATs for the illegal practice of dentistry. The suit was withdrawn after the attorney general of Alaska

ruled that the DHATs were practicing under federal legislation and therefore not subject to state law. Federal regulations set the DHATs scope of practice; however, the services they can provide under general supervision can be limited by a supervising dentist.

In 2009, the Minnesota state legislature passed legislation authorizing creation of two categories of dental therapists, a dental therapist (DT) and an advanced dental therapist (ADT). As the legislation was passed to enhance access to care, DTs and ADTs must practice in settings serving low-income and underserved populations.

Literature on legislation, registration and licensure of dental therapists is sparse for most countries. Since most countries limit dental therapists to governmental service, they are not necessarily licensed or registered. Their scope of practice regulates their provision of care, with responsibility for supervision and review designated to their respective ministries of health.

Legislation, registration and licensure vary from country to country. National, state or provincial legislation authorizes the practice of dental therapists. Regulation is generally by dental councils (dental boards). In the many countries where dental therapists are public employees in school dental services, they are certified and regulated directly by the government's ministry of health or their employing service. In a few countries where more autonomy for practice is granted, dental therapists are licensed as professional practitioners, just as are dentists.

PRACTICE SETTINGS AND SCOPES OF PRACTICE

In many countries, the setting for the practice of dental therapists has expanded from school-based clinics to community-based clinics, hospital clinics and mobile dental units.

However, the service has continued to focus on caring for schoolchildren, though not exclusively, as care is also provided to adults in some countries. Dental therapists in some jurisdictions are permitted to work in private practices caring for children. A few countries, however, also permit dental therapists to care for adults in the private sector. Although some countries are expanding the role of dental therapists to include adult care, children's dental care continues to be the most common assignment of dental therapists in the global oral health workforce.

The following countries use dental therapists as public employees serving children in a school dental service: New Zealand, Australia, Hong Kong, Singapore, Malaysia, Jamaica, Trinidad and Tobago, Bahamas, Anguilla, Papua New Guinea, Sri Lanka, Seychelles, Brunei, Guyana, Samoa and Suriname. Verbal evidence suggests that in the several countries for which literature could not be obtained,

dental therapists also function primarily in caring for schoolchildren. In these countries, the dental therapist's scope of practice is similar and includes basic procedures for providing primary preventive and restorative care for children as indicated previously.

While dental therapists' scope of practice typically is restricted to children, an increasing number of countries permit dental therapists, frequently with additional training, to treat adults as well. In New Zealand and Australia, dually qualified hygienists/dental therapists may provide dental therapists' treatments to children and adolescents, but only dental hygienists care for adults—absent special "adult competency" certification in restorative care.

OVERSIGHT, SUPERVISION AND SAFETY OF CARE

The literature on dental therapists emphasizes their oversight and supervision by dentists to protect the public. As the majority of dental therapists work with children in public school-based programs, supervision is by a government dentist, who may or may not be on site. Dental therapists adhere strictly to protocols and standing orders, which are determined by the government service in which they work.

Levels of supervision vary among countries, and in different settings within the same country. In some countries, dental therapists may practice independently without dentist supervision; in others, they may work independently, but with a collaborative/consultative relationship with a dentist.

The literature does not document any issues of safety or harm as a result of care provided by dental therapists.

QUALITY OF TECHNICAL CARE

There have been many evaluations of the technical quality of care provided by dental therapists over the past 60 years. The studies have consistently found that the quality of technical care provided by dental therapists (within their scope of competency) was comparable to that of a dentist, and in some studies was judged to be superior.

This monograph documents the results of assessments and studies that have taken place in many countries, including the United States, New Zealand, Australia, the United Kingdom and Canada. The continued use of dental therapists in the 54 countries and territories identified provides tacit documentation of an acceptable quality of technical care provided by dental therapists.

ACCESS TO CARE AND EFFECTIVENESS OF CARE

The impetus for adopting dental therapists as part of the oral health workforce has typically been the objective of improving both access to care and effectiveness of care for children.

In most countries, dental therapists are public health employees deployed in school dental programs. Global studies show high and steadily increasing enrollment in school dental programs over time, and reveal their positive influence in improving access to care for large numbers of children—sometimes essentially the entire population of elementary schoolchildren in a given area.

In New Zealand in 2010, over 60 percent of children ages 2 to 4 years were enrolled in and utilized the publicly-funded child oral health services; 98 percent of 5-to-13-year-olds participated. In recent years, participation in Australia has been 62 percent; in Hong Kong 88 percent; and in Malaysia 96 percent of elementary schoolchildren and 67 percent of secondary school students have been enrolled. When the school dental program in Saskatchewan existed, 80 percent of schoolchildren were enrolled. It is thought that children from lower socioeconomic groups are more likely to benefit from school dental programs staffed with dental therapists.

Evaluations of dental services based on the dental health of the population must be seen in the light of falling levels of dental caries due to other factors, such as fluoridation, and the many factors that mediate the relationship between service provision and population health. However, data indicate that dental disease rates of children decline subsequent to the introduction of dental therapists in the oral health workforce.

The degree to which dental caries in children has been effectively treated is a strong and reliable indicator of the accessibility and effectiveness of dental care. Epidemiological data available since 1965 document that New Zealand has been more effective in treating dental caries in its public school-based program of care provided by dental therapists, than has the United States in its system of care in private offices by dentists.

According to the New Zealand Ministry of Health, in the 2010-11 year, the number of decayed filled teeth (dft) for children 2 to 11 years old was 1.6. Of this only 0.3 was due to decay, with 1.3 being filled teeth. Comparable numbers reflecting dental therapists' success in treating schoolchildren with dental decay exist in other countries as well.

A number of reports suggest the cost-effectiveness of dental therapist-led school dental services. The school dental programs in New Zealand and Australia cost less than private fee-for-service systems for the same service. The average cost of

school-based dental care in New Zealand in 2010-11 was $99 (U.S.) per child. In the private sector in New Zealand, an examination, radiographs and cleaning in 2010-11 was $102 (U.S.), and a one surface restoration cost $99; a fissure sealant $47.

In Australia, one study indicated that the annual cost savings by using dental therapists for care within their scope of practice, rather than dentists, could result in savings of 14-19 percent in dental expenditures. Another Australian study found that in one state the average cost of care for a child in a given year in the private sector was $265, versus the cost for care by dental therapists in the school dental service of $52.46.

The opportunity for more cost-effective care is related, in part, to the salary differential between dental therapists and dentists. An average New Zealand dental therapist earns between $30,000 to $40,000 (U.S.), and private-practicing dentists earn $120,000 to $150,000 a year (U.S.).

However, the cost-effectiveness of dental therapists cannot be calculated in isolation because they often work as part of a team, with dentists supervising them. The cost of these dentists should be incorporated into cost comparisons; therefore, more appropriate comparisons are between services that do and do not employ dental therapists.

PERSPECTIVES OF THE DENTAL PROFESSION TOWARD DENTAL THERAPISTS

The perspective of the dental profession is well-represented in the literature on dental therapists. A comprehensive range of views is evident, but in general these views polarize into opponents and proponents. In some cases, the intellectual quality and tone of the debate has reflected poorly on the dental profession.

Many dentists and professional dental associations in the United States are opposed to the inclusion of dental therapists on the dental team. They have asserted that dental therapists threaten the safety of the public due to providing a lower quality of care and that they open a wedge for unqualified individuals to practice dentistry. Dental therapists have been described variously as a hazard and "a menace to the public, a menace to the [dental] profession, and an injustice to those seeking to enter the ranks of the [dental] profession."

Proponents of dental therapists refute the assertions of the opponents and have accused them of having a hidden agenda, particularly of looking after their own economic interests. They cite studies that have shown that dentists, despite not knowing who dental therapists are or what they do, oppose them anyway.

Proponents claim that dental therapists' care has been evaluated on numerous occasions and in multiple countries. They argue that they provide high-quality, safe and effective care equal to that of dentists working under the same conditions, and do so at a lower cost. Dental therapists included on the dental team are thought to liberate dentists for more complex treatment. They also argue that services employing dental therapists extend the geographical reach of dentistry, increase access to care, and provide a safety net for those who cannot obtain care. Proponents equate the use of dental therapists with the use of dental hygienists in that they help free the dentist to do other work. They also compare dental therapists to 'mid-level' providers such as nurse practitioners, who function effectively in other areas of health care.

Both proponents and opponents of dental therapists have attributed views to the general public, often in the absence of evidence. Proponents claim that "patients—both adults and children—of every socioeconomic stratum will find care delivered by dental therapists to be entirely acceptable." Opponents have argued that they would not be accepted by the public, and might be resented by individuals in lower socioeconomic groups as providing second-class, inferior care.

The literature in this research indicates that, in general, the dental profession in the countries reviewed are supportive of the role dental therapists play in caring for the oral health of the population, specifically with regard to children. To the extent that concern or dissatisfaction could be identified in the literature, it typically related to dental therapists treating adults or practicing independently. The evidence suggests that once dental therapists have been introduced in a country, professional support for them increases over time.

Harold Hillenbrand, the respected executive director of the American Dental Association from 1946 to 1970, said: "When the dental history of our time is eventually written, I believe the New Zealand Dental Nurse Program will be considered one of the landmark developments in the practice of dentistry and dental public health." He went on to say that New Zealand has "pioneered in a very effective method for delivering dental health services to children." Finally, he concluded "the New Zealand experience proves that we can develop an auxiliary program—and a very advanced one—that is acceptable to and approved by the profession of the country involved."

PERSPECTIVES OF THE PUBLIC TOWARD DENTAL THERAPISTS

In the United States, philanthropic foundations frequently provide leadership for the public in identifying societal problems and funding pilot projects to stimulate both private and public sectors in resolving them. The problem of access to health care and its negative impact on the health of poor and underserved populations

has been a focus of several U.S. foundations in recent years. With respect to oral health issues, these foundations have recognized that dental therapists in the oral health workforce can assist in addressing the problems of access and disparities. They have provided funds for research, advocacy and implementation of oral health care programs. Among them are the Josiah Macy Jr., Pew, Rasmuson, Robert Wood Johnson, and W.K. Kellogg foundations.

The W.K. Kellogg Foundation commissioned a national survey in 2011 on the views of Americans on the issue of access to dental care. "More than three-quarters of respondents (78%) support an effort to train a new dental provider—a licensed dental practitioner—to work under the supervision of a dentist to provide preventive, routine care to people without regular access to care."

The high level of use of school dental services employing dental therapists in a large number of countries is strong evidence that the dental therapist can provide care that is acceptable to and valued by the public. Numerous and detailed evaluations of these programs, summarized in this monograph, reveal strong patient and parental support for care by dental therapists.

The people of New Zealand consider the School Dental Service with its dental therapists a New Zealand "icon." Another report states: "The School Dental Service has become an integral component of the New Zealand culture. To Kiwis it is like motherhood, apple pie and the flag."

Parents in Saskatchewan were "outraged" at the transfer of the school-based plan to the private sector.

No evidence could be found to indicate that the public perspective of dental therapists in any country was other than positive.

CONCLUSIONS

The global literature indicates:

1. Dental therapists practice in 54 countries and territories, including highly developed, industrialized ones as well as developing countries.
2. There are variable lengths of training for dental therapists, from two to four years, with two years being the tradition.
3. There is a movement in a few countries to integrate the training, and therefore scopes of practice, of the dental therapist and dental hygienist. Typically this is in a three academic year (27 months) program.
4. Dental therapists, in general, are not licensed professionals, but rather practice as registered auxiliaries.

5. Dental therapists practice primarily in public clinics, typically associated with caring for schoolchildren.
6. Dental therapists' scope of practice is primarily in caring for children, although several countries permit caring for adults.
7. Dental therapists typically practice with general supervision by dentists.
8. Dental therapists provide technically competent care.
9. Dental therapists improve access to care, specifically for children.
10. Dental therapists are effective in providing oral health care within their scope of practice.
11. Dental therapists have a record of providing oral health care safely.
12. The dental profession in a country accepts the care provided by dental therapists as valuable; however, there are some exceptions to this.
13. The public values the role of dental therapists in the oral health workforce.
14. Dental therapists included in the oral health workforce have the potential to decrease the cost of care, specifically for children.

Section 1

INTRODUCTION

"Oral Health in America: A Report of the Surgeon General" in 2000, and the subsequent *"Call to Action to Promote Oral Health"* in 2003, highlighted the problems in oral health for many Americans. The problems are particularly acute for poor children and children of color who face barriers to accessing oral health care; barriers that have created significant disparities among children in the United States. In addressing this issue, some efforts have focused on the inadequacy of the oral health care workforce, with calls for expanding the workforce to include the development and deployment of individuals with the skills in caring for children that are traditionally associated with the school dental nurse/dental therapist. Using school dental nurses/dental therapists (also known in the United States as dental health aide therapists, dental therapists and dental practitioners) originated in New Zealand in 1921. That model has since spread to more than 50 other countries and territories.

Adding dental therapists to the oral health care workforce in the United States has resulted in controversy, which is related to a lack of understanding of the historical efforts of dental therapists internationally. The research reported in this monograph is an attempt to provide a literature-based approach to understanding the practice of dental therapists around the world. The research reviews the global literature on the practice of dental therapists, including the historical literature relevant to the concept of dental therapists that exists in the United States. The literature identifies and cites documents of the work of dental therapists with regard to history and distribution; training and education; legislation; registration and licensure; practice settings and scopes of practice; oversight, supervision and safety of care; quality of technical care; access to and effectiveness of care; perspectives of the dental profession toward dental therapists; and perspectives of the public toward dental therapists.

This monograph is organized into 18 sections, beginning with the methodology employed in conducting the literature review and the results of the review.

Section 3 on the United States provides a basis for understanding the access to oral health care issues and the oral health workforce problems in the United States. All of the literature in the United States related to the concept of introducing dental therapists to the workforce was reviewed, dating from 1932. In subsequent sections, the experiences of a number of nations where the use of dental therapists could be documented with literature are reviewed.

Several countries receive particular attention, as they have experienced the most extensive use of dental therapists, and have the largest volume of literature documenting the work of dental therapists. These countries are New Zealand, Australia, the United Kingdom, Canada, the Netherlands, Hong Kong, Singapore, Malaysia, Thailand and the United States. Some countries and territories are reviewed in the context of the region in which they exist: Africa, the Caribbean and the Pacific Islands. Finally, several countries that did not fit the above descriptions are reviewed in a section titled "Other Nations." The monograph concludes with a Summary and Conclusions.

The monograph is essentially an annotation of the global literature, with minimal discussion. The contributors have attempted to provide an assessment of the global literature without opinion or comment. As a consequence of this commitment, large sections of the document are actual quotes from the literature, in order to reduce any potential bias in summarization.

This document is not an evidence-based systematic review of the literature. Rather, it is intended to identify the literature and annotate relevant documents that assist in characterizing the use of dental therapists worldwide.

It will be noted that the style of writing varies slightly from section to section. This is because of the number of different contributors to the monograph.

The monograph concludes with an extensive bibliography of more than 1,000 documents that were identified as germane to the use of dental therapists globally. Two-thirds of the documents in the bibliography are cited and summarized in the monograph.

Section 2

REVIEWING THE LITERATURE

METHODOLOGY

A number of articles have been published in recent years and in many countries, including the United States, regarding the use of dental therapists in the workforce to improve access to oral health care. The articles and the references cited served as a basis for identifying as many of the documents as possible that exist globally that reference the use of dental therapists in the workforce. In consulting the literature, several countries were selected for intensive research due to their significant use of dental therapists. As previously noted, dental therapists have been identified—through documented research, verbal evidence and statements in other publications—in at least 54 countries and territories.

Consultants in each of the countries considered to have a substantive literature on dental therapists were asked to participate in the research. They are all knowledgeable academics or public health officials with a history of having dealt with the issue of the dental workforce. In addition to reviewing published articles, they focused on identifying "gray" documents—that is, reports of governmental and nongovernmental organizations (NGOs) that addressed the practice of dental therapists, but were not listed in the published literature. In addition to obtaining copies of the documents, the consultants also translated those that were in languages other than English and prepared written summaries. Seventeen people from throughout the world contributed to this work.

The following databases were searched: ISI Science Citation Index; ISI Social Science Citation Index; Clinical Controlled Trials Register, Cochrane Library; Cumulative Index to Nursing and Allied Health Literature; Database of Abstracts of Reviews of Effects (DARE); System of Indexing Grey Literature in Europe (SIGLE); Medline; and PubMed. Google Scholar and the Google search engine were also searched. Keywords searched were "dental nurse," "school dental nurse," "dental therapist," "school dental service," "school dental therapist," "school-based dental care," "dental auxiliaries" and "dental workforce." In addition, searches were conducted of the governmental and dental association websites of all countries known to have dental therapists in their oral health workforce. The documents and associated references thus obtained are listed in the bibliography.

RESULTS OF REVIEW

Documents

The bibliography consists of books, monographs, governmental reports, nongovernmental reports, theses and dissertations, letters and articles from the published literature of dentistry.

The authors of the report identified, collected and prepared annotations of the documents, which subsequently formed the substance of the report. The bibliography identifies 1,100 documents relevant to issues of the oral health workforce meeting the needs of society for oral health care. Two-thirds of these are annotated in the report. These are printed in boldface type in the bibliography.

The final preparation of the report was the responsibility of the three members of the core research team: Drs. Nash, Friedman and Mathu-Muju.

Countries

The research identified dental therapists as members of the oral health workforce in 54 countries and territories. As is well known, using dental therapists in the oral health workforce began in New Zealand in 1921, with the establishment of a two-year training program for dental nurses to staff a School Dental Service. The 54 countries and territories using dental therapists are listed in the accompanying table. Documents regarding the work of dental therapists/nurses were identified and annotated from 26 of these countries, which are in boldface print.

It is interesting to note that as the concept of using dental therapists spread throughout the world, it seemed to follow a pattern of implementation in countries that, like New Zealand, were members of the Commonwealth of Nations; those countries had experienced an association with the British Empire. Thus, of the 54 countries and territories employing dental therapists, 33 are members of the Commonwealth of Nations; these are identified in the below table with a "C."

Early adopters of the concept in the 1940s, '50s and '60s include Malaysia (1948), Sri Lanka (1949), Singapore (1950), Tanzania (1955) and the United Kingdom (1959). In the '60s and '70s, additional countries added dental therapists to their oral health workforces, including Australia (1966), Thailand (1968), Jamaica (1970), Canada (1972), Fiji (1973), Seychelles (1974), South Africa (1975), Trinidad and Tobago (1975), Suriname (1976) and Hong Kong (1978). The initiation of the training of dental therapists at the Fiji School of Medicine resulted in dental therapists being trained from additional Pacific Island countries, where

they returned to serve. The use of dental therapists also spread throughout the Caribbean with the adoption of school dental nurses in Jamaica and the establishment of a training program there.

In 2002, the Netherlands expanded the training of dental hygienists to include dental therapy. In the United States, the Alaska Native Tribal Health Consortium introduced dental therapists to care for Alaska Natives in tribal villages in 2005. In 2009, the state of Minnesota authorized the training and practice of dental therapists.

The date of initiation of dental therapists could not be determined for some countries included in this study: Guyana, Brunei, Samoa, Papua New Guinea, Anguilla, Zimbabwe and Botswana.

Additions/Deletions to Previous Publications, and Research Limitations

Nash, Friedman, Kardos and colleagues (**2008**) identified 53 countries as using dental therapists. Some of these countries had been listed in previous publications. However, based on the current research, errors were discovered in those reports.

One factor contributing to the errors was the use of the term "dental therapist," which means different things in different countries. For example, Nigeria and Paraguay were previously reported to use dental therapists; they do not. Those countries use the term "dental therapist" to describe individuals who perform as dental hygienists.

Adding to the confusion, in some countries such as Malaysia, the original terminology of "dental nurse" or "school dental nurse" has been retained.

The term "dental therapist" is also used in some instances to describe the work of the expanded function dental assistant/auxiliary (EFDA). Some confusion has developed in the literature as a result of studies at the University of Alabama (**Hammon et al., 1971; Bethart et al., 1972**). These articles employed the term "dental therapist" in the title, suggesting that the authors evaluated the functioning of dental therapists. They were actually studies of the use of expanded function dental assistants. One of the principals in this effort (Nash) recently learned that the human resources classification system at the University of Kentucky designates expanded function dental assistants as dental therapists.

As a result of the confusion in terms and other information, a number of countries thought to use dental therapists—that is, operating auxiliaries based on the New Zealand model—have been removed from the countries previously identified in the literature. They are Cambodia, Estonia, Ethiopia, Ireland, Jordan, Latvia, Nigeria and Paraguay.

There is some evidence that the few dental therapists identified in Switzerland work primarily as dental hygienists. One article was published in 1997 regarding the use of dental nurses in Cambodia (**Mallow, Klaipo, Durward, 1997**). However, the dental nurses described in the program were trained for only four to five months and, as a consequence, would not comport with the type of training and practice traditionally associated with the New Zealand-style dental nurse/dental therapist. It is known that a group of dental therapists were trained at the dental school of the University of Antioquia in Medellin, Colombia, in two-year, New Zealand-style curricula beginning in 1967 (**Barr, Barr, 1980**). Documentation exists that 10 graduates of the program subsequently were employed by the Colombia Ministry of Health. However, the program was discontinued and further documentation regarding it could not be identified. Dental therapists also reportedly exist in Oman, but this could not be confirmed.

Based on this research, the following countries and territories have been added to the list that was published by Nash, Friedman, Kardos et al. as using dental therapists: Papua New Guinea, Samoa, American Samoa, Brunei, Federated States of Micronesia, Kiribati, Palau-Belau, Solomon Islands, Tokelau, Tonga, Northern Mariana Islands and Vanuatu.

This report contains and reviews documents of 26 countries. No documents were located or identified for the other 28 countries and territories. There is strong (verbal) evidence that dental therapists practice in 16 of the 28. They are Barbados, Cook Islands, American Samoa, Federated States of Micronesia, Granada, Kiribati, Marshall Islands, Nepal, Palau-Belau, Solomon Islands, Tokelau, Tonga, Vanuatu, Vietnam and Northern Mariana Islands.

However, there is only suggestive evidence—that is, statements in other publications, unable to be confirmed with documentation in this effort—that dental therapists practice in the other 12 countries: Belize, Benin, Burkina Faso, Costa Rica, Gabon, Gambia, Laos, Mali, Malawi, Myanmar, Togo and Swaziland.

Other Reports of the Countries in Which Dental Therapists Practice

Guile, Hagens and de Miranda (**1981**) reported on dental nurses'/dental therapists' characteristics around the globe in an article on the development and deployment of dental nurses in Suriname. They identified 22 countries; of these, 14 are included in this report with documentation: Australia, Canada, Fiji, Guyana, Jamaica, Malaysia, New Zealand, Papua New Guinea, Singapore, Sri Lanka, Suriname, Tanzania, Trinidad and the United Kingdom. Identified by the authors but not able to be documented in this research were Colombia, Cuba, Indonesia, Senegal and Uganda.

In a master's degree thesis at the University of Sydney in 1986, Amer (**1986**) identified 35 countries using New Zealand-style dental nurses/dental therapists, as well as 42 countries using dental hygienists. Countries he identified that this study was unable to confirm included Burma, Colombia, Costa Rica, Cuba, Ghana, Indonesia, Kenya, Mexico, Nigeria, Pakistan, Senegal, Sierra Leone, Taiwan, Tobago, and Turkey. He indicated that 9,540 dental therapists existed in the world at that time.

In "World Dental Demographics," Zillèn and Mindak (**2000**) identified 26 countries using dental therapists. They included Anguilla, Australia, Bahamas, Benin, Burkina Faso, Canada, Estonia, Ethiopia, Gabon, Gambia, Grenada, Indonesia, Iran, Jordan, Kiribati, Latvia, Nepal, New Zealand, Singapore, South Africa, Sri Lanka, Swaziland, Thailand, Togo, United Kingdom and Zimbabwe. This study concluded that dental therapists do not exist in Estonia, Ethiopia, Indonesia and Latvia. We were unable to find documentation of the existence or nonexistence of dental therapists in Benin, Burkina Faso, Gabon, Gambia, Swaziland or Togo. Thus, we have left them on the list of countries with dental therapists, but as indicated above, they are countries for which we have no documentation. Zillèn and Mindak did not include a number of countries identified in this work as having dental therapists. They also did not include countries previously identified to have dental therapists for which this effort found questionable evidence: Cuba, Colombia and Cambodia.

Developed and Developing Countries

The use of dental therapists exists in both developed and developing countries. Five of the top six countries of the world on the Human Development Index use dental therapists in their oral health workforce: Australia (2), the Netherlands (3), the United States (4), New Zealand (5) and Canada (6). The country holding the top position in the index is Norway, which does not use dental therapists. Other countries employing dental therapists in the top 50 countries of the index are Hong Kong (13), Singapore (26), United Kingdom (28), Brunei (33) and Barbados (47).

The International Monetary Fund lists the following countries using dental therapists as having "advanced economies": Australia, Canada, Hong Kong, Netherlands, New Zealand, Singapore, United Kingdom and United States.

The Economist conducted a quality-of-life survey in 2005. The following "therapists' nations" were included in the ranking: Australia (2), Singapore (11), United States (13), Canada (14), New Zealand (15), Netherlands (16), Hong Kong (18) and United Kingdom (29).

Included on the list of Newly Industrialized Countries (NIC) that use dental therapists are South Africa, Malaysia and Thailand.

Compiling these statistics indicates that 13 of the countries employing dental nurses/dental therapists are developed countries. The remaining 41 would be considered developing or undeveloped countries and territories.

COUNTRIES AND TERRITORIES USING DENTAL THERAPISTS IN THEIR ORAL HEALTH WORKFORCES

(54 Total)

Countries (26) in **boldface type** have documents included in this report.
Countries and territories with a **"C"** following are members of the Commonwealth of Nations.

American Samoa	**Anguilla/C**	**Australia/C**
Bahamas/C	Barbados/C	Belize/C
Benin	**Botswana/C**	**Brunei/C**
Burkina Faso	**Canada/C**	Cook Islands
Costa Rica	Federated States of Micronesia	**Fiji/C**
Gabon	Gambia/C	Grenada/C
Guyana/C	**Hong Kong/C**	**Jamaica/C**
Kiribati/C	Laos	Mali
Malawi/C	**Malaysia/C**	Marshall Islands
Myanmar	Mozambique/C	Nepal
Netherlands	**New Zealand/C**	Northern Mariana Islands
Palau-Belau	**Papua New Guinea/C**	**Samoa/C**
Seychelles/C	**Singapore/C**	Solomon Islands/C
South Africa/C	**Sri Lanka/C**	**Suriname**
Swaziland	**Tanzania/C**	**Thailand**
Togo	Tokelau/C	Tonga/C
Trinidad and Tobago/C	**United Kingdom/C**	**United States**
Vanuatu/C	Vietnam	**Zimbabwe/C**

Section 3

UNITED STATES

PROVIDING A CONTEXT: THE ORAL HEALTH OF AMERICA'S CHILDREN

"Oral Health in America: A Report of the Surgeon General," released in 2000, and the subsequent "National Call to Action to Promote Oral Health" in 2003, highlighted the problems in oral health for many Americans. The problems are particularly acute for children. Efforts to address this crisis have focused on the inadequacy of the oral health care workforce, with calls for expanding the workforce to include individuals with skills in caring for children, such as New Zealand's school dental nurses, now designated "dental therapists."

Epidemiology of Dental Caries in Children

- Dental caries (tooth decay) affects 58.6 percent of 5-to-17-year-old children, and is therefore the nation's most common childhood disease—five times more common than childhood asthma and seven times more common than hay fever **(USDHHS, 2003).**
- Beltrán-Aguilar et al. (**2005**) found that 41 percent of 2-to-11-year-olds in the United States had experienced dental caries in their primary teeth.
- Twenty-eight percent of children ages 24 months to 60 months have early-childhood caries, an increase of 4 percent from 1988-94 to 1999-2004. Caries in 2-to-4-year-olds increased from 18 percent to 25 percent during that period, as did the prevalence of untreated tooth decay in that age group, from 18 percent to 24 percent **(Dye et al., 2007).**
- The prevalence of untreated dental caries in the primary dentition increased from 16 percent in 1988-94 to 19 percent in 1999-2004 **(Dye et al., 2007).**
- Dental caries in the primary dentition of 2-to-11-year-olds increased significantly between the National Health and Nutrition Examination Survey (NHANES) study of 1988-94 and the NHANES study of 1999-2004, 1.39 dft to 1.58 dft (**Dye et al., 2007).**
- Dental caries prevalence in children is higher for children living at less than 100 percent of the federal poverty level versus children living at greater than or equal to 200 percent of the federal poverty level **(Dye et al., 2007).**
- Dental care is the most prevalent unmet health need in children **(Newacheck et al., 2000).** Children lose 52 million hours of school time each year due to dental problems **(Gift et al., 1992).**

- Economically disadvantaged children experience nearly 12 times as many restricted-activity days from dental disease as do children from economically advantaged backgrounds **(GAO, 2000a).**
- Eighty percent of dental disease is found in 20 percent to 25 percent of children (approximately 18 million children), primarily from African American, Hispanic, American Indian/Alaska Native and low-income families **(Kaste et al., 1996)**.
- Seventy-nine percent of American Indian/Alaska Native children ages 2 to 5 have tooth decay, 68 percent of which is untreated **(Gehshan, Straw, 2002).**

Access to Care

- Significant numbers of carious teeth in children are not restored, and the numbers restored decline with an increase in the level of poverty **(Vargas, Crall, Schneider, 1998).**
- Children who are not covered by dental insurance are three times more likely to have an unmet dental need than their counterparts with either public or private insurance **(USDHHS, 2000)**.
- Children whose families have incomes below 200 percent of the federal poverty level are three times more likely to have unmet dental care needs than children from families at or above 200 percent of the federal poverty level **(Newacheck et al., 2000**).
- Poor children have one-half the number of dental visits of children from high-income families **(GAO, 2000b).**
- Fewer than one in five children covered by public insurance received a preventive visit in one year-long study **(USDHHS, 1996).**
- One in four children had not seen a dentist prior to enrollment in kindergarten **(USDHHS, 2003).**
- Beltrán-Aguilar and colleagues (**2005**) found approximately 21 percent of children ages 2 to 11 in the United States had untreated tooth decay.
- Only 22 percent of all children under 6 receive any dental care **(Mouradian et al., 2003).**

Barriers to Access

- The dentist-to-population ratio is declining from its peak of 59.5 to 100,000 in 1990 and is projected to drop to 52.7 to 100,000 in 2020 **(ADA, 1999).**
- The number of federally designated dentist shortage areas has risen from 792 in 1993 to 4,091 in 2008, with 48 million people living in these areas **(ADEA, 2003; USDHHS, 2009).**
- Twelve percent of the population is African American, but only 2.2 percent of dentists are African American; 10.7 percent of the population is Hispanic, yet only 2.8 percent of dentists are Hispanic **(Brown, Lazar, 1999).**

- Student dentists do not receive adequate instruction and experience in dental school in caring for children **(Seale, Casamassimo, 2003a**).
- One study found that approximately 10 percent of dentists will treat children from families with public insurance **(USDHHS, 1996).** Another more recent study indicates that in 2000, approximately 25 percent of dentists received some payment from public insurance; however, only 9.5 percent received more than $10,000 **(Gehshan et al., 2001).**
- In 2004, 45 percent of California's pediatric dentists participated in the states' public dental insurance program **(Morris et al., 2004).**
- Nationally, a 2009 survey found that 53.2 percent of pediatric dentists received reimbursement from public insurance **(Slonkosky et al., 2009).**
- Yet the majority—40 million—of America's 78 million children will be covered by public insurance in 2013 (**Kaiser Family Foundation, 2009).**
- There is a general lack of advocacy for oral health issues in general, and for access to dental care for low-income people in particular **(Gehshan, Straw, 2002).**

U.S. LITERATURE RELEVANT TO DENTAL THERAPISTS, 1938-2012

Early References to 'Dental Therapists' in the 20th Century

The first reference in the literature in the United States to an individual other than a dentist providing care for children appears to be by Dr. Alfred Owre, at one time dean of the School of Dentistry at the University of Minnesota, and subsequently dean of the School of Dentistry at Columbia University. Owre's biography **(Wilson, 1937)** includes an article that had been published by Owre in the Journal of the American Association of Medical Colleges titled "Dental Education as Related to Medical Education" **(Owre, 1931).** He said, "Intraoral work should be permitted to several types of specifically trained assistants, under the responsible supervision of the specialist [dentist]… It is poor economy to insist that only the specialist's hands may work in the oral cavity. Dental hygienists, of course, are already taught in some universities. I believe their training, for example, could well include much of children's dentistry, and without exceeding a calendar year." Owre's comment appears to be the first time in the American literature that paraprofessionals in dentistry were advocated to provide irreversible dental care for children. [Of historical note is that Dr. Owre was a member of the Carnegie Foundation commission that produced the document "Dental Education in the United States and Canada: A Report to the Carnegie Foundation for the Advancement of Teaching," known as the "Gies Report." He was the author of the minority report of the commission, which had argued for the integration of dentistry with medicine as a specialty of medicine, developing the "oral physician."]

Guy S. Millbery, dean of the School of Dentistry at the University of California in San Francisco, also commented on such an auxiliary in the 1930s (**Millbery, 1938**). He addressed the American Public Health Association in 1938 on the topic of "Possibilities and Means of Improving Dental Conditions in the United States." In his address he focused on addressing the needs of children. No specific reference was made to the New Zealand school dental nurse. However, he referenced the work of nurses in Great Britain who, after a two-year course of study, attended to expectant mothers providing pre- and postnatal care, as well as a program in Maryland where such individuals delivered babies. He continued, "I believe all of you will agree with me that such an operation is far more serious for the patient than cleaning teeth, filling small cavities, and extracting temporary teeth." He then raised the question: "Does it not seem possible to you that we should be able to train persons to do these simple operations for children in two years' time?" However, he concluded, "The dental profession probably will not accept this program."

In reviewing the use of auxiliary personnel in dental care programs at the annual session of the American Public Health Association in 1948, Walls said, "Unfortunately the child suffers most from the lack of man power" **(Walls, 1949).** He stated that few dentists care for children and that general dentists seem "largely indifferent" to the needs of the child. He postulated that this was due to the fact that children are commonly difficult patients, and that dentistry for children brings relatively small financial rewards. In spite of this, he expressed the view that children should receive more dental service beginning at an early age and on a constantly continuing basis. Of interest in Walls' address was his disagreement with a comment attributed to Allen O. Gruebbel in which Gruebbel stated that the demand for services rather than the need should be the guiding principle in increasing the number of dentists and auxiliary personnel. Walls declared: "I believe that dental services should be made readily available to every child."

Walls then proceeded to describe in some detail the structure and function of the New Zealand School Dental Service and the work of the school dental nurse—possibly the first such description in the American literature. He expressed the opinion, which he said was shared by others, that a research project should be undertaken in the United States regarding the use of auxiliary personnel to provide care for children. He indicated that a committee of the APHA was actively engaged in studying the problem of securing more dental services for children and was "planning steps to secure an experimental study on the use of the auxiliary operator with a two-year course of education."

The Massachusetts Experience, 1949-1950

The initial attempt in the United States to develop an individual with skills traditionally associated with the New Zealand school dental nurse was in 1949. However, it is unknown whether this effort was directly related to the work of Walls and his committee of the American Public Health Association mentioned above.

In July 1949, the Massachusetts legislature passed Senate Bill 714, which became Chapter 473 of the Massachusetts Acts of 1949. The act was designated "an emergency law, necessary for the immediate preservation of the public health and convenience." The legislation directed the Department of Public Health to institute a five-year program for training "feminine personnel" who were hygienists to receive two years of training, after which they would be permitted to prepare and fill cavities in children's teeth under the supervision of a dentist in a dispensary or clinic approved by the Commissioner of Health. The legislation authorized funding from the U.S. Children's Bureau to the Forsyth Dental Infirmary for Children in Boston to conduct the training and research (**ADA, 1950a**).

Valdo A. Getting, commissioner of public health for the state of Massachusetts, published— with William H. Griffin, director of the dental division of the Department of Public Health, and William D. Wellock, also of the dental division—an "Announcement" in the New England Journal of Medicine that reproduced the legislation and described the relationship that would exist between the Forsyth Dental Infirmary for Children and the Department of Public Health in implementing the project **(Getting et al., 1949, 1950).** Their announcement included a comment authored by Philip Adams, president-elect of the American Dental Association; James Dunning, dean of the Harvard School of Dental Medicine; and J. Murray Gavel, president of the Massachusetts Dental Society. They stated that the Massachusetts Dental Society had approved the project in principle at its meeting on March 11, 1949. Also included in the announcement was a statement by Paul K. Losch, chief of the dental division of the Children's Medical Center of Boston, that was an excerpt from a letter Dr. Losch had written to Sen. G.W. Stanton, chairman of the Committee on Public Health, dated Feb. 23, 1950, in which he endorsed the project: "As a teacher at Harvard of dentistry for children for twenty years and as Chief of Dental Services at the Children's Medical Center of Boston, I am convinced by experience that the supply of dental services for children falls far short of the demand. If the training of auxiliary hands is proven possible by this experiment, a means of great benefit to the public will be realized. It will simply mean if proven successful that the well-trained, qualified dentist can multiply the effectiveness of his knowledge by these auxiliary hands performing a time consuming, technical service."

The Council on Dental Education of the American Dental Association in July 1949 had deliberated on the topic of the training and employment of dental nurses and

had issued a statement on the topic: "The Council feels that the care of children's teeth requires skill equal or superior to that given to adults and for that reason anyone who attempts to care for the dental needs of children must take the same training required of those expecting to be licensed as dentists" **(ADA, 1950a).**

In October 1949, in a report to the House of Delegates of the American Dental Association, the Council on Dental Health stated: "Attempts are now being made to introduce into this country … the New Zealand style dental plan for children…. There is a complete lack of reliable information on the soundness and effectiveness of this program as it operates in New Zealand." The House of Delegates passed four resolutions opposing the Massachusetts experimental program at its session in San Francisco, Oct. 17-20, 1949 **(ADA, 1950a).**

On December 23, 1949, Dr. Harold Hillenbrand, secretary of the ADA, sent a letter to Dr. Getting communicating the resolutions passed by the House of Delegates objecting to the dental nurse initiative in Massachusetts.

Dr. Getting responded on Jan. 25, 1950, stating that in Massachusetts there was a "lack of dental care. Nearly one hundred per cent of teen-age children show evidence of dental caries; yet less than sixty per cent have received dental care of a single permanent tooth. Moreover, there is an irreparable loss of permanent teeth by multiple extractions in over 50 percent of our teenage children. The facts concerning care of deciduous teeth are even more appalling. Observations made by this Department can only lead to the conclusion that the practice of pedodontia is practically nonexistent." Dr. Getting continued by stating, "It is difficult at this time to understand the grounds on which it [the American Dental Association] logically can object to research which evaluated new methods of meeting the problem of dental disease … The Department humbly suggests that the resolutions adopted by the House of Delegates of the American Dental Association … may perhaps have been hurried and therefore inconsistent with the declared objectives of the American Dental Association" **(ADA, 1950a).**

In February 1950, the American Dental Association sent Allen O. Gruebbel, Secretary of the ADA Council on Dental Health, to New Zealand to conduct an objective and comprehensive study of the New Zealand school dental nurse and School Dental Service. Gruebbel reported his findings in the September issue of the Journal of the American Dental Association. His work was also published in more detail in a monograph **(Gruebbel, 1950a; 1950b)**. He concluded the following (direct quotes):

- *Available evidence indicates that the dental caries experience in New Zealand was at least twice as high as in most areas in the United States.*

- *The adoption of the dental nurse and adolescent dental scheme in keeping with the way of life of New Zealand, which for many years has been based on the concept that the State has a primary responsibility for all of the essential needs of the individual, as contrasted with the concept which has wide acceptance in the United States that the individual is primarily responsible for his own personal needs and those of his family.*
- *The universal dental care plan for children in New Zealand is a beginning for a large scale system of state dentistry.*
- *Dental services in New Zealand are dominated largely by representatives of Government as is shown by the fact that there are 759 State employees listed under the category of 'dental personnel' as compared with 667 private practitioners.*
- *Dentistry for children … is almost completely neglected by the dental profession in New Zealand and until three years ago was not taught in the dental school. Owing to the fact that under the dental nurse plan, dental care for children has been relegated almost entirely to partly trained auxiliary personnel, the scheme has had a deleterious effect on the scientific development of pedodontics.*
- *The deliberate effort to create a sub-professional outlook and attitude among school dental nurses is paradoxical and illogical…. School dental nurses are trained to perform the mechanical operations involved in cleaning, filling and extracting teeth. The scientific aspects of these operations are deliberately excluded from the course of instruction in order that school dental nurses will not develop an attitude they are members of a profession.*
- *Parents in New Zealand have a false sense of security regarding the dental health of their children because of the belief that their dental needs are being met.*
- *The dental profession in New Zealand at the present time is in an untenable position by insisting on the one hand, that school dental nurses are fully qualified to render services.*
- *There are many signs in New Zealand of the almost complete dependence on individuals on State for personal needs.*
- *Political, cultural and economic consequences of socialism are strikingly evident in New Zealand. Excessive social legislation has greatly increased the power of central government and has lessened individual freedoms; it has encouraged mediocrity and has stifled the urge to excel; it has discouraged personal initiative and has caused heavy dependency on the State for individual needs; it has immensely increased the tax burden and, thereby, has reduced opportunities for capital investment in individual enterprise and commercial expansion.*

The controversial Massachusetts initiative was ended on July 24, 1950, when Massachusetts Gov. Paul Dever signed a bill rescinding Senate Bill 714 enacted one year previously, authorizing the Department of Public Health to institute a five-year program at the Forsyth Infirmary for Children similar to the school dental nurse program of New Zealand **(New York State Dental Association, 1950; ADA, 1950b).**

Alfred Asgis, in October 1950, stated reasons for opposing the Massachusetts "Dental Nurse- Operator" project at Forsyth in the New York Journal of Dentistry **(Asgis, 1950).** In the article he summarized his reasons, which had previously been presented before the New England section of the American College of Dentists. The project:

"1) was not a dental research project; 2) was not an experimental project; 3) was not a dental education project; 4) will not solve children's dental problems; 5) will not ameliorate conditions in children's teeth; 6) will lower the quality of dental care for children; 7) will separate a vital dental operation from the theory and practice of dentistry; 8) will open a wedge for admission of unqualified persons to dental practice; 9) will entice processing laboratories to seek legal sanction to engage in "oral prosthesis" under a dentist's supervision; and 10) will dismember the dental profession and undermine dental culture." He concluded with a comment (unattributed) in the Boston Daily Globe: "… it will bring about sublevel dentistry and it is an attempt to admit unqualified persons to the practice of dentistry in the United States."

Studies in the 1960s and '70s on Expanding Functions for Dental Auxiliaries

A number of studies were undertaken in the 1960s and '70s to evaluate the ability of dental auxiliaries to expand their functions in caring for patients. During this period, six notable programs studied the delegation of *reversible* expanded functions to dental assistants, most notably the placement of rubber dam and the restoration of teeth in which cavity preparations had been accomplished by a dentist: the Great Lakes Naval Training Center **(Ludwick et al., 1963);** the Indian Health Service **(Abramowitz, 1966, 1973)**; the University of Alabama **(Hammon, Jamison, 1967; Hammon, Jamison, Wilson, 1971)**; the University of Minnesota **(Rosenblum, 1971)**; the United States Public Health Department Dental Manpower Development Center in Louisville, Ky. **(Lotzkar et al.,1971);** and a program in Philadelphia **(Soricelli, 1973)**. All these projects demonstrated that reversible procedures could be effectively taught to dental assistants in a reasonable period of time.

Subsequent research by Kilpatrick **(1971)**, Pelton et al. **(1973a, 1973b)**, Redig et al. **(1974)**, Mullins et al. **(1979)** and others concluded that the use of auxiliaries in an expanded role increased dentist productivity.

An article discussing the possibility for using a "dental associate" as a member of the dental team was published in P.A. Journal **(Keith, Milgrom, 1974).** The authors contrasted the use of auxiliaries in medicine and dentistry, stating that while paraprofessionals were widely used in medicine, the concept in dentistry was not highly developed. After reviewing the use of dental assistants, dental

hygienists, and dental laboratory technicians, they advocated a role for a "dental associate." In doing so they referenced as a "dental associate" the dental nurse in New Zealand, as well as the studies in progress at Forsyth, the University of Kentucky and the University of Iowa in teaching dental hygienists to do irreversible procedures. In reviewing the reaction of organized dentistry to the use of paraprofessionals performing irreversible procedures, they cited the speech by John Ingle to the Conference of Dental Examiners and Dental Examiners advocating the development of dental nurses to work in school-based settings caring for children (**Ingle, 1972**). The ADA president in 1972, Dr. Carl Laughlin, was quoted as describing such schemes as advocated by Dr. Ingle "mediocre in conception and harmful in execution." Keith and Milgrom continued by citing the ADA House of Delegates action in 1972 in which resolutions were passed stating: "… all duties involving intra- oral patient services … shall be performed under direct supervision of the dentist." Additionally, one resolution declared that "development of new categories of dental auxiliaries is not accepted by the American Dental Association and that only the dental assistant, dental hygienist and dental laboratory technician are recognized as dental auxiliaries" (**ADA, 1973**). The authors concluded, "The dental profession remains conservative in the utilization of auxiliary personnel and strongly resists the creation of a dental associate. Therefore it is unlikely that a practitioner analogous to a physician's assistant will be developed in dentistry in the near future."

Keith (**1975**) conducted a research project for a Ph.D. degree at the University of Kentucky titled "The Profession of Dentistry as Seen through the Issue of Expanded Functions for Auxiliary Personnel." He found a general pattern of support for the use of auxiliary personnel in a content analysis of the literature at that time. However, "support decreased sharply when expanded duties for dental hygienists were proposed." Based on the overall findings of his research, he concluded that dentistry's "general response to the auxiliary issue demonstrates a greater orientation and commitment to the preservation of professional interests than public interests."

Although occurring in the early 1990s, it should be noted that the American Dental Association convened a panel to study and report on "The Dental Team in 2020: Future Roles and Responsibilities of Allied Dental Personnel" **(ADA, 1995).** The committee's draft report acknowledged that some aspects of their report and recommendations were inconsistent with existing association policy and/or state dental practice acts, and "therefore may cause some discomfort within the dental community." In making its recommendations, the 68-page report considered population demographics; need and demand for dental care; health and disease trends; technological changes; health care policies/government activism; and trends in dental practice. In addition to the important role of the traditional dental assistant and dental hygienist, the report called for three new allied dental personnel: 1) a restorative dental

assistant—an individual trained in expanded dental assisting; 2) a preventive dental assistant— a person trained to perform expanded dental assisting duties relative to supra-gingival scaling and other preventive services; and 3) a dental health practitioner—an individual trained to provide oral health assessment and preventive services to specific patient populations in institutions and other populations primarily outside the dental office. This individual would perform the same functions as the traditional dental hygienist, but would provide patient services without the routine presence of supervisory dentists. No "irreversible procedures" were included in the panel's recommendations. The panel's view on the "discomfort of the dental profession" proved to be prescient as the draft report, after being circulated to communities of interest, was never advanced past the Board of Trustees to the ADA House of Delegates for consideration.

A comprehensive, systematic review of the literature on the role and value of auxiliaries in dentistry has been conducted by Galloway et al. **(2002**).

In 1968, Sir John Walsh, dean of New Zealand's national dental school at the University of Otago from 1946 to 1971, addressed a conference on oral health celebrating the centennial of the existence of the Harvard School of Dental Medicine **(Walsh, 1968a).** In his address he suggested the employment of a "Care Index," with such an index being calculated by developing a ratio of the filled teeth component (f/F) of the deft or the DMFT to the overall deft or DMFT. In 1968, the Care Index in New Zealand was 72 percent—meaning 72 percent of all elementary schoolchildren's teeth affected by dental caries had been restored. Data indicated that the Care Index for the United States was 23 percent. Dean Walsh made the claim that the Care Index provides a convenient measure of the effectiveness of a country in treating dental caries. Dean Walsh included in his address a quote from John F. Kennedy's inaugural address: "Although children may be the victims of fate, they should never be the victims of neglect."

In the early 1970s, interest in the role auxiliaries could play in support of the provision of care expanded to include a consideration of irreversible procedures.

Among the most widely cited and substantive efforts was at the Forsyth Dental Center in Boston, Mass. The project, initiated in 1970 under the leadership of John W. Hein, director of Forsyth, and Ralph R. Lobene, was designated "Project Rotunda." The full documentation of the effort was published in "The Forsyth Experiment: An Alternative System for Dental Care" **(Lobene, 1979**). The experiment at Forsyth was to train dental hygienists in a program of expanded duties, specifically in local anesthesia, cavity preparation and intra-coronal restorations. The curriculum was based on that of the New Cross School in the United Kingdom and the New Zealand School Dental Nurse Program. The curricula of the Royal Canadian Dental Corps and the University of Alabama were also referenced, although they did not include procedures such as actual cavity preparation.

The experiment sought to answer the questions: 1) Can dental hygienists be taught to give local anesthesia injections and do high quality preparation and restorations through a relatively short addition to their typical two-year curriculum? 2) How does productivity compare with that of a dentist working in comparable circumstance with an assistant? 3) What is the impact of the hygienist/assistant team on the costs and income associated with care delivery?

No problems arose for the experiment between 1970 and 1973. However, in 1973 the Massachusetts Board of Dental Examiners voted unanimously that the drilling of teeth by hygienists was a direct violation of the Dental Practice Act of Massachusetts. In March 1974, the attorney general ruled that "drilling teeth is deemed in the act to be undertaking the practice of dentistry, and the legislature had not exempted research from this provision." Forsyth was forced to close its "experiment" in June 1974, but not before the program was able to objectively document that hygienists could be taught to provide restorative dental services effectively, efficiently and in a cost-benefit effective manner. The projected training time to achieve the objectives of the program had been 47 weeks of 30 hours each; however, the project was able to achieve its desired educational outcomes in 25 30-hour weeks.

The cost of the 25 weeks of additional training was stated to be $2,300, compared with $50,000 needed to educate dentists, "making training hygienists to take over selected restorative dental procedures economically attractive." Post-treatment radiographs detected 5.1 percent of Class II restorations demonstrated overhanging margins; this compared with 24.9 percent found in pretreatment radiographs of restorations placed by dentists. Of the patients receiving care, 99.1 percent indicated satisfaction with the care received; only 46.3 percent correctly identified the dental therapist as a hygienist.

Lobene concluded:

1. *The advanced skills hygienist working under the direct supervision of a dentist provided services of high quality, equal to those of dentists working under the same conditions of peer-review.*
2. *Appropriately supervised hygienist-assistant teams provided restorations of higher quality than that generally provided by dentists not working under some form of quality control or peer-review.*
3. *Advanced skills hygienists working under the direction of and upon prescription of a dentist administered local anesthetics safely and effectively.*
4. *[Advanced skills hygienists] could be useful and have a positive economic effect on a solo practice or clinic providing care for a large number of caries-susceptible people.*

5. *Some dentists practicing in a solo setting can probably supervise as many as three auxiliary teams, but in order to assure the highest quality of care, a solo dentist should not be permitted to supervise more than two hygienist-assistant teams.*
6. *Training advanced skill hygienists who can provide 60 percent to 70 percent of the services of the dentist makes better economic sense than continuing to increase the number of new dentists.*
7. *The solo private practice dentist using hygienist-assistant teams to provide restorative care could not only charge lower fees but increase his net income.*

The Forsyth experiment has also been documented in additional reports in the Journal of Dental Education **(Lobene, Berman, Chaisson, Karelas, Nolan, 1974)** and Dental Hygiene **(Lobene, 1976)**, as well as at a symposium, "Research in the Use of Expanded Function Auxiliaries," sponsored by the Department of Health, Education and Welfare **(Lobene, 1974).**

In 1972, Jay W. Friedman visited New Zealand to review the School Dental Service staffed by dental nurses (now designated dental therapists). His observations and photographs were published in the Journal of the American Dental Association **(Friedman, 1972**). He concluded: "The immediate advantage of a school-based service, staffed by dental nurses, and the long- range benefit to adults has been well documented. Many New Zealand dentists were concerned initially with the effects of a school dental service on their economic and professional status. These same concerns are expressed in countries that are developing this type of program at present. The experience in New Zealand has demonstrated that the provision of dental care by nurses within the restricted environment of schools does not detract in any way from the dental profession. Quite the opposite—it results in greater awareness among the general population of the necessity for periodic dental care, thereby increasing the demand for treatments by private practitioners."

John Ingle, the dean of the University of Southern California (USC) School of Dentistry, in 1972 proposed the use of school dental nurses, as employed in New Zealand, to address the problem of dental caries in America's schoolchildren **(Ingle, 1972)**. Friedman and Ingle, on behalf of the USC School of Dentistry, prepared a proposal for a $3.9 million demonstration grant from the U.S. Public Health Service to train dental nurses **(Friedman, Ingle, 1972)**. The grant would have resulted in a two-year training program to prepare school dental nurses; a six-month course to train dental assistants to work with the school dental nurses would run concurrently. Twenty-five dental nurses and dental assistants were to be trained. Provision was included in the grant for dental hygienists to be granted advanced standing in order to complete the program in one year. Training was to include preventive dentistry procedures (patient education, topical fluoride application, placement of fissure sealants), administration of local anesthesia, the

restoration of primary and young permanent teeth, extraction of primary teeth and space maintenance. Subsequent to training, the school dental nurses were to be placed in selected schools of the Los Angeles public school system to work under the general supervision of dentists.

One of Dean Ingle's strongest opponents of the issue of training school dental nurses was Frederick J. McGovern, who at the time was chairman of the Dental Education Council of the California Dental Association. He suggested that the concept could signal the "decline and fall of U.S. dentistry" **(McGovern, 1972).** He argued rather for the adoption of the expanded function dental assistant (EFDA). He stated that "the school dental therapist concept must be stopped … the New Zealand Dental Nurse is unnecessary. Obviously it can be concluded that Dean Ingle's proposal is unsound and unwise."

At approximately the same time as the USC proposal, the governor of California, Ronald Reagan, established a committee to study the function of all dental auxiliaries in order to make recommendations to the California legislature and the State Board of Dental Examiners. As a result of the Ingle and Friedman initiative and the establishment of a governor's committee, the then California Dental Association and the Southern California Dental Association established a committee to study the New Zealand dental care system, analyze the relationship of the school dental nurse to private practice, assess the work of the school dental nurse, and compare the New Zealand and California systems **(ADA, 1973)**. The committee was chaired by Dale Redig, dean of the University of the Pacific School of Dentistry, and included Floyd Dewhirst, George Nevitt and Mildred Snyder. The committee traveled to New Zealand in late 1972. While there, they conferred with the faculty of the University of Otago, New Zealand's only school of dentistry, and visited the three training programs for school dental therapists operated by the New Zealand Department of Health. In addition, the committee spent time observing the care of schoolchildren by dental nurses, as well as conducting interviews with the dental nurses. Members of the committee examined 119 children in six locations. They abstracted information from clinical records and reviewed treatment statistics of the Division of Dental Public Health.

The committee reported their conclusions to the California Dental Association and the Southern California Dental Association in an article in the March 1973 issue of the Journal of the Southern California Dental Association **(Redig et al., 1973)**. They reported that "there is little doubt that dental treatment needs related to caries for most of the New Zealand children age 2½ to 15 have been met." Additionally, they said they were "impressed with the long standing commitment of the dental profession and people of New Zealand to the dental care of children."

In conclusion, the committee's report stated:

> *An attempt to solve the weaknesses in the California public and private dental care systems by establishing a New Zealand dental nurse type technician is unwarranted. Such an approach ignores several realities that must be considered:*
>
> - *The skill-level of the New Zealand dental nurse, particularly related to lack of training in diagnosis, treatment planning, x-ray technique and pain control, would be unacceptable to most of the profession….*
> - *The high degree of standardization observed in the training of the dental nurse, and in the operation of the treatment program, would not be acceptable to auxiliary students in the United States….*
> - *The changes in the New Zealand dental nurse system needed to make it acceptable in the United States would make it a different system….*
> - *Equipment and supplies currently found in facilities of the New Zealand school dental nurse clinics would be unacceptable to the California profession and public….*
> - *The cost of establishing dental clinics in every elementary school in California would be considered prohibitive by many taxpayers….*
> - *Dental care provided by an independent dental nurse working alone would probably not be accepted by the public in California…. Many persons of low income would resent the implication of a "second class" service which they would be forced to accept because of their inability to pay for the customary services used by the more affluent members of society.*

Friedman and Ingle wrote letters to the editors of both the Journal of the American Dental Association and the Journal of the Southern California Dental Association objecting to the conclusion of the committee's report. They expressed "dismay by the conclusions of the committee which consisted largely of unproven assertions about professional and public unacceptability of such a program in this country. Most of the conclusions were merely restatements of objections previously voiced by the dental profession, and were scarcely related to the observations of the study committee in New Zealand" **(Friedman, Ingle, 1973a; 1973b).** James Dunning, then dean of the Harvard Dental School, in a letter to the editor of the Journal the American Dental Association, called the Redig committee study "the most amazing combination of careful investigation and irrelevant value judgment I have seen in a long time" **(1974).** Dunning also commented that the summary article that appeared in the Journal failed to note that the full report indicated that only two of 857 restorations evaluated by the committee needed prompt replacement.

In 1973, the University of Kentucky submitted a grant for $293,000 to the Robert Wood Johnson Foundation for an "Expanded Duties Dental Hygiene Project" **(Spohn, Chiswell, Davison, 1973).** An external Educational Advisory Committee

composed of Ralph Lobene, Patricia Niles, Nancy Sisty, Rosemarie Valentine, Dale Redig and Irene Woodall was appointed to consult with the investigators **(Lobene, Niles, Sisty, Valentine, Redig, Woodall, 1975**). The project developed and evaluated a curriculum to train dental hygienists in providing dental care for children. Thirty-six students completed the program; 31 were students in the basic four-year undergraduate dental hygiene curriculum, one was a member of the faculty of the Department of Dental Hygiene, and four graduate dental hygienists were enrolled to determine the feasibility of offering an expanded duties curriculum in a post-dental hygiene program. These individuals participated in a compressed curriculum that provided 200 hours of didactic instruction in children's dentistry, as well as 150 hours of clinical practice. The program specifically addressed primary care for the child and included instruction in administration of local anesthesia, restoration of teeth with amalgam and stainless steel crowns, pulpal therapy, and the fabrication and placement of band and loop space maintainers.

The first annual report submitted to the Robert Wood Johnson Foundation gave the results of a double-blind, criterion-based clinical and radiographic evaluation (by private practicing dentists) comparing the restorative skills of the trained dental hygienists with fourth-year dental students **(Spohn, Davison, Chiswell, Herring, Curtis, 1975)**. A statistically significant difference was found between the two groups, with the dental hygienists performing better on the clinical assessment. Radiographic assessment also favored the quality of the dental hygienists; however, the differences were not significant. Practically, the differences between the two groups were minimal, as all restorations placed were judged to be clinically acceptable. At the time of the final report, of the 36 graduates, four practiced for a period of two years in Manitoba with the Indian population; one of these subsequently taught in the Saskatchewan dental nurse program. Four of the graduates entered the University of Kentucky, College of Dentistry and obtained degrees in dentistry. Seven of the graduates became teachers in dental hygiene programs. The remaining were practicing as dental hygienists in providing reversible expanded function procedures **(Spohn, Chiswell, Davison, 1976).**

The University of Iowa conducted a study of expanded functions for dental hygienists from 1972 to 1976, funded by the W.K. Kellogg Foundation and the U.S. Public Health Service **(Sisty et al., 1978).** Similarly to the University of Kentucky's program, a special curriculum was designed within the baccalaureate degree program to teach students certain reversible and irreversible dental procedures, including anesthesia, restorative dentistry for children and adults, and periodontics. Forty-eight students participated in the experimental program over the four years. The curriculum consisted of an eight-week summer session between the junior and senior years and two academic semesters in the senior year. At the end of the senior year, operative and periodontal procedures

completed by the experimental dental hygiene students and senior dental students were evaluated in an examiner-blind study. The evaluated operative procedures included a Class II preparation and amalgam restoration and a Class III preparation and composite restoration. Both operative procedures were evaluated twice, once on a patient and once on a dentoform. The periodontal procedures were completed on patients and included a periodontal examination, a periodontal treatment plan and one quadrant of root planning and soft tissue curettage. Three examiners rated each student's performance in an examiner-blind situation. The results of the study showed that, in general, dental hygiene students were able to perform the selected operative and periodontal procedures at a comparable level to dental students.

Sisty, Henderson and Paule (**1979**) subsequently published a review of the literature on expanded functions by dental auxiliaries, many of which are cited above. They concluded that "the results of all studies indicate that dental auxiliaries can, with proper training, perform selected reversible and irreversible dental procedures at an acceptable level of quality." They advocated for additional studies in private practice settings as well as in different delivery systems using varying configurations of expanded function dental auxiliaries.

In 1975, Congress conducted hearings on National Health Insurance. Jay W. Friedman and Ralph R. Lobene were both asked to testify. Friedman testified emphasizing the importance of a school-based program of dental care for children in any national health insurance program. He cited the success of school dental nurses in the New Zealand school-based dental service. Using data from the Saskatchewan school-based program with dental nurses, Friedman estimated that the initial year of such a program would cost approximately $35 per child, and result in a potential savings of approximately 65 percent of the costs of comparable care in a private dental office. He emphasized that the "dental profession should not be allowed to stand in the way of developing not only an alternate delivery system but also alternative paraprofessional personnel."

He quoted testimony given by Dunning and himself the previous year before the House Committee on Ways and Means. In it, they had emphasized the importance of school-based care: "Even if private dental practitioners increase their productivity by using expanded duty dental assistants, the question remains how the children can be transported to the dentist. The answer is they generally cannot. From the standpoint of obtaining health care services, children must be considered nonambulatory, that is, they must be taken to the dentist by adults.… If the majority of our children are to receive dental care, the services must be provided, in large part, in school-based programs" **(Friedman, 1975).**

In his testimony, Lobene reviewed the results of the Forsyth Experiment, citing the positive findings regarding dental hygienists' ability to provide restorative care.

He went on to say: "The findings of this study relative to productivity and income support the conclusion that the use of advanced skills hygienists—dental assistant teams working under the direct supervision of dentists—should enable the dental profession to deliver more high quality restorative dentistry to more people for less cost than if the dentist provides the care with his own hands" **(Lobene, 1975).**

Institute of Medicine Conference, 1977

In 1977, the Institute of Medicine (IOM) of the National Academy of Sciences, in cooperation with the Pan American Health Organization, convened a conference of international experts to examine worldwide approaches to dental care delivery systems. With the leadership of John I. Ingle, at that time a staff member of the IOM, the conference was conducted in Washington, D.C., on May 5 and 6, at which 93 individuals prominent in dentistry participated. Funding for the conference and publication of the proceedings was from the W.K. Kellogg Foundation. (At that time Ben Barker was program director for the Kellogg Foundation.) The proceedings were subsequently published with the title "International Dental Care Delivery Systems: Issues in Dental Health Policies" **(Ingle, Blair, 1978).** The proceedings reflect presentations on dental care delivery systems in multiple countries. Of particular note is a section titled "The New Zealand Legacy," in which three chapters discuss the use of school dental nurses in New Zealand **(Logan, 1978)**, Australia (**Logan, 1978**) and Saskatchewan, Canada **(Lewis, 1987)**.

In a chapter of the proceedings titled, "What Can We Learn from Others?," Harold Hillenbrand, executive director of the American Dental Association, stated, "When the dental history of our time is eventually written, I believe the New Zealand Dental Nurse Program will be considered one of the landmark developments in the practice of dentistry and dental public health." He went on to say New Zealand has "pioneered in a very effective method for delivering dental health services to children." He concluded, "The New Zealand experience proves that we can develop an auxiliary program—and a very advanced one—that is acceptable to, and approved by the profession of the country involved" *(***Hillenbrand, 1978***).*

During the 1980s and 1990s, no articles in the United States literature were identified relative to the oral health care workforce as related to dental therapists.

The Surgeon General's Report, 2000

"Oral Health in America: A Report of the Surgeon General" in 2000 highlighted the problem of oral health in America. The report stated: "During the last 50 years, there have been dramatic improvements in oral health, and most middle-aged and younger Americans expect to retain their natural teeth over their

lifetimes. However, this report illustrates profound disparities that affect those without knowledge or resources to achieve good oral care. Those who suffer the worst oral health include poor Americans, especially children and the elderly. Members of racial and ethnic groups also experience a disproportionate level of oral health problems. And, those with disabilities and complex health conditions are at greater risk for oral diseases that, in turn, further complicate their health" **(USDHHS, 2000**).

The report, and a subsequent "National Call to Action to Promote Oral Health," resulted in a decade of literature further documenting the problem of oral health in America, and proposals advocating strategies for addressing the oral health needs of Americans **(USDHHS, 2004)**. The addition of a dental therapist/ pediatric oral health therapist to the oral health care workforce was advanced as a potential strategy.

The General Accounting Office reported on its study of factors contributing to low use of dental services by low-income populations (**GAO, 2000b**). The report stated, "Medicaid and S-CHIP beneficiaries and other low-income people have low rates of dental visits and high rates of dental disease relative to the rest of the population." To help determine why, the report addresses (1) factors that explain low dental service use by Medicaid and SCHIP beneficiaries and (2) the role of other federal safety-net programs in improving access to dental care. Shortage of dentists was not the only access problem indicated. The major factor contributing to the low use of dental services among low-income persons was locating dentists to treat public insurance beneficiaries. Many dentists do not accept beneficiaries of governmental program funding because of low reimbursement rates, onerous administrative requirements, arbitrary denial of claims, and broken appointments. However, the report stated that "raising reimbursement rates—a step 40 states have taken recently—appears to result in a marginal increase in use, but not consistently."

In 2001, the National Conference on State Legislatures conducted a conference, "Increasing Dentists' Participation in Medicaid and SCHIP" (**Gehshan et al., 2001**). This survey reports on the number of dentists treating Medicaid patients between 1998 and 2000. Among the strategies employed to increase participation are increasing reimbursement rates, providing bonuses, and simplifying authorization and payment procedures. Also discussed is expanding the use of dental hygienists to include independent practice and to be reimbursed for specific services. The results have been mixed, with some states increasing service to Medicaid beneficiaries and others decreasing service. Among the study's conclusions: "Despite all state efforts, the survey shows that two-thirds of the states for which data is available lost ground in expanding the pool of dentists who actually provided dental care for Medicaid patients."

The Robert Wood Johnson Foundation funded a study by the National Conference of State Legislatures, the report of which was "Access to Oral Health Services to Low-Income People: Policy Barriers and Opportunities for Intervention for The Robert Wood Johnson Foundation" (**Gehshan, Straw, 2002**). The report stated, "those who work on oral health issues seem very much rooted in (and mired in) the present, and are not thinking about bold new solutions." Further, "a consistent theme…is the lack of effective advocacy for oral health issues in general and access to dental care for low-income people in particular." Gehshan and Straw stated that the most powerful advocacy group for oral health is the state dental association, but that the associations are "poor advocates for access to dental services particularly for Medicaid and S-CHIP beneficiaries, as they are perceived as self-serving in seeking increased reimbursement rates."

The Alaska Initiative and Subsequent Workforce Controversy

After consultation with the Indian Health Service (IHS), a preliminary proposal titled "Training Mid-Level Practitioners for Children's Dentistry" was forwarded in 2001 to the Robert Wood Johnson Foundation on behalf of the Forsyth Institute (**Nash et al. 2001**). The proposal called for the training of pediatric oral health therapists and indicated that "the Indian Health Service, because of its federal status, infrastructure, history and commitment to personnel development, and staffing of clinical facilities with paraprofessionals from the tribes, is uniquely positioned to undertake development of such an innovative model." The proposal cited the years of success of using dental therapists in New Zealand, as well as the experience of Canada in employing dental therapists to provide care for five First Nations bands there. The project was to run from July 2002 through June 2007 at a budget of $13,025,000. Further development of the preliminary proposal was not pursued by the foundation.

While the initial proposal was not funded, under the leadership of Ron Nagel of the Indian Health Service in Alaska, the Alaska Native Tribal Health Consortium (ANTHC) was able to procure funding for the training of dental therapists to care for Alaska Natives. A brief history of the initial aspect of the dental therapist initiative in Alaska was published by Nash and Nagel in the Journal of Dental Education (**Nash, Nagel 2005a**). Concurrent with Forsyth's initial discussions with the Indian Health Service, the ANTHC was beginning the development of dental health aides under the provisions of the congressionally authorized Alaska Community Health Aide Program. The initial plans were for the development of a primary health aide, functioning primarily as a community dental health educator, as well as an expanded function dental health aide (EFDHA). As a result of the previous discussions between the IHS and Forsyth, a third level of dental health aide was conceptualized: a dental health aide therapist (DHAT). In early 2003, six

Alaska Native students traveled to New Zealand to begin a two-year academic goodprogram to be trained as dental therapists.

In late summer 2003, Nash authored an essay that appeared in the Journal of Dental Education titled "Developing a Pediatric Oral Health Therapist to Help Address Oral Health Disparities among Children" (**Nash, 2004**). He had returned from a sabbatical at the University of Otago, where the Alaska students had just begun their study to become dental therapists. In the essay, he reviewed the epidemiology of dental disease among children, the barriers to accessing care for children and the lack of effective leadership/advocacy for children by the profession of dentistry. He cited the National Council of State Legislators' report reviewed previously; New Zealand's approach to caring for its children using school dental therapists; the United States' earlier unsuccessful attempts to train dental therapists; and how pediatric oral health therapists could be trained and could practice in the United States, concluding with an appeal to professional values in ensuring that all of America's children had access to adequate oral health care.

Nash indicated that the total deft/DMFT of the children in New Zealand and the United States are comparable; however, there are differences in the components of these epidemiological indices. He cited a 2003 report that reported that 53 percent of children were caries-free, with a mean eft of 1.8 (**New Zealand National Health Committee, 2003**). At age 12 and 13, 42 percent of the children were caries-free, with a mean eft of 1.8. What Nash found surprising and fascinating about these data is that the decayed (D/d) component was not included in the figures. He reported asking the epidemiologist at the Faculty of Dentistry at the University of Otago, and was told that these data represent the children enrolled in the School Dental Service and are collected at the end of the year. During the school year the decayed teeth have either been restored or extracted. Because of this, the schoolchildren are essentially free of dental caries at the end of the school year.

Nash also reported that New Zealand and Kentucky have approximately the same population, and roughly the same number of children. He reported that in 2002-03, Kentucky spent $40 million caring for the 43 percent of its children who were eligible for Medicaid/S-CHIP. [The actual utilization rate of the 43 percent eligible to receive care through public insurance benefits was not reported; nor were data for expenditures for dental care by private insurance or cash payments by parents to dentists for the remainder of Kentucky's children that year.] In contrast, New Zealand spent $34 million (U.S.) caring for all of its children enrolled in the School Dental Service, ages six months through age 17, reported to have been 97 percent of school-age children, and 56 percent of preschoolers.

Nash also reported on the view of the public relative to the use of dental therapists caring for children in the School Dental Service. He cited Stanley (**2000**), who referred to a dental therapist in a New Zealand Dental Journal article as an "icon"

and quoted Thomson, a professor at the dental school, as saying, "The School Dental Service has become an integral component of the New Zealand culture. To Kiwis it is like motherhood, apple pie, and the flag" *(***Nash, 2004***).*

The American Dental Association, upon learning of Alaska Native students studying to become dental therapists in New Zealand, established a task force to explore alternative options for delivering high quality oral health care to Alaska Natives. The task force advanced 14 recommendations to the ADA House of Delegates at the annual session in October 2004 (**ADA, 2004)**. Two of the recommendations dealt specifically with dental health aide therapists (DHAT): 1) "The ADA work with the ADS [Alaska Dental Society] and tribal leaders to seek federal funding with the goal of placing a dental health aide trained to provide oral health education, preventive services and palliative service (except irreversible procedures such as tooth extractions, cavity and stainless steel crown preparations and pulpotomies) in every Alaska Native village that requests an aide"; and 2) "The ADA is opposed to non-dentists making diagnoses or performing irreversible procedures." The resolution passed the House of Delegates overwhelmingly on a voice vote.

The ADA obtained four consultants in 2004 to examine the access to care problem of Alaska Natives: Howard Bailit, Tryfron Beazoglou, Amid Ismail, and Thomas Kovaleski. In April 2005, they submitted their report, "Integrated Dental Health Program for Alaska Native Populations" (**Bailit et al., 2005**). They recommended that the dental therapist model be replaced with a lesser-trained individual, a community oral health provider (COHP). This individual would have organizational and management duties in a proposed integrated system and would also have clinical responsibilities, including atraumatic restorative treatment (ART), treatment of mild periodontal disease by prophylaxis and scaling, and management of acute pain and infection under the direction of a dentist.

The American Journal of Public Health published "Improving the Oral Health of Alaska Natives" in May of 2005, co-authored by a past president of the American Dental Association and the ADA staff (**Sekiguchi et al., 2005a**). After reviewing the geographic barriers to care in Alaska and the current way in which care was being provided and was proposed to be provided by dental health aide therapists, the authors concluded that "the use of DHATs to provide diagnostic and treatment services for caries, tooth removal and pulpotomies is not a prudent way to meet the dental therapeutic needs of the Alaska Native population. Their educational background, dental training, and experience are very limited. The data indicate that there is a high prevalence of severe oral disease in the Alaska Native population…. This situation demands that the high level of skill and experience of a dentist is required to effectively address these challenging diagnostic and therapeutic needs."

In August 2005, also in the American Journal of Public Health, an alternative perspective on confronting the oral health disparities of the American Indian/Alaska Native population with using a dental therapist was advanced (**Nash, Nagel, 2005b**). After describing the problem of oral disease in the American Indian/Alaska Native population, reviewing the New Zealand model of utilizing dental therapists, as well as dental therapists' utilization by Health Canada in caring for First Nations individuals, the authors described the history and status of dental therapists' approach to confronting oral disease and disparities in Alaska.

Three past presidents of the American Public Health Association wrote a Letter to the Editor of the Journal taking issue of the May commentary by Sekiguchi et al., in which he and colleagues had challenged the dental therapists practicing in Alaska (**Allukian, Bird, Evans, 2005**). They said, "Although the ADA has a good track record of supporting preventive measures, such as community water fluoridation and most public health programs, they [sic] have a long record of preventing anyone except dentists from providing treatment, even to the underserved.… Because organized dentistry is lobbying state and federal decision makers to stop this pilot program … we cannot help but think that there was a hidden political agenda for their publication. In times of dwindling resources, complex access issues, and evidence-based medicine, dentistry and public health, now is not the time to block innovative programs trying to serve the underserved."

Also writing a letter to the editor challenging the Sekiguchi article were 13 leaders of the Oral Health Section of the American Public Health Association (**Campbell et al., 2005**). They opined that Sekiguchi and colleagues had offered no evidence for their opinion that dentists are the only personnel qualified to provide these services and that DHATs cannot be effective substitutes. The authors concluded by endorsing the program "as a practical and innovative response to address the extensive oral health needs of these communities."

Sekiguchi and colleagues responded to the two critical letters by saying, "The ADA considers protecting the oral health and safety of the public as its obligation; allowing non-dentists to provide irreversible surgical procedures jeopardizes both, particularly Alaska Natives, because of the extent and severity of oral diseases they suffer" (**Sekiguchi et al. 2005b**).

Nash reiterated his advocacy for developing and deploying a pediatric oral health therapist in the Journal of Public Health Dentistry. He suggested four potential practice environments for pediatric oral health therapists: schools, Indian Health Service clinics, private dental offices, and the offices of pediatricians (**Nash, 2005a**).

The executive director of the American Dental Association, James Bramson, and the chief policy adviser of the ADA, Albert Guay, commented on Nash's article in a subsequent issue of the Journal of Public Health Dentistry (**Bramson,**

Guay, 2005). In it, they argued that the distribution of resources in our health care system, including the dental workforce, is based on the demand for care. That is, practitioners are primarily located where there is adequate demand for their services by individuals who can pay for those services. This system does not always place resources in all areas where they are needed. The efficient allocation of resources in a demand-based system can result in a maldistribution of resources according to needs, much as a distribution system in a needs-based system can result in a maldistribution of resources according to the demand for services. In arguing against the addition of a pediatric oral health therapist, they concluded, "A two-tiered oral health care system, where a group of people receive care from a lesser-trained provider, is anathema to the concept of equality for all of our citizens. The idea that 'something is better than nothing' for some people insidiously erodes the goal of the best health care possible for all and institutionalizes the acceptance by society of second level care for some."

In responding to Bramson and Guay in the same issue of the Journal, Nash suggested that the core issue between the ADA and himself was a difference in philosophical assumptions regarding health care delivery. He said that they "rightly draw a distinction between the effective demand for dental care and the need for care. In espousing 'a self-producing system that operates without direct subsidization by government,' they acknowledge that the tradeoff in such a market-driven system is the maldistribution of resources in relationship to need. I contend that this is at the heart of our access and disparities problems today." Nash went on to draw a distinction between consumer goods and social goods, a distinction drawn by the free market theorist Adam Smith. Nash said that Smith stated that for a market to function, it had to be based on a foundation of what he called social goods, among which were security, health and education. Such goods were for Smith outside the marketplace and not subject to the law of supply and demand. Rather they were understood as basic human needs to be met by society so that a marketplace could even exist. He concluded that "a dental delivery system for children based on demand rather than on need is not a system that meets the demands of social justice" (**Nash, 2005b**).

The first group of dental therapists returned to Alaska from the University of Otago in January 2005, following the completing of their studies and the awarding of diplomas as dental therapists. In September 2005, Louis Fiset, an affiliate associate professor at the University of Washington, conducted a study assessing the quality of care they had provided to Alaska Natives (**Fiset, 2005**). The assessment criteria used in the evaluation of care included record keeping, cavity preparation, cavity restoration, patient management, and patient safety. He stated that during his four-day site visit, the performance of the dental therapists met the standards of care he had established in every regard. He went on to say, "Their basic training and subsequent preceptorships have produced competent providers. Each is equipped to not only provide essential preventive services

but simple treatments involving irreversible dental procedures such as fillings and extractions. Their patient management skills exceed the standard of care. They know the limits of their scope of practice and at no time demonstrated any willingness to exceed them. On multiple occasions they demonstrated their ability to recognize and avoid clinical situations that might pose a threat to patient safety. My first hand observations convince me that statements by dentists and dental societies suggesting that dental therapists cannot be trained to provide competent and safe primary care for Alaska Natives are overstated."

In a letter to the editor of the Journal of Public Health Dentistry, Friedman (**2006**) corrected Bramson and Guay's (**2005**) "Comments on the Proposed Pediatric Oral Health Therapists," which had been published previously as a response to Nash. They had misidentified Friedman as being with the New Zealand Public Health Department, rather than an American public health dentist. Furthermore, they attributed the quote by Friedman in his 1972 paper on the New Zealand dental nurse, "We train first-rate technicians, not second-rate dentists," to Friedman, rather than correctly to a spokesperson from the Division of Dentistry of the New Zealand Public Health Department (**Friedman, 1972**). Friedman went on to affirm in his letter that "dental therapists do not claim to be dentists, any more than physician assistants, nurse practitioners, and midwives claim to be physicians. Each functions within the parameters of specific training, under the supervision of dentists and physicians, respectively."

The American Public Health Association issued a policy statement, "Support for the Alaska Dental Health Aide Therapist and Other Innovative Program for Underserved Populations," on Nov. 11, 2006 (**APHA, 2006**). The policy statement reviewed the oral health status of Alaska Natives, the development of the Dental Health Aide Therapists, the criticism of the American Dental Association, the effectiveness of therapists internationally, and the success of innovative public health programs in the past, concluding:

> *Given the evidence of safe and effective oral health care delivered by Dental Health Aide Therapists and the need for such services for populations in remote and under-served areas and the support for having those oral health services, therefore, the American Public Health Association:*
>
> - *Actively supports the Dental Health Aide Therapists (DHAT) Program and other innovative programs and practices to help prevent and alleviate the great unmet oral health needs of Alaska Natives;*
> - *Encourages the Governor of Alaska and other administrative and legislative leaders in Alaska to recognize and support the Dental Health Aide Therapist Program as a legitimate, practical and responsible program to help meet the need of Alaska Natives;*

- *Urges key members of the Congress, the administration, federal and Alaska health agencies, and Alaska dental, public health and Native Tribal organizations and other groups to support the Dental Therapist program;*
- *For other underserved populations in other parts of the United States resolves to strongly support DHAT and other innovative and effective programs, aimed at improving access to preventive and therapeutic oral health services for other underserved populations in the United States;*
- *Supports efforts to inform, as needed, national and state health, public health and dental associations and agencies and legislative and judicial bodies, and the general public, of APHA's support of such programs;*
- *Urges Congress, the administration, and federal agencies to improve oral health policies, programs and funding so that fluoridation, health education, preventive and therapeutic dental services are provided for all underserved individuals and communities who lack these services in the* United States.

The Alaska Law Review in 2007 published an article by Erik Bruce Smith, "Dental Therapists in Alaska: Addressing Unmet Needs and Reviving Competition in Dental Care" **(Smith, 2007**). Smith reviewed the poor state of oral health of Alaska Natives and suggested that the ability of dental therapists to practice under a federal license offers the potential to improve the situation. He stated that the opposition of the American Dental Association was "tightly linked to inherent self-interest of dentists in being the only source for dental services." Such an approach, he said, results in a neglect of underserved individuals, whereas dental therapists are a viable low-cost alternative to dentists. Smith speculated that the ADA will ultimately have to address the issue of serving the members of the population that it has been inadequately serving. He concluded, "the creation of dental therapists in Alaska is consistent with the trend toward less restrictive regulation in most American industries, and hopefully foreshadows the future development of low-cost alternatives to current high-cost healthcare options. Ultimately, dental therapists will improve both the oral health of Alaska Natives and improve the overall market for dental healthcare by forcing a much needed form of competition back into the market."

A group of 12 international experts published a review of the use of dental therapists internationally in 2008 (**Nash, Friedman, Kardos *et al.*, 2008**). Using World Health Organization data as well as information obtained from a global survey, they listed 53 countries that used dental therapists; more than 14,000 dental therapists were being employed internationally in these countries. The article also profiled the practices of dental therapists in six countries with a long and prominent usage of dental therapists: New Zealand, Great Britain, Australia, Canada, Malaysia and Tanzania. The article cited multiple studies documenting that dental therapists provided quality technical care, comparable to that of dentists, within their scope of practice, and that acceptance and satisfaction of care provided is evidenced by widespread public participation. The authors concluded:

"For most countries of the world, there is a need for more dentists and more dental therapists. For a significant number of individuals throughout the world, access to basic dental care will not be available without the utilization of dental therapists in the workforce."

The treatment provided by dental health aide therapists in Alaska was assessed by Bolin in a pilot study in 2008 (**Bolin, 2008a**). Bolin audited the dental records of 406 patients that had 640 procedures completed by both dental therapists and dentists. He assessed four quality-of-care indicators: notation in the patient record, treatment consistency with diagnosis, adequacy of radiographs and reports of adverse events. On average, patients treated by dental therapists were younger by 7.1 years than those treated by dentists. The presence or adequacy of radiographs was higher among patients treated by dentists than those treated by dental therapists, with the differences being concentrated in preschool children. He found no significant differences among the two groups in the consistency of diagnosis and treatment or postoperative complications as a result of the primary treatment.

The Journal of the American Dental Association published, along with the pilot study by Bolin, a commentary by Albert H. Guay, chief policy adviser at the American Dental Association, challenging aspects of the research (**Guay, 2008**). Guay argued that the assessment and adequacy of a clinical treatment requires much more than a chart review. He stated that the "far-reaching conclusion drawn by the author [Bolin] that 'no significant evidence to indicate that irreversible dental treatment provided by DHATs differed from similar treatment performed by dentists' cannot be drawn from the design of the study or from the data generated." Bolin, in response to the commentary, acknowledged that appropriate clinical research should be conducted to examine outcomes and that a definite assessment of quality and adequacy of clinical treatment requires more than a chart review (**Bolin, 2008b**). However, he maintained that a retrospective analysis of existing clinical records is a reasonable and scientifically appropriate approach, as evidenced by the Journal's peer review process of the study's soundness in methodology and analysis.

Friedman argued for providing care to children in a school-based program in an editorial in the Journal of Public Health Dentistry. He enumerated the reasons that prevent many school-aged children from receiving care as: the high cost of fee for service care; the refusal of many dentists to accept the lower reimbursement rates of Medicaid; the increasing shortage and maldistribution of dentists; the disinclination of many dentists to treat poor and minority children, or to treat children at all; and the social barriers that include ethnic/cultural attitudes and values, deficient education, single parentage, household debts and inadequate transportation. He lamented the Healthy People 2010 goal of 57 percent annual utilization of dental care by children, commenting on the failure to care for the other 43 percent of children. Since "children are essentially non-ambulatory, they

must have someone with the desire, time, money and means to take them to health care providers. If there is no one to bring these children to dental care then dental care must be provided for them in schools, preferably by dental therapists whose competency has been well documented" (**Friedman, 2008**).

The Minnesota Dental Association published a monograph written by four members of its staff, describing the circumstances surrounding the authorization of the practice of dental therapists in Minnesota; Minnesota was the first state to authorize such practice (**Glasrud et al., 2009**).

The statute change in the Minnesota Dental Practice Act in 2009 resulted in the creation of two categories of dental therapists: dental therapist (DT) and advanced dental therapist (ADT) (**State of Minnesota Revised Statutes, 2009**). The statute provided that a DT may only work with a dentist on-site, while an ADT may work with the general supervision of a dentist. The scope of practice differs only in that an ADT may extract mobile permanent teeth and prescribe limited medications. As the DT and ADT legislation was passed to address problems of access to care, these two new members of the dental team are required to practice in defined settings, specifically those serving low-income and underserved populations.

The legislation specified that a person practicing as a dental therapist must graduate from an educational program approved by the state board of dentistry or accredited by the Commission on Dental Accreditation or another board of dentistry national accreditation organization. Licensure for a dental therapist license required: 1) Graduation with a baccalaureate degree from a baccalaureate or master's degree program approved by the board of dentistry; 2) Pass a comprehensive, competency-based clinical examination approved by the board and administered independently of a group that provides dental therapy education; 3) Pass a "jurisprudence examination" on Minnesota laws related to the practice of dentistry. An advanced dental therapist must meet all the requirements of a dental therapist, be licensed as a dental therapist and obtain advanced certification from the board of dentistry. Certification as an ADT requires: 1) Completion of a master's degree advanced dental therapy education program; 2) Completing 2,000 hours of dental therapy clinical practice with direct or indirect supervision; 3) Passing a board-approved certification examination to demonstrate competency, under the advance scope of practice; and 4) Submitting an application for certification.

In May 2009, the Pew Center on the States published, in cooperation with the National Academy for State Health Policy and the W.K. Kellogg Foundation, "Help Wanted: A Policy Maker's Guide to New Dental Providers" (**Pew Center on the States, 2009**). The report offered three major reasons for the development of new dental providers: shortages of dentists persist, people who cannot afford private dentists have limited options for care and expanding public

dental coverage will not sufficiently increase care. Three principal proposals were identified as being discussed by policy makers, dental professionals and stakeholders: the dental therapist, the community dental health coordinator, and the advanced dental hygiene practitioner. The report compared and contrasted these three providers by summarizing their history, as well as their proposed post-secondary education, regulation, supervision, practice settings and scope of services. The report suggested that policy makers would need to: 1) collect baseline data; 2) assess the current dental workforce and educational infrastructure; 3) identify potential funding sources; and 4) appraise the political landscape and identify who is likely to support and oppose the plan and why. The report concluded by identifying implementation steps: 1) create a strong, broad-based partnership of stakeholders; 2) obtain legislative approval; 3) handle regulatory issues; 4) develop an appropriate educational framework; and 5) identify and make necessary systemic modifications.

The president of the American Academy of Pediatric Dentistry in 2009 wrote an editorial in the academy's journal, Pediatric Dentistry, declaring that midlevel providers are not in the best interest of children (**Hinson, 2009**). He stated that "as the United States looks to health care reform, a salient feature is that reform is the role of primary care. The role of primary care is not a role to be filled by mid-level providers, but by dentists and physicians trained to deliver comprehensive care to our population." He said that he did not think it was in the best interest of the country to have a "dual standard of care," indicating that states need to appropriate to dentistry its share of Medicaid dollars, and that appropriation of existing funding was the first step in addressing the access problem. Hinson concluded that "the United States has the best model for delivering dental care that exists.… It is my opinion that a dual standard of care, a new menu of mid-level providers, a 'fast-track education,' and a focus that is driven by cost savings are not in the best public interest."

Nash, a pediatric dentist and fellow of the American Academy of Pediatric Dentistry, challenged President Hinson's views in a subsequent issue of the Journal (**Nash, 2009a**). He argued that an individual does not require 10 to 11 years of post-secondary education to provide primary care for children, citing the success of New Zealand and many other countries in providing primary oral health care for children with dental therapists trained in two-year programs of post-secondary education. He argued against a dual standard of care as well, but indicated that dental therapists do not provide a different standard of care within their scope of practice. Nash indicated that there was scant evidence to support Hinson's view that the access to care problem for children would be resolved if society would increase reimbursement rates for children on public insurance. He concluded by expressing the view that "It is no longer reasonable, nor practical, nor effective for us to pontificate in defense of the current delivery system and oral health workforce for children. Society is simply exhausted with us continually

saying essentially give us more money and leave us alone. Dr. Hinson's letter suggests an attitude and orientation—protectionism of our professional prerogatives—to the problem of access to oral health care for America's children that is endemic in our Academy; an attitude that will only result in a diminution of the leadership and respect we have earned over many years of advocating for what is best for the oral health of children; not necessarily what is best for us pediatric dentists."

Academic Pediatrics devoted an issue of the journal to the problem of access to oral health care by America's children. In it, Nash again proposed adding a pediatric oral health therapist to the health care team to improve access (**Nash, 2009b**). He described the workforce barriers to access for children and indicated how the international approach of adding dental therapists to the oral health care team could improve access. He argued that it would be more economical to care for children with dental therapists as members of the workforce. A model for developing dental therapists was advanced. The offices of pediatricians and family physicians were suggested as potential settings in which pediatric oral health therapists could practice in an attempt to improve access to oral health care for children.

A strategy for expanding the role of dental hygienists in order that they might gain the traditional skills of the international dental therapists has also been advanced in the Journal of Dental Hygiene (**Nash, 2009c**). Dental hygiene programs are required to be of two academic years' duration by the Commission on Dental Accreditation. Such programs typically result in an associate degree. It was reported that there were 255 associate programs in the United States. However, 48 bachelor's degree programs and 17 programs offering a master's degree in dental hygiene or a related discipline also exist.

The article compared the knowledge and skill competencies of dental hygienists, which were also inclusive of those of an international dental therapist providing care for children, with those knowledge and skill competencies of a dental therapist not included in the typical dental hygiene curriculum. It was suggested that the additional competencies of the dental therapist could be added to a dental hygiene curriculum by increasing the required program length by one year, from two to three years. However, a modular approach to the hygiene curriculum was recommended to enhance program flexibility. A core curriculum for both those desiring to be trained as a hygienist or dental therapist would constitute the first year of the program. The second year would consist of two tracks, one for those wanting to exit after two years as a hygienist, and one for individuals wanting to exit after the second year as a dental therapist. For individuals desiring both credentials, a return to the program for a third year in the track of the second year that had not been previously pursued would result in the gaining of both credentials.

In 2009, the Institute of Medicine sponsored a workshop, "The U.S. Oral Health Workforce in the Coming Decade." Nash described the success of international programs in providing oral health care for children (**Nash, 2009d**). He reviewed the activities in New Zealand, Malaysia, Australia, Canada and Great Britain and concluded with four lessons to be learned for the United States: 1) dental therapists provide quality care for children; 2) dental therapists can be effectively trained to provide competent care in a two-academic-year program; 3) placing dental therapists in schools effectively addresses access to care concerns for children; and 4) dental therapists provide cost-effective, economical care.

Dental Clinics of North America published a volume on access to oral health care in the United States in 2009. Nash's chapter, "Improving Access to Oral Health Care for Children by Expanding the Dental Workforce to Include Dental Therapists," was primarily a review of the several articles he had previously published (**Nash, 2009e**). No new information was included and no new arguments advanced.

"Training New Dental Health Providers in the U.S." was a monograph published by the W.K. Kellogg Foundation (**Edelstein, 2009**). The monograph began with a taxonomy of conventional U.S. dental providers (dentists, dental hygienists, dental assistants and expanded function dental assistants); unconventional U.S. providers (dental therapists, in Alaska and Minnesota); and proposed U.S. providers (community dental health coordinators and advanced dental hygiene practitioners). The training programs of each of the various types of providers, both in the United States and internationally, was reviewed, with comparisons of program length and content. Critical policy decisions about training dental therapists were stated as the length and content of training, which Edelstein suggests related to six decisions: 1) scope of practice, 2) supervision, 3) deployment, 4) accreditation, 5) certification and 6) licensure. The monograph concluded by advancing goals for developing dental therapists in the United States:

- *To expand the availability of basic dental reparative services to socially disadvantaged subpopulations.*
- *To engage caregivers whose social background, knowledge of underserved populations, cultural experience and language match those of targeted populations.*
- *To establish a career ladder for under-represented minorities.*
- *To improve cost-effectiveness in educating providers of basic care and purchasing dental care.*
- *To strengthen the dental safety net.*
- *To maximize the role of dentists as the most expert dental care provider capable of managing patients with the most complex treatment and management needs.*

Nash argued in an editorial in the Journal of Public Health Dentistry that dental therapists in the United States should focus their care on children, not adults (**Nash, 2010)**. He advanced and justified seven reasons for doing so:

- Ethical considerations support dental therapists focusing their care on children. Ethics requires that when resources are inadequate to address the needs of all, then what resources exist should be distributed most favorably to children.
- Prevention of oral disease supports dental therapists focusing their efforts on children. If a lifetime of oral health is to be achieved, it must be initiated in childhood.
- Safety considerations support dental therapists focusing their care on children. Students graduating from dental schools today are inadequately trained to care for the myriad of chronic diseases affecting the U.S. population; clearly dental therapists are not.
- Complexity of care supports dental therapists focusing on children. Adult dental care is complex in ways in which care for children is not. In safety net settings, where many advocate that dental therapists practice, patients will likely present with mutilated dentitions and significant periodontal disease. Dental therapists should not be asked to address such complex conditions with their circumscribed training.
- Economic considerations support dental therapists focusing on children. As a result of the expansion of the Children's Health Insurance Program, the majority of America's children will soon have public dental insurance through Medicaid and SCHIP—40 million of our 78.6 million children. Health care reform offers no adult dental benefit.
- International experience and research supports dental therapists focusing their care on children. The overwhelming preponderance of experience of dental therapists internationally has been on children, not adults.
- Professional barriers support dental therapists focusing their care on children. Many dentists do not want to treat kids. It is more lucrative to treat adults. Organized dentistry will be less threatened, and thus more readily accept a paraprofessional on the dental team whose focus of care is not adults, but rather children.

A survey of board-certified pediatric dentists found that pediatric dentists were not supportive of adding a dental therapist to the oral health care workforce (**Toolo, Nash, Mathu-Muju et al., 2010**). Even though 75 percent of those responding to the survey had no knowledge of the concept of a dental therapist, 71 percent disagreed with adding such an individual to the dental team. Additionally, most disagreed that adding a dental therapist to their dental team would enable them to care for more children with public insurance. Public health pediatric dentists were more knowledgeable of the concept of dental therapists and more supportive of them participating in the care of children in the United States.

The Georgia Dental Association (**2010**) produced "A White Paper on Georgia's Oral Health Status, Access to and Utilization of Oral Health Care Services." In an executive summary, the paper reviewed the components of Georgians' ability to access dental care: health status, oral health literacy, workforce, financing care,

government programs, safety net, innovative outreach and external influences. A number of statements opposing expanding the workforce by using dental therapists were highlighted in the paper; these individuals were referenced in the paper as midlevel providers (MLPs). Below are excerpts from the paper relative to midlevel providers:

- *Some entities propose a new level of dental provider called a Mid-Level Provider as the solution to access…. While these groups may be well intentioned, their solution is not based on science or data that support adding MLPs to the dental workforce actually improves access or lowers the cost of care.*
- *New Zealand has employed MLPs since 1921. However, reports indicate that this strategy has not solved access to dental care or improved the oral health of its citizens ... The recent data prompted New Zealand to reconstruct its dental delivery system. What this information underscores is that merely creating different types of providers to augment care from a dentist does not provide appropriate and accessible oral health care.*
- *Proposals for a two-year training program for a Dental Health Aid [sic] Therapist (a type of MLP) would allow under-educated individuals to diagnose disease and perform irreversible procedures. Taking a step back in education is not a solution; it is a problem that will adversely impact the oral health of future generations.*
- *In our quest to improve Georgians' access to oral health care, we must never compromise patient health or safety.*
- *The current workforce is adequate and the plan is in place to expand to meet the workforce need in Georgia as the population increases.*
- *Any new category of provider will be faced with the same influences that create dentist shortages in certain areas and communities. It is impossible to alleviate distribution shortages by adding a new category of dental provider, such as the mid- level provider.*
- *There are distinct differences between the delivery of dental and medical services … Because of these differences, medical model solutions should not be artificially imposed onto the dental model.*
- *Dentistry has served its patients quite well through the prevention-based 'dental team concept' rather than a "point of entry" concept. The dental team concept serves the function of dentistry and patients' access to care with its focus not merely on diagnosis of dental diseases, but rather on prevention and continuity of care through treatment.*
- *Rather than focusing on the issue of underfunding of government-based programs or focusing on programs to boost the dental IQ of the populace, some foundations are proposing to dismantle the current dental delivery model and promote the institution of lesser trained individuals (MLPs) providing dental services. The use of MLPs is not a solution. It is another problem and one that can compromise the health and safety of the patient.*

The American Academy of Pediatric Dentistry issued "Analysis and Policy Recommendations Concerning Mid-level Providers" (**AAPD, 2010**). The organization indicated that "growing concern and attention to access to care issues have prompted a variety of proposals that call for workforce strategies involving greater use and, in some cases, the development of new so-called 'mid-level providers.'" As a consequence, the organization created a Task Force on Work-force Issues in 2008 to examine various models of mid-level providers. The paper reviewed the use of four "existing mid-level providers," including the New Zealand dental therapist, the Canadian dental therapist, the Alaska dental health aide therapists and expanded function dental auxiliaries/assistants. Additionally, three "proposed mid-level models" were examined: the advanced dental hygiene practitioner, the Minnesota dental therapist, and the community dental health coordinator. The work of the task force resulted in the following recommendations:

- *Existing and proposed mid-level provider models that are conceptually compatible with AAPD core values, oral health policies and clinical guidelines, and definition of the dental home include: EFDAs (Expanded Function Dental Auxiliaries), Dental Therapists working under the supervision of dentists, and CDHCs (Community Dental Health Coordinators). Use of EFDAs has been thoroughly evaluated, is a part of accepted practice in over 20 states and several federal programs. Therefore:*
- *AAPD supports greater use of EFDAs based on extensive evaluations of their effectiveness and efficiency in a wider range of private and public settings as part of dental teams. On the other hand, additional evaluation of the performance, safety, and efficiency of other models that are consistent with AAPDs core values and definition of a dental home (e.g. dental therapist and CDHC models) is warranted. Therefore:*
- *AAPD recommends further evaluation of Dental Therapists and CDHC (Community Dental Health Coordinator) models prior to policy decisions regarding their use. AAPD has serious reservations about the premise, potential viability and presumed impact of the AHPD [sic] (Advanced Dental Hygiene Practitioner) model, which are shared by other organizations that have embraced the dental home. Therefore:*
- *AAPD joins others in rejecting the ADHP model on the basis of its incompatibility with the principle that dental care should be provided directly by or under the supervision of a dentist. Existing and proposed mid-level providers that do not meet the criteria for a dental home may serve as valuable members of the dental care delivery team under arrangements that have been demonstrated to expand access to care without compromising quality or safety. Therefore:*
- *AAPD supports the use of mid-level dental providers who perform or assist in the delivery of specified reversible procedures and certain surgical procedures under the general supervision of a dentist, provided such arrangements have been thoroughly evaluated and demonstrated to be safe, effective, and efficient and to not compromise quality of care.*

The paper concluded by stating: "AAPD believes that all children deserve access to quality dental care. Some may offer proposals based on what has been characterized as the 'something is better than nothing' approach to care. However, AAPD believes that the oral health needs of all children are best met through ongoing, comprehensive dental care provided through the collaborative efforts of dental teams comprised of adequately trained oral health professionals under the direction of competent dentists—in short, in quality dental homes. AAPD looks forward to working with all who embrace this concept and seek to achieve this goal for all children."

An independent assessment by RTI International of the Alaska DHAT program, "Evaluation of the Dental Health Aide Therapist Workforce Model in Alaska," was funded by the W.K. Kellogg, Rasmuson and the Bethel Community Service foundations and released in October 2010 (**Wetterhall et al. 2010**). The evaluation focused on five key areas:

- Patient satisfaction, oral health related quality of life, and perceived access to care.
- Oral health status.
- Clinical technical performance and performance measures.
- Record-based process measures and evaluation of clinical facilities.
- Implementation of community based prevention plans and programs.

Over a 2½-year period, the investigators "conducted a case study of five unique villages." The intent of the authors in setting up the study included "recognition of the fact that any long-term evaluation of the DHAT program will require a carefully designed and executed baseline assessment…. Our approach was designed to help provide this information."

The conclusion of the report stated, "The various indicators that were applied in these case studies to evaluate implementation of this program demonstrate that the five dental therapists who were included in this study are performing well and operating safely and appropriately within the defined scope of practice. The data indicate that the therapists who were observed are technically competent to perform these procedures within their scope of practice. The patients who were surveyed were generally very satisfied with the care they received from the therapists."

However, at the time of the study, the DHATs were still in the first phase of implementation, which was focused upon treating a backlog of dental disease. The "second prong of this approach was to begin implementing preventive measures—including education through the school system by village-based therapists." Therefore, future studies would be needed to evaluate the long-term impact of DHATs on community health.

The American Dental Association released a commentary on the Kellogg Foundation's "Report of the Dental Health Aide Therapist Workforce Model in Alaska" (**ADA, 2010**). The ADA concluded, "The report was limited in focus to case studies of 5 individual DHATs. It does not address the efficiency of the DHAT model and does not provide a conclusive evaluation of the clinical technical performance of DHATs. Significantly, the authors stressed that the impact of the program beyond Alaska cannot be determined at this time."

Journal of Public Health Special Workforce Issues

The Journal of Public Health Dentistry issued two special editions on the issue of the oral health workforce in the United States. Annotations of the articles in these two issues follow.

Among the disparities described by Hilton and Lester (**2010**) is that "the majority of dentists (84 percent) are solo practitioners who do not participate in government-sponsored dental coverage plans, which are a primary source of care for low-income people." Among the new workforce models are the dental therapist and the community dental health coordinator, who will be recruited from the communities they will serve, whereas the Minnesota advanced dental therapists will be drawn from the existing dental hygiene workforce. The authors emphasize that "A commitment to increasing diversity and improved cultural competency is crucial in improving access and health outcomes at all levels … [and that] savings will not translate to the patient level unless fees are set at a lower level for procedures performed by the new workforce members…"

Edelstein (**2010**) described the "limited capacity and overall insufficiency" of the dental safety net in the United States as "highly variable in availability, comprehensiveness, continuity, and quality. It is comprised of federally qualified health centers (FQHCs) and other health centers … as well as dental schools, hygiene programs, public school clinics, and mobile dental programs… Many of the underserved, particularly children, are insured by Medicaid and Children's Health Insurance Program, but are unable to obtain care primarily because of the lack of dentists who participate in these programs … Adults … fare worse … as the majority of states provide inadequate or no dental coverage." As for policy alternatives for safety net workforce, "Policymakers' interest in additionally authorizing dental therapists and dental hygienist therapists to provide basic preventive and reparative with a focus on underserved children is evident in the establishment of the dental health aide therapist in AK, dental therapist in MN, and congressional action to investigate training for this alternative dental provider."

Glassman and Subar (**2010**) emphasized that "The absolute number and percentage of the population of dependent individuals in institutional settings are growing

dramatically in the United States. The current dominant office-based oral health delivery system is not adequately addressing the oral health needs of these populations and is unlikely to do so in the future." Among their recommendations: "Dental professional institutions need to prepare graduates for community-based practice and with people with complex medical, physical, and social conditions…. Use existing oral health professions in new ways … [such as] allow dental hygienists to work with patients in community settings without the specific authorization of a dentist…. Develop new oral health professionals … [such as] dental therapists … and the community dental health coordinator proposed by the American Dental Association…. Reform the oral health reimbursement system … [to allow], for example, payment for fluoride varnish applications by oral health professionals and physicians … and a fundamental rethinking of what strategies are likely to improve oral health of dependent individuals in institutional settings and provide reimbursement for those interventions."

Based on their literature review, Skillman et al. (**2010**) concluded that "Rural populations have lower dental care utilization, higher rates of dental caries, lower rates of insurance, higher rates of poverty, less water fluoridation, fewer dentists per population, and greater distances to travel to access care than urban populations." In addition to increasing water fluoridation, providing better oral health education and better use of school-based programs, they recommended recruiting potential providers from rural areas, allowing dental hygienists to practice independently, involving medical providers in oral health care, using mobile clinics to reduce travel barriers and creating new types of providers such as dental therapists.

Garcia and colleagues (**2010)** asserted that "There are several key areas where change is critically needed in order to ensure successful implementation of any new workforce models. These areas include a) the public and private financing of dental care, b) the dental educational system, and c) state and federal policies … While we may have a system that provides dental care for those who can afford it, it fails to provide basic preventive and primary oral health services for nearly one-third of Americans." Among the workforce models envisioned, "The Dental Therapist Model has the strongest evidence for success, having been evaluated on numerous occasions over the past 5 decades and in multiple countries. It has been shown to be effective in bringing safe, high-quality oral health care to underserved communities, and is likely the most cost-effective model, in part given its limited, post-high school education requirements."

In his paper, Edelstein (**2011a**) reviewed the scope of traditional and proposed dental providers, and their training, coordination and policy issues, concluding, "Training dental therapists in the United States holds promise to expand the availability of basic dental care … Thoughtful and collaborative determinations of scope of practice, supervision, deployment, and appropriate education

preparation can help meet the goal of safe, quality, accessible dental care for all who seek it … and can further advance the dentist as the most sophisticated and expert member of the dental team and as a more central member of the larger healthcare system."

Evans (**2011**) presented the recommendations of an American Association of Public Health Dentistry (AAPHD) panel of academicians, funded by the W.K. Kellogg Foundation and Josiah Macy Jr. Foundation, who were assigned the task of developing an educational plan for dental therapists. Among the basic principles: reduce barriers to care; work in a team setting; emphasis on prevention; general supervision by dentists; scope of practice limited to competencies. Templates were presented for a Two-Year Post-Secondary Dental Therapy Curriculum in either a trimester or a quarter school year, along with brief descriptions of the content of recommended courses. Also included was a list of the AAPHD panelists.

Gelmon and Tresider (**2011**) summarized recommendations of the above panel for the accreditation of "a new oral health provider, the dental therapist.... An educational accreditation program for an emerging profession requires collaboration among key stakeholders representing education, practice, licensure, and other interests. Options … include establishment of a new independent accrediting agency; seeking recognition as a committee with the Commission on Accreditation of Allied Health Education Programs; or working with the Commission on Dental Accreditation (CODA) to create a new accreditation program within CODA. These options are not mutually exclusive, and more than one accreditation program could potentially exist."

Williard, with the assistance of Fauteux (**2011**), provided the background for the development and training of the Alaska Dental Health Aide Therapist (DHAT), which grew out of the federally sponsored Alaska Community Health Aide Program (CHAP). Originally trained in New Zealand, the DHAT current training program begins at the University of Washington DENTEX Training Center in Anchorage; the second year is completed at the Yuut Elitnaurviat Dental Training Clinic in the rural community of Bethel. Then, upon successful completion of a six-month preceptorship, DHATs are awarded certification (standing orders of competency) for a specific scope of practice under general supervision and may be assigned to practice in isolated rural communities, as well as other community health centers. Services "not on the standing orders must only be performed under direct or indirect supervision … Eleven of Alaska's 27 native health corporations have hired DHATs, deploying them in a variety of settings and under several types of supervision. This paper presents three profiles of well-established relationships between DHATs and dentists … chosen because they offer a window on three types of DHAT supervision and the various ways in which DHATs are safely and effectively expanding access to oral health services."

Lamster and Formicola (**2011**) summarized the presentations at the "2010 Dunning Symposium: The Practice of Dentistry for the 21st Century." The new federal health reform law (Patient Protection and Affordable Care Act) will "provide health insurance coverage for most of the approximately 50 million persons currently without … will require insurance companies to provide basic dental coverage for children …" Also emphasized were the "need to reshape the delivery system … Delegating … more routine procedures to mid-level providers to help cover the uninsured … The current private practice system was serving about 75 percent of Americans well and should be left to operate as it currently does, but that 25 percent of the population is suffering from poor oral health and has limited or no access to dental care ... The 21st-Century practitioner who would have the capacity to utilize more of the comprehensive education in the nation's university-based system of education … would concentrate their direct practice efforts to treat the more complex restorative cases or more medically complex patients … by utilizing mid-level providers, physicians, and nurses may be needed to augment the dental workforce 'reflecting a growing awareness of an unmet need that is accelerating at an unsustainable pace'… Mid-level providers can be viewed as dental extenders who will allow the dentist to treat the more complex orally and medically compromised patients."

Yoder and DePaola (**2011**) presented the pathways toward developing dental therapists as developed by a subcommittee of the American Association of Public Health Dentistry's panel of academicians, funded by the W.K. Kellogg Foundation and Josiah Macy Jr. Foundation. "Creating career pathways to facilitate current dental and other healthcare providers becoming dental therapists can be an efficient means to expand the dental workforce and reduce barriers to access to oral health services ... Forging clear pathways for already trained dental providers to gain and use new skill sets is a goal that offers significant advantages including the potential for lowered cost for dental services in the public and private sectors. The Federal government should fund pilot studies to evaluate the costs and effectiveness of services and improvement in access to care."

"It Takes a Team: How New Dental Providers Can Benefit Patients and Practices" was the title of a report issued by the Pew Center on the States (**Pew, 2010a**). The report was the first to examine the potential effects of dental therapists and hygienists/dental therapists on the productivity and profits of private dental practitioners, where 92 percent of the nation's dentists work. Three scenarios were examined in the study: 1) impact on a solo pediatric dental practice; 2) impact on a general dental practice; and 3) impact on a small group practice with associate dentists. The scenarios were calculated using the Productivity and Profit Calculator, a financial tool created for Pew by Scott & Co. Inc. in close consultation with a panel of dentists, dental hygienists and dental office managers.

Given assumptions for varying scenarios, the profit and productivity impact was assessed. For a solo pediatric dental practice, adding one dental therapist resulted in a profit impact of +29 percent and a productivity impact of 30 percent. For a solo general dental practice, the profit impact was +27 percent and the productivity impact was also 30 percent. The impact for a small group practice with associate dentists was less—profit impact of 12 percent and productivity impact of 10 percent. The study also reported on the impact of adding a hygienist to practices, as well as a hygienist/dental therapist. Other practice circumstances were also assessed, including the impact of a specific percent of public insurance patients in a practice."

The report concluded:

> *Hiring an allied provider can make smart business sense for a private dental practice by increasing productivity and—in the process—meeting the needs of many low income Americans who currently go without care. To make these innovations and benefits a reality for patients and practices, states first must authorize allied providers. As policy makers consider new workforce models, this report and the Productivity and Profit calculator can inform their deliberations and proposals. State leaders, dentists, public health advocates, and other stakeholders should be heartened to know that expanding the dental team is an effective strategy to improve access to care, but they cannot overlook the importance of setting adequate Medicaid reimbursement rates. While raising rates is difficult during tight fiscal times, research confirms its positive impact on access, and several states, including Maryland and Rhode Island, have taken this step in recent years despite tight budgets. As the American Dental Association notes on its website, "for people who live in areas where a dentist is not available or who cannot afford treatment, access to dental care can be difficult." Shortages of dentists and low Medicaid rates that discourage practices' participation have serious health, education and economic consequences—consequences felt by millions of families firsthand. With stakes so high, now is the time to welcome new allies to the team.*

The American Dental Association (**2011a**) responded with a review of Pew's "It Takes a Team," examining the validity and accuracy of the report, through an analytical review using economic theory, survey data and practice level data. The ADA reported several flaws in the report, including: 1) misrepresentation of solo general and dental pediatric practices; 2) the assumption of unlimited demand for services; and 3) the assertion that the employment of dental therapists will significantly improve Medicaid patients' access to dental care. The ADA stated that "we believe these flaws lead to erroneous conclusions regarding the potential contribution of new allied providers, the benefits that may be accrued to Medicaid patients, and dentists' net incomes."

The Pew Center on the States issued a brief describing "The Minnesota Story: How Advocates Secured the First State Law of Its Kind Expanding Children's Access to Dental Care" (**Pew, 2010b**). In May 2009, Minnesota became the first state to approve the licensing of a new oral health practitioner called a dental therapist. The law allows the creation of two new types of practitioner: a dental therapist who will work with a dentist on-site and an advanced dental therapist who will work under a collaborative practice agreement with an off-site dentist. Dental therapists will hold bachelor's degrees and advanced dental therapists will have master's degrees. The brief described in some detail the work of grass-roots advocates in Minnesota in overcoming the objection of the Minnesota Dental Association in gaining legislative approval of the dental therapist initiative.

The California Dental Association engaged ECG Management Consultants to assess the economic viability of adding three alternative practitioner models to the oral health workforce to help care for the underserved. The three models were dental therapists (DTs), dental health aide therapists (DHATs) and advance dental hygiene practitioners (ADHPs). The assessment included evaluation compensation levels, cost of training, cost of practice, estimated productivity and potential revenue for each practitioner. The study found that using DT or DHAT practitioners is a cost-efficient approach, but would require a more sustainable reimbursement basis than modeled. Based on a one-operatory, one dental assistant practice mode and procedural-based reimbursement, only the best payer mix (50 percent Denti-Cal and 50 percent average private dental benefits plan) broke even. The magnitude of the difference in expenses for the ADHP makes this model unrealistic, based on economics alone (**California Dental Association, 2010**).

The report concluded:

> *Studies suggest that intensive technical training programs, such as the DT/DHAT program, can effectively train quality practitioners in a short period of time. They reduce the cost of providing dental services in low-access areas. Compared to the ADHP, they offer a more rapid response to the current access issue. However, beyond economics, policies and approaches must be in place to successfully recruit and retain practitioners. Creating a pipeline of nontraditional applicants and limiting their scope of practice is key to retaining practitioners. Recruiting practitioners from a culturally and/or socioeconomically diverse background will require additional effort and financial resources to overcome the effect of the lower socioeconomic level; however, educating a person from a disadvantaged community and reinserting them into that community has benefits beyond provision of dental services. This person becomes a role model of achievement in that community and stimulates the area economy.*

Articles on Workforce in the California Dental Journal

Nagel once again reviewed the development and implementation of the Dental Health Aide Therapist (DHAT) in Alaska (**Nagle, 2011**). He documented the access-to-care problem for Alaska Natives; reviewed the use of dental therapists internationally to improve access to care; chronicled discussions of the issue with the Alaska Native Tribal Health Consortium (ANTHC); characterized the American Dental Association's challenges to the ANTHC initiative to introduce dental therapists in Alaska; and described the training of dental therapists that had begun in Alaska, after having been initiated in New Zealand. He concluded: "The Alaska Tribal Health Consortium, with the cooperation of the IHS [Indian Health Service], and supported by a number of philanthropic foundations, have provided leadership for demonstrating that the international model of developing and deploying dental therapists can be utilized in the United States to improve access to care for Alaskans, and, as a consequence, has had a significant impact on reducing oral health disparities and improving oral health. The effort offers a model for incorporating dental therapists as members of the dental team in other states and settings."

"Societal Expectations and the Profession's Responsibility to Reform the Dental Workforce to Ensure Access to Care for Children" was the title of an address by Nash before the House of Delegates of the California Dental Association in November of 2009. The speech was subsequently published in the Journal of the California Dental Association (**Nash, 2011a**). Nash began by characterizing the nature of a profession and the expectation society can justifiably have as a result of granting dentistry the status of a learned profession. He argued that while there are business dimensions to professional practice, dentistry is not a business, and to view it as such leads to a fallacious understanding of the obligation of the profession to ensure that all children have access to dental care. He advanced the idea that it is in the "enlightened self- interest" of dentistry to do what is necessary to ensure access to care; and said: "What is good for the oral health of the citizens of the United States is good for the profession of dentistry, including its business dimensions." He concluded by stating: "Dentistry needs thoughtful, committed, courageous leadership from members of the profession. Dentistry must distinguish itself by being a true profession, a profession that can be trusted to place the welfare of society first and foremost in all of its deliberations, by being faithful to the covenant that exists with society; by creating a more effective and less expensive way to ensure oral health care for all of our children; and by not only meeting but exceeding expectations."

Cumby and colleagues (**2011**) described the Community Dental Health Coordinator (CDHC) as being a possible change agent in promoting access to care. Cumby stated that the "American Dental Association's initiative with the

CDHC sets a new standard for introducing a potential member of the dental team by utilizing an evidence-based approach rather than a lobbying one." The vision for the CDHC was described as including an integrated dental health system that includes a patient record, a secure online data base and mobile technology to enable remote supervision by a licensed dentist. The supervision would permit the CDHC to provide preventive and palliative treatment at remote sites. The CDHC was designed to be a community health worker for dentistry.

The primary focus of the CDHC was stated to be to reduce the incidence of oral health disparities in underserved populations by improving access to dental care and by targeting the causes of oral disease. The curriculum for training the CDHC focuses on the five main functions perceived for the individual: oral health assessment, oral health promotion, prevention of dental disease, palliative care and patient navigation. The curriculum is 18 months in length, with the first 12 months spent in course work and the last six months in a community-based experience, a full-time internship. The pilot training program is being conducted through the College of Dentistry at the University of Oklahoma. Course work for the 12 months of the curriculum was reported to be occurring at Rio Salado College in Tempe, Ariz. The American Dental Association was reported to be funding the project through 2012 and seeking funding from other organizations for its continuance. The article concluded with the "Oklahoma Story" relative to access, and the challenges facing full implementation of the Community Dental Health Coordinator project.

The need to expand the dental workforce in order to get help for children was the focus of an article by Gehshan and Mijic (**2011**). The needs of children for oral health care were contrasted with the current dental workforce's ability to address those needs. The authors documented the current and future anticipated shortage of dentists, noting that the current dentist-to-population ratio is at its lowest level in nearly 100 years. The American Dental Association projects that the number of dentists available to meet the increasing population will increase only slightly from 2010 to 2020. Inadequate funding for dental care was identified as a major barrier to access to care for low-income children. While 4 percent of the nation's health care spending is devoted to dental care, only 1 percent is spent for dental care for public insurance recipients. Legal and regulatory barriers as well as cultural barriers were also reviewed as impediments to adding a new member to the dental team such as the New Zealand dental therapist. However, the Affordable Care Act of 2010 was cited as changing the landscape regarding workforce solutions and access to dental care for low-income and underserved children.

Gehshan and Mijic concluded:

> *Given that the access barriers brought to national attention 10 years ago by the U.S. Surgeon General remain a huge challenge today, it is clear that new*

> *thinking and approaches are necessary in order to expand care to children who need it. Some innovative dental workforce solutions are being developed across the country that promise to expand access. More states are expected to propose new providers such as dental therapists. Several dental associations and workforce experts are looking at developing a three-year modular program that would provide training for both dental hygiene and dental therapy. These ideas would build on the current educational and delivery system and keep dentists in their role as the most highly trained and compensated members of the dental team, and as team leader. As the field moves forward, dentists will need to learn how to incorporate these providers into practice and adapt to new delivery systems. More such efforts are needed that target unmet need among children and build on research and evidence about what works.*

Friedman (**2011**) reviewed the history and current status of the international dental therapists for the series of articles on oral health care workforce by the Journal of the California Dental Association. The origin of dental therapists in New Zealand was documented, as well as the expansion of dental therapists to other countries, both developed and developing ones. He reviewed the development and practice of dental therapists in New Zealand, Australia, Great Britain, Fiji, Canada and the Netherlands. Dental therapists were stated to provide preventive, restorative, and minor surgical treatment, mostly for children in government-sponsored health programs. The quality of care dental therapists provide and their acceptance by the public and dental profession were well-documented, Friedman wrote. Further, "not only do dental therapists provide basic dental care to underserved populations; they enable dentists to practice at a higher level of proficiency and efficiency." It was noted that dental therapists had been effectively serving Alaska Natives in remote communities since 2005.

The authors of the RTI International report on dental therapists published a subsequent paper that focused on the technical competence of dental therapists working in five different Alaskan communities (**Bader, Lee, Shugars, Burrus, Wetterhall, 2011**). The data presented in the study were "obtained through three separate data collection activities performed at each of the five sites." Evaluations of amalgam, resin and stainless steel crown restorations placed by dental therapists versus dentists were completed. "Of 84 amalgams placed by therapists, ten (12 percent) had deficiencies … of the 41 amalgam restorations placed by dentists, nine (22 percent) had deficiencies…. Of 47 composite restorations placed by therapists, seven (15 percent) had deficiencies … of 25 [composite] restorations placed by dentists, three (12 percent) were deficient." When it came to stainless steel crowns, "thirty stainless steel crowns restorations placed by therapists and 10 placed by dentists were evaluated. One therapist placed restoration (3 percent) and one dentist placed restoration (10 percent) were deficient."

Based on these results, the authors concluded that "therapists are performing at an acceptable level, with short-term restorative outcomes comparable with those of dentists treating the same populations." They suggested that "further evaluations of therapists should shift their principal focus from clinical technical performance of therapists to effectiveness of the therapist program in improving the targeted population's oral health."

PEW released another report in 2011 titled "The State of Children's Dental Health: Making Coverage Matter" (**Pew, 2011**). The crux of the report was the concern that despite 5.3 million more children becoming eligible for dental insurance with the passage of the Affordable Care Act, "without changes in state policies, expanded coverage is unlikely to translate into more dental care for every child in need…. Expanded insurance coverage must be coupled with policies that meaningfully improve children's access to care."

Pew noted that in spite of the fact that "Across the 50 states and the District of Columbia, almost 48 million people live in areas identified by the federal government as areas in which there is a shortage of dental health professionals," no states authorized a new allied dental provider in the last year. However, it was observed that "Public health advocates in Ohio, Kansas, New Mexico, Vermont and Washington have begun developing proposals to add dental therapists to the dental team, and these efforts are being supported by the W.K. Kellogg Foundation…. Stakeholders in California, Maine and New Hampshire also are working, with support from PEW, to develop proposals that expand the dental workforce."

The PEW report concluded that "states must do much more to improve children's access to care, particularly by strengthening preventive care efforts and broadening the pool of providers."

In July 2011, the Institute of Medicine released a report on improving access to care for vulnerable and underserved populations (**IOM, 2011**). The brief suggested that to be successful, an evidence-based oral health system for the United States should, among other variables, "Rely on a diverse and expanded array of providers who are competent, compensated, and authorized to provide evidence-based care."

The ADA continued its position of unequivocal opposition to the addition of dental therapists to the workforce in a 2011 workforce paper titled "Breaking Down Barriers" with the statement that "only dentists should diagnose disease, develop treatment plans and perform surgical/irreversible procedures." The ADA's stance was that "like any other economic sector, health care is market driven … In the economic sense, the populations in the most common underserved settings—remote rural areas, Native American communities and inner cities—cannot support a dental practice because no one is paying adequately for their care" (**ADA, 2011b; 2011c)**.

The emphasis on oral health care as a market-driven commodity, as opposed to a basic human right, was further illustrated in comments about federally funded dental clinics that "have a critical role in communities that for whatever reason cannot attract sufficient private dental practices." The viewpoint of the ADA is that dentists working in these clinics "do so out of a powerful sense of social responsibility"; however, "the system cannot sustain itself relying solely on doctors who, upon completing grueling years of education and training, to say nothing of attempting to borrow and repay the cost of completing dental education, choose such selfless career paths … These positions must pay competitively." The ADA's main solution to the access-to-care issue for children is to recommend increasing Medicaid reimbursement rates to market-based levels. One of the criticisms of the ADA regarding the dental therapist delivery model was that "we know of no empirical studies of the economic feasibility of dental mid- levels."

Special Issue of the American Journal of Public Health

In a special issue of the American Journal of Public Health in October 2011, the following authors comment on the issue of expanding the oral health care workforce.

Bertolami (**2011a**) stipulates that "1. there is a significant problem with access to dental care in the United States; 2. children dying of dental disease because of a lack of care is utterly repugnant and unacceptable; and 3. even if a two-tier system of dental care arises, the premise that some care is better than no care is irrefutable…. 4. dental therapists initially practicing under the supervision of licensed dentists will not evolve over time into independent practitioners who will compete with dentists….5. patients—both adults and children—of every socioeconomic stratum will find care delivered by dental therapists to be entirely acceptable."

Lamster and Formicola (**2011**) observe that "the profession is able to offer a high level of care to approximately 75 percent of the public through the private practice system. By contrast, at least 25 percent of the public—or 75 million Americans—have either limited or no access to oral health care ... Dentistry can be expected to extend care to the underserved by using midlevel providers without disturbing the current private practice system … but this implementation will take a new commitment by the profession to come together and utilize a new type of provider [the dental therapist] to reach the 25 percent of the public that cannot obtain care."

Lamster and Eaves (**2011**) present the case for enlarging the scope of dental practice to include primary health care, "such as screening for hypertension, diabetes mellitus, and dermatopathology; smoking prevention and cessation activities; and obesity intervention … For this model to be successfully introduced, there will need to be a redistribution of responsibility among the members of the

oral health care team. It is logical and necessary for dentists to assign treatment of uncomplicated problems to other members of the oral health care team, including mid-level practitioners."

Edelstein (**2011b**), drawing an analogy with industrial innovations, states, "For proponents of dental therapy, development and deployment of therapists in the United States constitutes an appropriate, albeit potentially disruptive, innovation." He does not provide documentation that proponents consider dental therapists potentially disruptive, but rather considers that "Dental therapists—midlevel dental providers who are roughly analogous to nurse practitioners in medicine—might constitute a disruptive innovation within U.S. dentistry. Proponents tend to claim that dental therapists will provide more equitable access to dental care; opponents tend to view them from a perspective that focuses on retaining the current attributes of the dental profession. Therapists display traits similar to those of disruptive innovations: their attributes are different from dentists', they may not initially be valued by current dental patients, they may appeal to current dental under-utilizers, and they may transform the dental delivery system. Whether dental therapists constitute a disruptive innovation will only be determined retrospectively."

Wetterhal and colleagues (**2011**) examined the care provided to Alaska Native people by dental therapists at five sites. "The Alaska Native people in rural Alaska face serious challenges in obtaining dental care. Itinerant care models have failed to meet their needs for more than 50 years. The dental health aide therapist (DHAT) model, which entails training midlevel care providers to perform limited restorative, surgical, and preventive procedures, was adopted to address some of the limitations of the itinerant model. We used quantitative and qualitative methods to assess residents' satisfaction with the model and the role of DHATs in the cultural context in which they operate. Our findings suggest that the DHAT model can provide much-needed access to urgent care and is beneficial from a comprehensive cultural perspective."

NYU Global Nexus Publication, 2011

In 2011, the College of Dentistry of New York University released their alumni journal, Global Nexus. The issue was devoted to workforce issues. The issue was introduced with an article by Charles Bertolami, the dean of the college, in which he asked the question, "What just happened?" relative to the movement to introduce dental therapists into the U.S. workforce (**Bertolami, 2011b**). He indicated that even when the issues of the type and length of training they receive are resolved, introducing these practitioners into the oral health delivery system will "probably be more complicated than what is anticipated by either ardent advocates or vociferous opponents." He predicted that "dental therapists

will not evolve over time into independent and competing dental therapy practices." Rather, "therapists will resemble pharmacists … from the employment perspective." He meant by this that dental therapists will be employees rather than entrepreneurs managing private practices. He suggested that there are scenarios, even likely ones, in which access to oral health care is not improved by the introduction of dental therapists into the oral health workforce. "Rather than dental therapists finding employment in community dental clinics, schools, and other community-oriented facilities, a setting is easily imagined in which these new categories of practitioners are hijacked—at considerably better pay—into a fully corporatized model of dental care, one unlikely to be attentive to the needs of the underserved; or, if congenial to those needs, only incidentally so."

Bertolami continued by suggesting that though the work of dental therapists in New Zealand and Australia had resulted in some success, the introduction of dental therapists into the "highly privatized model of dental care in the United States is simply unpredictable." In a section titled "Never Attribute to Malice," he argued that though the dental profession had seemingly resisted the introduction of dental therapists in the early 1950s and again in the 1970s, both in the state of Massachusetts, attributing the resistance to "the ulterior motive of protecting its own interest rather than the public's" should not be concluded; the context must be considered. He advanced the efforts of dentistry at the time to introduce water fluoridation and promote fluoride dentifrices as examples of the profession working for the public good. He stated that "an alternative explanation is that organized dentistry really did believe that they were protecting the public's interest and that less qualified practitioners really did represent an unwarranted risk."

Bertolami concluded, "I am very reticent to criticize the profession or to question its motives. It does seem reasonable to ask whether the dignity accorded the human person and the privilege of providing direct patient can adequately be imprinted through a purely technical education."

Using a sociological concept of the required qualities and behaviors of a "profession," Nash stated that dentistry is under a professional imperative to care for the oral health of America's children (**Nash, 2011b**). He criticized the profession for focusing on the solution to the access problem for children by paying dentists more money to care for public insurance recipients, when such an approach has been only marginally effective, and not possible when there were no more public funds available. In such a quandary, he argued the profession must lead in advancing a model for an alternative delivery system that will enable children to be cared for within the financial resources society can provide. He advanced the New Zealand approach of dental therapists caring for children in school-based programs as a cost-effective strategy in which dentistry could fulfill its professional imperative.

Ann Battrell, the executive director of the American Dental Hygienists' Association (ADHA), reviewed the background and forecast for the organization's Advanced Dental Hygiene Practitioner (ADHP) for Global Nexus (**2011**). The organization had called for the creation of an ADHP at its 81st annual session in 2004. The ADHA's vision was for the ADHP to be "a master's- level educated, licensed oral healthcare provider who will leverage the existing dental hygiene workforce to have an even greater impact on the delivery of oral health care to those in need." The ADHP was said to be "intended to serve in a capacity similar to that of the nurse practitioner—as a new member of the oral healthcare team who could provide an additional point of entry into the oral healthcare system for those who do not currently have access to routine dental care."

In March 2008, the Board of Trustees of ADHA adopted the "Competencies for the Advanced Dental Hygiene Practitioner." Concurrently, the first advanced dental hygiene practitioner program began to be developed by Metropolitan State University in Minnesota, based in part on ADHA's approved competencies.

Battrell suggested that among the several factors inherent in the design of the ADHP model that would have a positive effect on access were: 1) a ready workforce to implement the model; 2) taking a lesson from medicine; and 3) economic advantages. She concluded by saying: "ADHA, on behalf of 150,000 dental hygienists in America, is dedicated to remaining open to collaboration and flexibility on this issue. Dental hygiene wants to do its part to ensure that no American ever need go without adequate oral health care."

Carter Brown, a private practicing dentist, asked the question: "What does 'access' really mean: Is it the number of patients who receive care, the ability of patients to get care, the degree to which patients get care, or the ease with which they get care? I believe that a lack of clarity has caused us to lose sight of what we are trying to accomplish" (**Brown, 2011**). Brown expressed "frustration and sadness that so much time and debate and so many resources surround one proposed solution—the so-called midlevel provider—which focuses exclusively on treating disease that has already occurred. This is essentially increasing the speed at which you are bailing a very leaky boat.… Workforce is but a small part of the access factor."

Brown reviewed some of the measures that had been helpful to improving access to care in South Carolina. He emphasized that "Our goal is the best possible oral health care for as many people as possible. We need to quit arguing about whether therapists might hurt patients or what the definition of access is…. Focusing only on untreated disease leads, I believe erroneously, to the conclusion that we need more people to fill and pull teeth…. Midlevel providers have after decades failed to improve the oral health of the underserved populations or save money in the very countries that their advocates hold up as shining success that should be replicated here."

He concluded by stating that "creating a second tier of care is a treatment plan based on a faulty diagnosis. You cannot cure what you misdiagnose."

The Institute of Medicine's report "Improving Access to Oral Health Care for Vulnerable and Underserved Populations" characterized this time as a "transformative moment in the nation's healthcare system" and as an opportunity to explore new approaches to addressing dental access problems (**IOM, 2011**).

Subsequent to the IOM report, the W.K. Kellogg Foundation commissioned Lake Research Partners to conduct a national survey on the views of Americans on the issue of access to dental care (**W.K. Kellogg, 2011**). The key findings for the survey were:

- Four-in-ten (40 percent) survey respondents report that they have put off dental care in the last twelve months due to costs. Individuals with incomes less than $30,000, Latinos, those who lack dental insurance, and those with a high school diploma or less are among the most likely to put off dental care due to costs. Women are also more likely to put off dental care because of concerns about costs.
- Thirty percent of respondents report that they do not have a place to receive regular dental care.
- More than eight-in-ten think that there is a problem that so many Americans cannot afford dental care.
- Most survey respondents (82 percent) believe it is "very" or "somewhat hard" for people to get free or low-cost dental care in their communities.
- More than three-quarters of respondents (78 percent) support a new effort to train a new dental provider—a licensed dental practitioner—to work under the supervision of dentist to provide preventive, routine care to people without regular access to care.

The Robert Wood Johnson Foundation regularly publishes an anthology, "To Improve Health and Health Care." In 2011, a chapter was devoted to "Dental Health Aides and Therapists in Alaska"(**Solovitch, 2011**). It captured the personal stories of individuals in Alaska whose lives had been affected in a positive manner as a result of the implementation of dental health aides and dental therapists in Alaska. The narrative tells of the problems of oral health among Alaska Natives, the work of advocates both within the Alaska Native Tribal Health Consortium and the Indian Health Service, as well as the aides and dental therapists themselves. Solovitch also describes the battle between advocates for the practice of dental therapists in Alaska and the Alaska Dental Society and American Dental Association. Paul Sherry, the chief executive officer of the ANTHC, called it "the biggest fight of my life." While acknowledging that the Robert Wood Johnson Foundation did not play a major role in the introduction of dental therapists in Alaska, the story describes a small role the foundation played in helping support the work of the Rasmuson Foundation, which was a significant funder for implementing the program.

Friedman (**2012),** in a letter to the editor of the American Journal of Public Health, responded to Edelstein (**2011b**):

> *Innovation in health care cannot be compared with disruptive innovations in industries such as the effect of the Internet on newspapers, or the digital camera on film cameras and film manufacturing, or the automobile on the horse and buggy … Edelstein presents the views of both opponents and proponents of dental therapists, as though they have equal credence. But almost all the arguments in opposition are based on assertions that have been shown to be false. For example, opponents still say that dental therapists provide substandard care when their quality of care has been documented time and again in objective studies to be equal to that of dentists. They question if the public will accept or be satisfied with dental therapists when studies have confirmed a high level of acceptance and satisfaction. Giving equal space to false arguments can only have the effect of diluting the evidence that innovative health care providers such as nurse practitioners and dental therapists do not disrupt the professions, much to the benefit of the public.*

Section 4

NEW ZEALAND

New Zealand is an island nation in the southwestern Pacific Ocean, 900 miles east of Australia. It is about the size of the state of Colorado, nearly 1,000 miles long. The two main islands, the North and South islands, are separated by the tumultuous Cook Strait, between 15 miles at its narrowest and 43 miles at its broadest points. All populated islands have dental therapy services. New Zealand is a parliamentary democracy and constitutional monarchy, a member of the British Commonwealth of Nations that became self-governing in 1852. It was the first self-governing country to give women the vote, in 1893.

New Zealand has a strong social security system, comprehensive health care coverage, responsible environmental regulation and a strong union organized labor workforce. Seventy-five percent of its 4.3 million population live on the North Island, 85 percent in urban areas. Almost a third of Kiwis, as New Zealanders are known, populate New Zealand's largest city, sprawling Auckland on the North Island. European descendants, most from the United Kingdom, account for 77 percent of the population, Maori 15 percent, Asians 10 percent, other Pacific Peoples 7 percent, and others, less than 1 percent. The median age of the population is 37 years, with 20 percent age 14 or younger, 66 percent between 15 and 64, and 13 percent 65 or older. Education is compulsory from age 5 to 18, achieving a literacy rate of 99 percent.

New Zealand's top trading partners are Australia, China, the United States, the United Kingdom and Japan, in that order. Its main exports are dairy products, meat, forest products, fruit and vegetables, fish, wool and wine. Its main imports are machinery and equipment, vehicles and aircraft, petroleum, electronics, textiles and plastics. Tourism is also an important part of its economy.

ESTABLISHING THE SCHOOL DENTAL SERVICE AND TRAINING SCHOOL DENTAL NURSES

J.L. Saunders (**1964**), former director of the Wellington Dental Nurse training school and director of the New Zealand Division of Dental Hygiene, Department of Health, published "The New Zealand School Dental Service: Its Initiation and Development, 1920-1960" in 1964. In it, he provides a detailed review of the School Dental Service.

"A History of Dentistry in New Zealand," written by T.W.H. Brooking (**1980**) and published by the New Dental Association, also provides an extensive history of the School Dental Service and school dental nurses, in addition to the history of dentists in New Zealand. The first dental nurses' journal, Niho Pai (Maori meaning "Good Teeth"), was published in 1925 by the dental nurses themselves and came out regularly until about 1938. After this publication ceased, the New Zealand School Dental Service Gazette (1941-1991) was published by the Department of Health; in addition to articles, it also contained information and instructions to nurses on the everyday running of the School Dental Service. The Gazette would be the main source for the history of the service. After the Department ceased to distribute the Gazette, journals were published by branches of the New Zealand Dental Therapists' Association (NZDTA) prior to the establishment of the official New Zealand Dental Therapists' Association Journal in 1997. Recently, the decision was made to combine the NZDTA Journal and the Australian Dental and Oral Therapists Association (ADOHTA) Journal.

Two theses have been written on different aspects of the history of the School Dental Service. Prince **(1993)** examined gender issues and relationships within dental nurse training and the School Dental Service from 1923 to 1950, while Dewson's thesis looked at the period from 1920 to 1950 and argued that the dental nurse and the School Dental Service provided a direct link between the state and the family in this period. This connection gave the nurses opportunity to "inculcate notions of domesticity" and influence members of the public toward the importance of dental health **(Dewson, 2007).**

The following history of the New Zealand approach to caring for the oral health of children is quoted from "Oral Health Therapy Programs in Australia and New Zealand," edited by Annetta K.L. Tsang (**2010**). It is from Chapter 1, "A History of Oral Health Practice (Dental Therapy and Dental Hygiene) in Australia and New Zealand," by Julie Satur and Susan Moffat.

> *As early as 1905, F.W. Thompson, a New Zealand dentist, presented a paper entitled, 'The Teeth of Our Children' at the first conference of the then newly-formed New Zealand Dental Association (**NZDA**). Thompson had dentally examined children in Christchurch, none of whom had a sound set of teeth. He estimated that ninety-eight percent of New Zealand children did not receive the care they needed for their teeth. Thompson argued for state action on the grounds that sound teeth were the basis of good health (**Thompson, 1906**). Thompson's paper was well-received by dentists and was printed and distributed as a parliamentary paper (**NZ Department of Health, 1905**).*
>
> *NZDA members continued to examine children's teeth, largely at their own expense, in order to advise parents of treatment requirements. They also hoped*

*to gain enough evidence to convince the Government that some form of state intervention was needed to establish dental care for children (**Didsbury, 1907**).*

*In 1912, the newly-established School Medical Service further confirmed that the oral health status of New Zealand children was poor; with the NZDA estimating that 90 percent of children examined required dental treatment and that only 25 percent would be able to afford that treatment (**NZDJ, 1912**).*

*The appalling state of the nation's teeth became increasingly obvious during the First World War. A high percentage of recruits were rejected for service and many others required extensive treatment to be made dentally fit (**NZDJ, 1915; Brooking, 1980**). The state of the troops' teeth led to the formation of New Zealand's Dental Corps. The success of the Corps meant that politicians became more sympathetic to the eventual establishment of a state dental service for children (**Brooking, 1980**).*

However, the War also meant that there was little money available for dental treatment in children. Despite this, the need for state funding for children's dental treatment was still mentioned frequently at NZDA meetings and conferences, with various schemes being suggested to combat the problem. For, as the President of the NZDA, A.M. Carter, rather melodramatically stated in his presidential address of 1916,

> *"The war of the nations will end, and in our hearts we know Victory will be ours, but in the dental disease so rampant in our schools we have a more insidious foe, and one that has been far too long underestimated, and that is steadily sapping the vitality and lowering the stamina of our national life" (**Carter, 1916**).*

*In 1913, the then President of the New Zealand Dental Association, Norman K. Cox proposed a system of school dental clinics operated by the state and staffed by dentists and 'oral hygienists' to address the dental needs of children between the ages of 6 and 14 years. Cox (**1913**) suggested that these state dentists or "oral hygienists", be trained in a short course at the Dental School. There was opposition to this proposal from dentists within the NZDA and from H.P. Pickerill, Dean of the Dental School, who believed training school dentists at a lower standard to treat children was not desirable (**NZDA, 1913a**). However, a committee was formed by the NZDA to look into the proposed scheme and a NZDA deputation eventually met with the Ministers of Public Health and Education to discuss the proposal. While the ministers agreed that it was not enough merely to inspect children's teeth (as the School Medical Service was doing), they believed such a scheme would need careful consideration due to the costs involved (**NZDA, 1913b**). Unfortunately, there was little progress made on implementing the proposal before war broke out.*

*In 1917, Richmond Dunn a dentist from Wanganui, published a paper which emphasized the need for dental care for children and the effects of poor oral health on their general health. He was particularly concerned that the proposed school dental clinics would only provide treatment for dental caries. Dunn stressed the need for preventive care for children, including preschoolers. He believed that New Zealand's "Plunket Nurses" were the only people doing "real service for the race," as they were able to give advice and service that improved the health of children and produced "strong and useful men and women for the future" (**Dunn, 1917**). Dunn proposed the preparation of a Bill that would create a new profession of "dental nurse." The dental nurse would advise parents of their child's treatment needs, give oral health advice, examine teeth and carry out simple operative procedures. Having dental nurses would solve the problem of there being insufficient dentists in New Zealand to staff a school service and dentists would be relieved of the "child-work" that many of them found so "trying to the nerves" (**Dunn, 1917**).*

*Norman Cox, in turn, proposed that New Zealand be divided into areas staffed by dental officers and dental nurses, under a Director of Dental Services. The NZDA once again established a committee to investigate further possibilities and meet with Government ministers (**Cox, 1917**). The NZDA also gained the support of many influential groups, including the Plunket Society, British Medical Association, New Zealand Educational Institute, the University of Otago Council and the media. In 1918, a powerful deputation was favourably received and in 1919, the first four school dentists were appointed to the four main centres of New Zealand to form the basis of the School Dental Service (**NZDA, 1918; Brooking, 1980**).*

*There was much controversy surrounding the scheme, including opposition from within the NZDA. However, in September 1920, at a special meeting of the NZDA, delegates from the branches voted 16 to 7 to support the adoption of the School Dental Nurse Scheme (**NZDA, 1920; Brooking, 1980**). School dental nurses were to provide diagnostic and restorative services to children "in a rigidly structured set of methods and procedures which spared her the anxiety of making choices…" (**Leslie, 1971**).*

*The controversy surrounding the establishment of the scheme continued for some time. Leslie (**1971a**) reports that organized opposition was considerable on the grounds that the employment of dental nurses posed:*

> *"a menace to the public, (a) menace to the (dental) profession and an injustice to those seeking to enter the ranks of the (dental) profession by recognized avenues…"*

Colonel (later Sir) Thomas Hunter was appointed Director of the newly-established Division of Dental Hygiene under the Department of Health and was largely credited with the successful establishment of New Zealand's School Dental

*Service (**Brooking, 1980**). Under Hunter's direction, and despite opposition, the New Zealand School Dental Nurse was born, trained initially in a school in Wellington run by the Health Department with the first cohort graduating in 1923. After the Second World War, training schools were also established in Auckland (1952) and Christchurch (1956), providing by 1990, a workforce of around 900, and a 95 percent participation rate by New Zealand's school children (**Hannah, 1998a; Tane, 2002**). School dental nurses, (known as dental therapists from 1991) in New Zealand worked in mobile units and clinics attached to schools, providing diagnostic, preventive and treatment services and referring treatment beyond their skills to local dentists. Supervision was provided at a ratio of around 1 dentist to 50 school dental nurses with the purpose of ensuring therapists did not work beyond their skills and updated their practices (**Leslie, 1971a**).*

*In 1980, as a result of New Zealand's declining child population and reduced treatment needs, a decision was made to close the Auckland and Christchurch training schools. A review of dental nurse training established that an average of 25 graduates per annum would be sufficient to staff the School Dental Service. The Wellington School was retained, as it was centrally located, had the largest patient group and because there were no dental clinics in central Wellington (**NZ SDS Gazette, 1980**). In 1991, training of dental nurses passed from the Department of Health to the Department of Education, with the training being conducted by Wellington Polytechnic from 1991 to 1999 (**Molloy, 1991**) until a further review of dental therapy education occurred which recommended auspice by a University. The first students graduated from the University of Otago in 2000 with a Diploma in Dental Therapy. Eventually both the University of Otago and the Auckland University of Technology established degree programs for dental therapy. [**End quoted citation, from Tsang, 2010.**]*

These qualifications have now been replaced by "Oral Health" degrees (AUT in 2006 and Otago in 2007) enabling registration in both dental therapy and dental hygiene.

INTERNATIONAL COMMENTARY ON THE SCHOOL DENTAL SERVICE IN THE 1950S

As a result of widespread interest in the New Zealand School Dental Service, three overseas delegations visited to investigate the service during 1950.

Fulton's World Health Organization Report

From February to April 1950, Dr. John T. Fulton, the dental services adviser to the Children's Bureau of the United States, conducted a study of New Zealand's school dental nurse program through a fellowship from the World Health Organization

(WHO). The results of his study were reported in a monograph published by the WHO (**1951**). Fulton acknowledged the limitations of his study—it was an investigation of the caries control measures being used in New Zealand and their effectiveness as demonstrated in the mouths of a representative group of children. He found that the prevalence of dental caries was high in the average New Zealand schoolchild, but that much of it had been treated. At age 7, more than five deciduous molars had decay, yet 95 percent of these were filled. Two permanent teeth had been attacked by caries, but 75 percent had been treated with fillings. By the age of 14, the number of carious permanent teeth had risen to 10, yet 86 percent of these teeth had been filled. Fulton stated that "only 0.4 permanent teeth are missing."

While acknowledging the hazards of assessing quality due to lack of standard criteria, Fulton did conduct an assessment of quality. In examining 14-year-olds who had been treated by both dental nurses and dentists, he identified amalgam restorations that he considered extraordinary in quality; the child's name was recorded by an assistant. Subsequently, it was determined whether or not the 207 restorations identified had been placed by a dental nurse or a dentist. He found that 82 percent of the restorations judged by him as superior in quality had been placed by dental nurses, permitting him to say that the New Zealand dental nurse was capable of producing amalgam fillings of good quality.

Two final observations he made were that office hygiene was excellent, with clinics invariably being clean, neat and orderly. There were rigid rules concerning housekeeping of clinics and inspectors were meticulous on this score. He also indicated that patient management did not seem to present any problems, with the dental nurses obviously having the respect of the children. "They appear to stand in the same relation to the children as the school teacher." He observed several 3- and 4-year-old children being treated with the child's cooperation. In the last four chapters of the monograph, Fulton discussed the costs of care in the School Dental Service, the training of dental nurses, the dental profession generally in New Zealand and the historical development of the dental service.

United Kingdom Dental Mission to the Ministry of Health, the Department of Health of Scotland and the Ministry of Education

The United Kingdom sent a mission of five prominent members of the dental profession to New Zealand in February 1950 (**Bradlaw et al., 1951)**. This mission produced a comprehensive report that detailed the history and development of the School Dental Nurse Scheme in New Zealand and acknowledged the New Zealand Dental Association's role in urging the government to set up a school dental service. The mission noted that the Division of Dental Hygiene, which had responsibility for the School Dental Service, was organized on a triple foundation of research, health education and treatment, and that the division had carried

out valuable research that was explained as being complementary to that of the University of Otago. The recruitment and training of dental nurses, classroom atmosphere, curriculum and learning outcomes each received close scrutiny, as did the accommodation and welfare of the students.

The scope of treatment of the dental nurse was described as "partly preventive and partly remedial." While remedial treatment consisted of restoring and extracting deciduous and permanent teeth, the delegates noted that preventive treatment was also undertaken. This included oral prophylaxis, the application of fluoride, prophylactic odontotomy, and lectures and instruction in oral hygiene. Great importance was attached to dental health education and, as a result, children interviewed had a good knowledge of dental health. Furthermore, dental nurses were capable of both referring treatment outside their scope of practice and making orthodontic referrals.

The dental nurse to patient ratio was set at about one to 500, to allow time for the dental nurse to undertake dental health education. The mission calculated that, if all costs were included, the total cost per child per year for dental care within the School Dental Service (including biannual inspection and treatment) would be £1 8s 11d [U.S. $2.80 in 1950]. Parents were able to enroll their preschoolers and children for treatment. The philosophy of providing complete treatment for a restricted number as opposed to "the greatest good for the greatest number" was seen in light of the regulations applied to children who had not been enrolled in the service by the age of 7, or who failed to keep two appointments, or did not carry out the oral hygiene teaching given. Such children were required to visit a private dentist at the parents' expense before being admitted/readmitted.

Further discussion described the range of buildings and equipment and the establishment of the School Dental Clinic Committee with responsibilities for managing the clinic funded by the Department of Health. The dental nurse was attached to the staff of the school, and acknowledged as making an important contribution to the community she worked in. Although working within the school, the dental nurse was employed under the professional direction and supervision of the principal dental officer. Supervision and reporting on dental nurse performance impressed the mission, as did the development of "esprit de corps and a sense of corporate responsibility" in training that continued in the field.

The mission noted the high caries rate of both New Zealand children and adults but concluded that most adults at the time would not have had the opportunity of receiving care from the service. The report provided an overview of work output by the school dental nurse and standard of treatment, with positive comments on cavity preparation and fillings and the management of child patients. The authors commended dental health education and particularly the range of approaches used.

The delegates established that the dental nurses had the support of the New Zealand Dental Association, the dental profession and the general public. One member of the mission, who was delegated to talk to members of the public, found that those interviewed "were rather surprised that there should be any question of the value or usefulness of school dental nurses." In conclusion, members of the mission stated: "We are of the unanimous opinion that the training of the NZ school dental nurse has resulted in a high standard of technical efficiency in the treatment of children within the limits laid down…."

Dr. A. O. Gruebbel, Secretary of the Council on Dental Health of the American Dental Association

In 1951, the board of trustees of the American Dental Association sent a representative, Allen O. Gruebbel, to New Zealand to investigate the care dental nurses provided to children. Gruebbel's report was critical about the training the dental nurses received, the care they provided and New Zealand dental services in general **(Gruebbel, 1951).**

Gruebbel observed that because children's dental care was delegated to dental nurses, there were no courses in pedodontics taught at the dental school until recently. This meant that dentists had little knowledge of children's dentistry. He went on further to say that the dental nurse plan had, in fact, hindered the training of dental students and the advancement of dental research, as the majority of government funding was directed toward the School Dental Service and the adolescent (Dental Benefits) scheme rather than education for dental students and dental research.

Gruebbel questioned New Zealand's system of dental nurses providing care for children while private dentists provided care for adolescents. He believed that dental nurses should be able to treat adolescents if they could treat children, and that young children were more likely to need the expert services of a dentist than adolescents. "A greatly limited service for children performed by technicians is acceptable to both the profession and the Government in New Zealand, but this type of care is not acceptable for adolescents."

While Gruebbel was complimentary about the clean clinics and neat appearances of the nurses, he expressed concern about the adequacy of supplies, the materials used and the outdated equipment in some clinics. In addition, the nurses did not have access to radiography. Gruebbel judged most aspects of the quality of care given by the nurses as poor or mediocre, with the exception of "oral prophylaxis," which he found to be good. He found many copper amalgam fillings to be defective, and questioned the fact that the dental nurses would often place small pit fillings in occlusal surfaces rather than extend for prevention as per the G.V.

Black system of cavity preparation. He believed there was very little supervision of the dental nurses due to the heavy workload of the principal dental officers.

Gruebbel observed that the status of the dental nurse was not a professional one because "neither her training nor her experience was based on scientific knowledge." Dental nurses were not encouraged to read scientific articles or attend continuing education courses.

The recruits of World War I were compared with those of World War II and Gruebbel concluded that although there had been a reduction in the need for fillings, the dental health of the World War II recruits had not markedly improved.

Response to Reports—J. Llewellyn Saunders, Director, Division of Dental Hygiene, New Zealand Department of Health

In his comments on the three reports, Saunders remarked on the significance of the three independent visits to New Zealand, which allowed for discussion with the advantage of first-hand knowledge **(Saunders, 1951)**. Each group was given the fullest possible facilities for their investigators (assistance with travel arrangements, access to school dental clinics throughout the country, and information provided when requested—where it existed); meetings were arranged with dental professionals, officials of the NZDA and the Dental Hygiene Division of the Department of Health.

The United Kingdom and Fulton's reports of the investigations were checked and verified by the New Zealand dental authorities, as early copies of the reports were made available before publication for comment. The first opportunity to see Gruebbel's report came in a news release from the American Dental Association. The factual basis of this item was questioned, and not until a year later was the full report published and an opportunity given to comment upon its content. Seven areas of concern were selected by Saunders for further discussion—of significance among these the limited sample selected by this investigator: two South Island schools, most of whose students had been transferred from the School Dental Service (SDS) to Dental Benefits three years previously, the remainder two years before. The investigator took radiographs of students in the two schools—some of these children had never been treated by a dental nurse.

Saunders' review highlights the contrasted perception of quality. The WHO investigator examined the restorations placed in children's mouths, without knowing who had undertaken the work, and concluded "the NZ dental nurses are capable of producing good quality fillings," while the UK Mission was equally impressed—even to the extent of declaring that "cavity preparation was if anything on the side of perfection…."

In concluding, Saunders welcomed constructive criticism, and the stimulus leading to a careful review, but did not accept the view of the editor of the Journal of the American Dental Association commending a report that was not supported by facts.

JOHN WALSH'S 'CARE INDEX' AND THE LITERATURE OF THE 1960S

John Walsh, the dean of New Zealand's dental school at the University of Otago, addressed the American College of Dentists at the annual convocation of the College in San Francisco in 1964 (**1965**). His topic was the New Zealand dental nurse. In his opening comments, he said that "the world over must ask itself whether it is fulfilling its responsibility of taking care of the health of the world's population." He went on to quote: "Dentistry cannot expect to be regarded as a true profession until it stops expressing public concern about its own welfare. First and most important, it must start expressing an honest and serious interest in the dental health in all areas of the population."

Walsh also addressed the "Centennial Conference on Oral Health" at the Harvard School of Dental Medicine in 1968 (**1968a and 1968b**). As he had done in his 1964 address to the American College of Dentists, Walsh compared and contrasted the filled teeth in New Zealand and the United States to the total DMF teeth. He designated this ratio a "Care Index." The Care Index for New Zealand was 72 percent, versus 23 percent for the United States, and Walsh went on to say: "I doubt any other country in the world can match New Zealand's dental care of children." He suggested that the extent to which a nation meets the dental needs of its children is largely dependent upon the degree of cooperation that exists between the dental profession and the government. Countries with a high degree of cooperation have a high Care Index and those with a low degree, a low Care Index.

In 1956, there were 695 treatment centers for the School Dental Service, with 2,385 primary and intermediate schools being served out of the 2,423 schools—more than 98 percent. In the most recent annual report for the time, the number of dental nurses was 978 in 1,000 treatment centers, with half a million children receiving care. More than 2,300,000 fillings were placed in 1963. The ration of extractions to fillings had fallen from 73 percent in 1925 to 7.5 percent in 1945 and 3.6 percent in 1964.

In 1960, there were 19 extractions/100 patients, versus 407/100 patients in 1922. The 1963-64 report indicated that dental nurses had given 12,000 lectures promoting oral health to parents and children. The cost of the service in 1963-64 was approximately $10 per child (U.S.). Walsh continued by comparing the dental health of New Zealand children with those of children in the United States. DMF surfaces in both population groups were similar. However, the average ratio of filled teeth to DMF teeth was different. The average F:DMF for New Zealand was

82.8 percent; for the United States, it was 38.4 percent. He concluded with the statement, "We in New Zealand are justly proud of the School Dental Nurse."

Walsh stated a strong belief in the need for government intervention in the dental care of children: "If dentistry truly is a profession dedicated to serve the public interest, surely it should seek to stimulate every possible aid including civic and government action, and to cooperate with all responsible agencies, in order to stamp out dental disease; to defend the health of all people against attack by disease. Everyone accepts government action in the sphere of the defense against enemies but is not all disease an enemy of the people?" He reaffirmed a comment made to the American College of Dentists previously: "The worthiness of a society can be evaluated in terms of its concern for and care of the health of its children." He then quoted President John Kennedy's inaugural address: "Children may be the victims of fate—they must never be the victims of neglect." Dean Walsh concluded by saying: "Health is a birthright of all children, everywhere." Walsh's address was reprinted in the New Zealand Dental Journal (**1972**).

In 1965 the British Dental Journal published a paper by H.C. Davis of his visit to New Zealand from Great Britain in the mid-1960s. Davis stated that the object of his paper was to give a "fair assessment of the two systems [New Zealand's and the United Kingdom's New Cross dental nurses], without owning to any political clique or faction." He concluded that the similarities of the two systems were greater than their differences. "There is the same high standard of appearance and deportment, of manual dexterity, of gentle and kindly concern for children, and that almost tangible atmosphere of orderly calm in the clinics which never ceases to astonish the outside observer." Davis quoted Leslie [the director of dental nurse training program in New Zealand] as saying "We treat schools, not children." He found that the dental nurse and her surgery on school grounds are an intimate part of the life of the school. He reported that "the vast majority of the children attend state schools and there is an approximate 98 percent acceptance rate, the children being examined on entry at the age of 5. About 59 percent of pre-schoolchildren are also seen at the request of parents from the age of 2½ upwards."

Davis called the criticism of the New Zealand scheme of being reparative and not preventive "nonsense." The dental nurse aimed to prevent dental disease by dental health education, both of the children and their parents, and encouraged fluoridation of the local water supply. He stated that when the children moved on to secondary education they were turned over to local dentists with clean, well-cared for mouths. He confirmed that the dental nurses were supervised by a district dental officer assisted by a specially trained dental nurse inspector, who visited regularly to check the dental nurses' appearance, the cleanliness of her equipment, the accuracy of her records and the standard of her operative work. He found that one of the features of the service was a complete absence of the dental nurses working outside of their recognized sphere of practice.

Davis indicated the program had been criticized for the tension it created between the dental nurses and dentists; however, it did not appear to him to be the case. He pointed out that graduating dental students received a series of lectures on the scheme and its benefits, and that they visited clinics in small groups to observe the dental nurses in action. Davis criticized New Zealand's program for failing to offer dental benefits past age 16, and found it distressing that a high percentage of adolescents ceased to seek regular dental care subsequently.

In concluding, the role of the recently developed "experimental" New Cross auxiliaries was mentioned. It was noted that there were significant differences as the New Cross auxiliaries were assigned to the General Dental Council, from which they were placed in a clinic where the need was perceived to be the greatest. In such a system, the rigid central control of the New Zealand scheme was lost, as well as the unique relationship with an individual school. New Cross nurses were understood to be working side by side with highly trained dentists, but the dentists' handling and basic treatment of small children could be inferior to that of the nurses.

An evaluation of the dental care of children in both New Zealand and the United States was conducted by Beck (**1967**). He cited evidence to indicate that a more adequate coverage of children for dental care existed in New Zealand than in the United States. In the United States, half of the children under 15 had never been to the dentist, and 27 percent of children ages 5 to 14 had never been to the dentist. In New Zealand, 93 percent of children under age 16 participated in the National Dental Service. His controlled survey of children in the United States and New Zealand indicated that the major component of the DMFT in New Zealand was the F (filled) teeth, while the major component of the DMFT in the United States was the D (decayed) teeth. Beck quoted Dunning's book on dental public health in acknowledging that a limitation of his survey was not assessing the quality of restorations. Dunning said: "The question of quality of workmanship is an important one to consider, and both Fulton (**1951**) and Gruebbel (**1950**) have attempted an evaluation of it. Fulton's opinion was generally favorable, Gruebbel's less so in view of certain surface inadequacies noted in the fillings he inspected. Even if we assume that 28 percent of the fillings received by New Zealand children are defective as Gruebbel does, and if none of the fillings placed by American dentists are considered defective (an almost impossibly optimistic assumption), the New Zealand children in both Fulton's and Gruebbel's surveys still had more good fillings in their mouths than any known comparable group of American children of ages 12 to 14."

As a component of his research for a master's degree at the University of Michigan, David Roder wrote a paper describing observations of the scene and reviewing the literature of the New Zealand school dental nurse program (**1968**). He reviewed responsibilities of the nurses as: 1) dental health education; 2) examination, diagnosis and treatment planning; 3) oral prophylaxis and the topical application

of fluoride; 4) local infiltration anesthesia; 5) cavity preparation and the amalgam restoration of deciduous molars and the amalgam and silicate restoration of permanent teeth; and 6) the extraction of permanent and deciduous teeth. More than 1,000 dental nurses existed in school clinics at that time, with one dental officer responsible for 80 or more nurses. Supervision was limited to monthly or less visits. Equipment being used was primarily portable, and radiographs and chairside assistance were not typically available. Dental nurses were restricted to using only low-speed handpieces.

Roder reviewed the comments of seven individuals or delegations who had visited the New Zealand dental nurse program previously. An Australian delegation remarked that the activities were an "outstanding success." Barmes from Papua-New Guinea stated: "The sight of fully restored dentitions, all restorations highly polished and extensions fully prepared became monotonous; a most gratifying monotony indeed." Fulton concluded that the New Zealand dental nurses were capable of producing amalgam fillings of good quality. In Gruebbel's opinion, the standard of restorative care was only "mediocre."

While an exchange professor at the University of Western Australia, A.T. Morstad, professor and chairman of the Division of Prosthodontics from the University of Minnesota, visited New Zealand to study the school dental nurse program (**1970**). He randomly examined 50 children ages 3 to 13, and did not find any premature loss of primary or permanent teeth due to caries, in spite of the high caries rate in New Zealand. He identified five unique factors that led to the success of the school dental nurse program: 1) Acceptability by the child of the school environment for early dental care; 2) The child's preference for treatment by a dental nurse; 3) The dental nurse's suitability to undertake routine repetitive procedures; 4) Careful selection of trainees with motivation for high standards of work; and 5) The dental nurse as a member of the school system. He concluded with the judgment that "the system in New Zealand of employing two-year trained school dental nurses for pediatric dentistry is effective and productive. The dental profession in New Zealand deserves commendation for its pioneering efforts in the use of pedodontic auxiliaries."

The director general of Health of New Zealand, D.P. Kennedy, published a report on school dental nurses in the New Zealand Medical Journal (**1970**). The publication was in anticipation of the 50th anniversary of the school dental nurse program the following year. He viewed the results of the dental nurse scheme, citing the dramatic reduction in tooth mortality since 1923 (the first year of practice by the school dental nurses); the number of teeth extracted had fallen from 88.2 per 100 children to 12.6 per 100 children. He reported that so few permanent teeth had to be extracted (23.2 per 10,000 children) that the three schools for dental nurses no longer taught the extraction of permanent teeth, but had the nurses refer permanent extractions to dentists.

In 1946, the public health dental program had been extended from 13 years of age to 16 years, with treatment after 13 being provided by fee-for-service private dentists under contract from the government (Dental Benefits Scheme). Kennedy noted the value of the change. In 1952, 29 percent of army recruits between ages 18 and 21 who had not received dental benefits after leaving school had, or needed, dentures. By 1958, when the dental benefits provided for adolescents were becoming effective, the figure had fallen to 11.4 percent. In a comparable survey in 1963, the figure was 8 percent. Furthermore, the percentage of young people seeking treatment at their own expense (once dental benefits had ceased at the age of 16) was increasing.

Kennedy also referenced the contribution of the program internationally by identifying 20 countries New Zealand had assisted under the aegis of the WHO, Colombo Plan, and Special Commonwealth Aid to Africa Plan in modifying the dental nurse plan to meet the needs of their respective countries.

Eva Puder, a dental hygienist from the United States, published her observations regarding New Zealand dental nurses in an issue of the American Journal of Public Health (**1970**). She described the education of the dental nurse as an intensive two-year post-high school course, during which time the nurse is salaried by the government. On graduation she served her country in that capacity, and was unable to practice other than in the School Dental Service. At that time there were three training schools for dental nurses in Auckland, Wellington and Christchurch. The schools were headed by a principal (a dentist) and staffed by dental officers (dentists) and dental tutor sisters (experienced dental nurses.) For clinical operative dentistry training the ratio was 10 to 12 students to one instructor. Upon completion of the training program, the student was examined by a Board of External Examiners. Puder recounted her conversation with the president of the Christchurch Dental Society in which he asked many questions about dental hygienists in the United States. She learned that not all dentists in New Zealand thought that a dental hygienist needed to be added to the dental team as a second auxiliary to the dental nurse.

She reported that all of the clinics were on school grounds. They were separate buildings either attached to the school building itself or a short distance apart. The Department of Education funded the building of the school dental clinic, and the Department of Health funded equipment and services. In speaking to parents, Puder was impressed with their interest in telling her about the importance of dental health and how to achieve it—they were not aware she was a dental hygienist. She took more than 200 intraoral photographs, which she said provided evidence of principally "extremely well-cared for mouths."

Puder continued her essay by indicating the dentists in New Zealand had come to realize the value of the school dental nurse, and that it was actually an advantage to the dentist in that the private practicing dentist was able to treat a cooperative

patient oriented toward preventive dentistry. Concluding, she said that New Zealand had resolved a problem that existed in the United States. Asking the question of how the United States would resolve its manpower shortage, she said: "The answer rests with the dental profession."

THE SILVER JUBILEE OF THE SCHOOL DENTAL SERVICE, 1971

In 1971, the School Dental Service was 50 years old. The New Zealand Dental Journal opened the year with an editorial in its January issue, declaring: "The remarkable experiment of the New Zealand School Dental Service celebrates its golden jubilee in 1971. This new criterion of maturity emphasizes that, in its early days, [it] was very much an experimental and trial-and-error affair has long since ceased to be this and is an established, working, and valuable part of the country's dental services…. The enormous success in achieving a high standard of dental fitness in the child population reflects the soundness of the original idea of a school dental service…. The nurses can—and do—provide first-class dental services for children within their strictly defined auxiliary role…. Esprit de corps within the service has been a marked contributory factor to its success. Throughout the fifty-year history of the service the school dental nurses have demonstrated a tremendous enthusiasm for their work…. The school dental service has enjoyed the co-operation and goodwill of the New Zealand Dental Association. The idea of such a service arose not with government but within the New Zealand Dental Association—a professional and not a political decision…. Those far-seeing and humanitarian members of the New Zealand Dental Association concerned solely with the well-being of children, who conceived this programme fifty years ago would also be proud to see today the excellent service that has evolved, a service that their critics of the 1920s described as 'foolhardy' and 'a menace to public health and the profession.' How wrong those critics were. Congratulations, New Zealand Dental Service, on your fiftieth birthday" (**NZDJ, 1971**).

The New Zealand Medical Journal also published an editorial lauding the work of the School Dental Service on its jubilee (**1971**). "The achievements of this unique New Zealand School Dental Service over 50 years are very impressive. It is a success story all the way. In simple terms, New Zealand now has a dentally fit, dentally aware child population the like of which no other country can approach. Although the alleged unpleasantness of dentistry is still the butt of some playground humour ("murder house" is a common synonym for "school dental clinic" for many young New Zealanders) it is largely just that—playground humour. Virtually all children are very happy to skip a spelling or arithmetic class and visit their friendly school dental nurse for a dental appointment…. To thousands of dentists overseas New Zealand is best known as the country that originated school dental nurses…. The thousands of school dental nurses who in 50 years have made the New Zealand School Dental Service what it is today, can

take pride in their fine achievement. They have every reason for celebration on the occasion of their jubilee this year."

The New Zealand Ministry of Health published a monograph saluting the 50 years of the School Dental Service. Written by Dr. G.H. Leslie, director of the Division of Dental Health, the monograph was titled "Golden Jubilee: School Dental Service, New Zealand 1921-1971" (**1971a**). The epigram for the publication was a quote from Mark Twain that had been published in the New Zealand School Nurses' Journal in 1926: "Every man with a new idea is a crank until the idea succeeds." Also of interest is a copy of the medallion worn by the dental nurses on their uniforms that reads "Ut Prosim"—Latin for "That I may do good." The monograph summarizes the history of the School Dental Service and its dental nurses. The history is documented with a large number of pictures of classes of dental nurses, the school clinics in which they practiced, dentists who led the movement and the training facilities of the nurses. The last page of the monograph is blank, save for the quote from U.S. President John F. Kennedy (cited previously): "Although children may be the victims of fate, they should never be the victims of neglect."

In an article for the Australian Dental Journal, Leslie (**1971b**) reviewed the origin and planning of the School Dental Service; the training, function, and supervision of school dental nurses; the role of dentists in the service; the service organization and administration; and an evaluation of results. He noted that in 1970 there were 1,341 school dental nurses. That year they had placed 2,647,861 fillings and extracted teeth for 582,964 children. Such figures, he said, could result in the New Zealand scheme being just a "repair service" if it was not for other substantial results. Dental health education always accompanied treatment. From the inception of the program, dental nurses have been "crusaders" for dental health through prevention. Dental nurses had also been proactive in enrolling and improving the dental health of preschoolers. In 1949, only 19 percent of preschoolers had been enrolled for care; this had risen to 60 percent and def figures showed an improvement in their dental health.

LITERATURE OF 1970-2000

Dunning of the Harvard Dental School reviewed the use of dental nurses in New Zealand and Australia in the Journal of the American Dental Association (**1972**). While saying that his article would make no serious attempt to appraise the quality of the operative work, in both New Zealand and Australia he indicated the quality of the work he saw was good, and he accepted Fulton's (**1970**) favorable impression of the quality of work performed by school dental nurses, as well as that of Friedman (**1972**), when he photographed the mouths of about 100 children and found not one missing permanent molar.

At the time of Dunning's report, there were 1,350 dental nurses practicing in New Zealand. The ratio was one nurse to every 500 children from age 2½ to 13½, the age group actually served. One nurse could provide regular twice-yearly care for 450 children in non-fluoridated areas and 700 to 1,000 children in fluoridated areas. The three dental nurse training schools graduated about 200 graduates each year.

Dunning commented, in discussing his experience, that "any large scale incremental care plan for young children if it is to succeed must be brought to them in their schools. This concept implies the unsuitability of private dental offices alone for a nationwide program, except for the care of adolescents, at which time a transfer from care at schools to private offices should occur for children not already being handled in private offices. In this respect, the New Zealand contract plan for adolescents (Dental Benefits Scheme) offers an attractive example."

Michael Roberts, a pediatric dentist, and at the time Deputy Chief of Dentistry for the U.S. Public Health Service Hospital in San Francisco, reviewed the New Zealand school dental nurse program in an article for Public Health Reviews (**1975**). After comprehensively reviewing the history and operation of the School Dental Service, Roberts went over statistics comparing New Zealand and the United States. He cited figures that 72 percent of the decayed teeth in New Zealand children had been restored in comparison with 23 percent in the United States. In the United States, 76 percent of children had consulted a dentist less frequently than once a year, and almost 50 percent had never had a dental examination. Preventive measures were slowly being incorporated into the New Zealand health system. Approximately 50 percent of the population was drinking fluoridated water in 1971. Prior to 1962, only about 3 percent of the population received this benefit. It was reported by Roberts that the cost of the School Dental Service averaged $17.88 (U.S.) per child per year. The school dental nurse received a salary of $6,006 (U.S.); the average New Zealand dentist was earning $11,000 (U.S.) annually at that time.

The first use of the term "dental therapists" in the literature appears to be that by McKegg when he asked the question "Dental therapists—mistresses or servants?"(**1976**). McKegg indicated that he would use the terms "dental therapist" and "school dental nurse" interchangeably. Davies (**1972**) was quoted as estimating that the resignation rate of dental nurses from the School Dental Service was 10 to 12 percent per year. This compared unfavorably with the loss of dentists at 2.5 percent annually and a practice life of 40 years. McKegg lamented the lack of career path opportunities for dental nurses/dental therapists and suggested that such a lack has led to a high attrition rate. He proposed a restructuring of dental therapist positions to enable dental therapists to function in a number of capacities on the dental team. Among his suggestions were dental health education, participating in hospital dental service and as auxiliaries in the fields of orthodontics and periodontics. McKegg said, "With freedom comes responsibility, and to those critics

of the comparative freedom enjoyed by New Zealand school dental nurses, I would say this—the level of their responsibility is such that in 50 years of service there has never been a known case of illegal practice."

Lamenting the fact that dentistry had not thought or cared about career paths or possibilities for dental therapists, McKegg said that "studies of freedoms and responsibilities of medical nurses might indicate the areas where dental therapists should be given control of their own destiny to work alongside dentists as part of the dental team… The message is 'team.' We need new members…. Let us support, encourage, and when necessary direct them [therapists] for the benefit of team members individually and as a whole, and most importantly for the benefit of a public in need."

An editorial in the New Zealand Dental Journal indicated that there was some discussion occurring relative to the school dental nurses assuming responsibility for treating adolescents in secondary schools (**NZDJ, 1977**). The National Dental Program provided care for adolescents by private dentists under contract to the government. Broadening the scope of the dental service was being described by some as "the logical way to use people and facilities which are otherwise wasted." And, "dental nurses are trained to do about 90 percent of the routine work normally done by dentists." The editorial stated that the arguments being advanced were "unsound." "The training of school dental nurses is narrow, empirical, and overlaid with a modest academic base, as must be the case in a two-year course, or even one of three years as the nurses would like in the future…. Without training and experience in diagnosis, in treatment planning, and in more advanced procedures … it is impossible to perceive anything but a two-tiered system developing should nurses become responsible for the dental care of adolescents."

G.R. Ritchie, the assistant director of the Division of Dental Health, in addressing a meeting of school dental nurses, stated that all of the government's activities, including the School Dental Service, had one major objective—the improvement of dental health of the population (**1977**). Any discussion of the School Dental Service had to be made in the context of dental services as a whole. The government had implemented a policy in 1966 that included continued uptake of student dental nurses to enable two complete treatments per year for all preschool, primary and intermediate schoolchildren. He indicated that the objectives set 10 years previously had largely been met. Sixty-five percent of preschoolers and 89 percent of primary and intermediate schoolchildren were enrolled for dental care. The re-equipment program had made progress with the provision of modern dental chairs and lights, high-speed units, mechanical mixers and operating stools.

Ritchie indicated that the policy for the next 10 years recognized that there had been a fall in the birth rate and that there were many relatively young women with school dental nurse training who may wish to return to the work force. As

a consequence, a much lower recruitment rate was being planned, with only 120 students accepted. After discussing the need to control escalating government expenditures for health care, Ritchie said that while dental caries had been brought under control by fluoridation and the School Dental Service, efforts must be concentrated on reducing dental disease further. The number of fillings placed per child remained high and must be reduced. He argued for increased attention to all aspects of preventive dentistry by school dental nurses.

In discussing the state of dentistry in New Zealand at that time, Ritchie indicated that dentists were advocating for the introduction of dental hygienists into their practices. He said that it was possible that they saw ex-school dental nurses as a readily available source of dental hygienists. He suggested that dental nurses were also developing thoughts as to what their future should be. He posited that if the aspirations of all groups were met, there would be a proliferation of occupations all wanting to "climb inside one small mouth, and possibly duplicating services." Cost effective services were essential and the logical answer Ritchie suggested was the development of a dental team.

While a visiting professor at the School of Public Health, David Roder of South Australia published an article on the employment of dental nurses in the world **(1978**). He identified the term (school) dental nurse as an auxiliary who cut and restored cavities in children's teeth after a training period of about two years. While indicating that responsibilities varied from country to country, in general they administered local anesthesia, prepared cavities and placed restorative materials, and extracted primary teeth, and in some instances permanent teeth. He stated that no dental personnel have faced more opposition than dental nurses, yet at that time he identified that they practiced in approximately 30 countries of the world.

The arguments in favor of employing dental nurses were more compelling where there is a shortage of dentists. He cited a British study that indicated that when there was a manpower shortage in a professional field, it is a well-established practice to assign simpler duties to auxiliaries, thereby reducing the burden on the fully trained professional. The use of dental auxiliaries when there is a shortage of dentists, rather than training more dentists, was based on the assumption, with supporting evidence, that nurses would be more economical. Roder noted that Dunning (**1972**) had stated that the annual cost per patient was almost 50 percent lower in the dental nurse system, a figure confirmed by Redig et al. (**1972**).

The quality of care by dental nurses was reviewed, citing the work of Fulton (**1951**) and Gruebbel (**1950a; 1950b**). Additionally, the assessment of the (British) General Dental Council (**1966**) on the treatment provided by the New Cross dental auxiliaries was reviewed by Roder. The General Dental Council appointed 28 independent dentists to assess the quality of restorations placed by the New Cross auxiliaries. These dentists inspected 13,303 teeth restored by the auxiliaries for

2,892 patients in various geographic locations. Collectively, 91 percent of the nurses' restorations were rated as "satisfactory." Roder also reported on evaluations he had conducted in South Australia. In that study, he examined secondary schoolchildren after they had been out of the School Dental Service for 18 months, and compared them with adolescents who had not been treated in the dental nurse system. Of the 8,734 restored teeth in subjects treated by the dental nurses, 1.8 percent had a defective restoration, as compared to 2.6 percent of defective restorations for children treated by private dentists (**Roder, 1973, 1976**). Roder also cited the evaluation by Redig et al. (**1972**) when they inspected restorations by New Zealand nurses and found 87.3 percent of 331 copper amalgam restorations and 97.1 percent of 477 silver amalgam restorations to be satisfactory. Finally, he reviewed the evaluation by Ambrose, Hord and Simpson (**1976**) of the restorations of dental nurses in Saskatchewan. In that study they found that the quality of the amalgam restorations placed by nurses were superior to those placed by dentists, but that stainless steel crowns placed by nurses and dentists were of comparable quality.

Roder emphasized that dental nurses had typically been limited to use in government services, had generally been limited to treating children, and had not shown any tendency to extend their scope of work through career aggressiveness. An argument for the introduction of dental nurses in a country where there was need for an increased workforce was the short duration of their training and the speed with which they could be introduced into the workforce. He pointed out that those opposed to dental nurses cited the rate of edentulism among New Zealanders. However, he stated that there was no evidence that edentulism followed from the employment of dental nurses; many countries without dental nurses had high edentulism rates.

In 1977, the Institute of Medicine in the United States sponsored a conference on the international system for delivering dental care (**Ingle, Blair, 1978**). At that conference, Richard Logan (**1978**) of New Zealand reviewed the dental care delivery system of New Zealand. At that time, New Zealand had 1,373 clinics in the School Dental Service. For schools of more than 450 students, permanent clinics were built on the school grounds, typically to accommodate two dental nurses; schools with 240 to 400 pupils had smaller clinics designed for part-time use of a school dental nurse. The service was not compulsory, but 98 percent of primary and intermediate schoolchildren and 64 percent of preschool children participated, for a total coverage of 622,000 children. The average cost per child per year was $16.92 (U.S.), not inclusive of staff training costs. (Care for children not enrolled in the SDS was by private practitioners on a fee for service basis.) For many years, school dental nurses extracted permanent teeth, but when the demand declined to 0.3 permanent teeth extractions per nurse per year, teaching of permanent extractions was discontinued, with referral to dentists for permanent extractions. Care for adolescents was reported to be in the private sector by dentists contracted by the government; 95 percent of private practicing dentists

participated. Eighty-five percent of adolescents received care at a cost of $25.40 a year (U.S.); orthodontic care was not included.

Logan reported that at that time, New Zealand was able to train more dental nurses than required, as the three training schools produced 220 dental nurses annually, but only half that number were needed annually. In 1977, the student intake was reduced to 120. In part, the excess capacity for training dental nurses was said to be due to the increase in the average career life of a dental nurse. Prior to 1974 that career life was six to seven years, but by 1977 the average was 10 years and was continuing to rise.

Logan reported on a national survey of the dental health of 15-to-21-year-olds that found the overall standard of dental health of adolescents and young adults was high, and that a relatively minor caries problem existed, especially among males (**Beck, 1968**). An International Collaborative Study of Dental Manpower Systems organized and directed by WHO compared the Canterbury region of New Zealand with four other countries (**Hunter, Davis, 1976**). The DMF teeth of 13- and 14-year-old adolescents in Canterbury was the second highest of the five countries. However, all but 0.6 of the caries in a child had been diagnosed and treated; few teeth were missing or decayed. Ninety-four percent of the DMF score represented filled teeth, and less than 0.01 percent represented missing teeth.

Beck (1968) reported that the experience for 35-to-44-year-olds appeared much different. In Canterbury the M (missing) component of the DMFT (14.66) accounted for more than 50 percent of the total score of 22.0 for these adults, with a higher rate of edentulism in females (40 percent) than in males (30 percent); overall, the rate was 36 percent. Logan indicates that this age cohort was born between 1929 and 1938, and reached development before the School Dental Service in New Zealand had been fully developed. After age 16, all dental care had to be obtained in the private sector on a fee-for-service basis.

An editorial in the New Zealand Dental Journal also addressed the edentulism issue of New Zealand adults, as reflected in the International Collaborative Study of Dental Manpower Systems in 1976 (**NZDJ**, **1978**). The study had found that the prevalence of edentulism was heavily dependent on socioeconomic variables. The editorial suggested that prior to this finding, "New Zealand dentistry had been rather smug ... having boasted to the rest of the world that we possessed the greatest school dental service the world had ever seen. The alarming rate of edentulism in New Zealand shook us out of our smugness…."

The editorial commented further that steps were being taken "… to de-emphasize the control of caries by fillings" in the School Dental Service. And while there was cause for concern about the state of New Zealand adult oral health, the editorial stated, "We can take heart from the fact that every longitudinal indicator available

suggests New Zealand dental health is improving and has been for years." In 1953, 22 percent of young adults were fully edentulous; in 1968 the figure was 13 percent; and in 1976, 7.5 percent. The values of mean DMFT per person also improved from 16.7 in 15-to-19-year-olds in 1962-64 to 13.6 in 1976. The greatest decrease was in the D (decayed) component, which fell from 3.2 in 1962 to 1.3 in 1976. It was noted that there was a high dmft value of 8.5 in 1940 when the 38-year-olds in the study were 5 years old; it had dropped to 3.8 in 1977. The editorial concluded that it "is entirely reasonable to predict that today's 5-year-olds will be in much better shape when they are 38 in 2010! That is, if the dental profession makes prevention its primary goal."

Following the International Collaborative Study of Dental Manpower Systems, the Medical Research Council of New Zealand commissioned New Zealand's first national oral health survey, known as the 1976 Survey of Adult Oral Health and Attitudes to Dentistry in New Zealand (SAOH). This survey also found a high prevalence of edentulism and a heavily filled dentition among New Zealand adults. As a result, in 1978, a national workshop reviewed the state of oral health in New Zealand and formulated guidelines for the future development of dental services. A number of goals were agreed to including "adopting simple preventive-care methods, reducing the prevalence of dental disease at specific ages, and improving the co-ordination and delivery of dental services" (**NZMH, 2010**).

Hunter then reported on change in prevalence of dental caries in both 5-year-old New Zealand children (**1984a**) and 12- and 13-year-old children (**1984b**) in 1977 and 1982. In 1982, the mean dmft for 5-year-olds was 2.6. Forty-four percent of the children were caries-free. The dmft had fallen from 3.7 in 1977, a 30 percent decrease. The dmft of 5-year-olds had been 11.2 in 1932 and 7.5 in 1950. The 1982 dmft was 23 percent lower in areas with water fluoridation. Decayed teeth contributed 28 percent, missing teeth 5 percent, and filled teeth 67 percent to the total dmft. Forty-seven percent of the children were enrolled in the School Dental Service by age 3 and 87 percent by age 5.

The mean DMFT for 12- and 13-year-olds in 1977 had been 7.0, but by 1982 it was 3.7. Of the 3.7 DMFT, 3.6 represented filled teeth and only 0.1 decayed teeth. In the sample of 1,042 children, only three teeth were missing due to dental caries. Thirteen percent of the sample was caries-free.

Hunter attributed the decline in the dmft/DMFT to increased fluoridation, increased use of fluoride application and fluoride dentifrices, increased focus on prevention and dental health education in the School Dental Service, and the recent policy of "when in doubt [about a potential carious lesion] observe." However, Hunter also observed that there were differences in oral health between groups of 12–to-13-year-olds; children from fluoridated areas or children who were European had lower DMFT scores than their counterparts.

A summarization of the methods used to evaluate dental public health was written by De Liefde and Ritchie (**1984**). Initially, the extractions-to-fillings ratio was used to evaluate performance. In the 1960s, that measure was replaced by the number of restorations placed and the number of children enrolled. In 1976, as a response to the 1973 WHO Collaborative Study indicating that New Zealand children had a high DMFT, a review of the School Dental Service resulted in a decision to give priority to reducing the amount of restorative care needed by children. While the DMFT was primarily filled teeth, suggesting that the treatment needs of children were being met, the fact remained that there was a high caries prevalence, thus requiring restoration. Dental health education had always been a part of the program; however, greater emphasis was now given to it by establishing a preventive appointment for each child. Topical application of fluoride had now become part of routine care, and a new dental health syllabus for classroom teaching had been introduced. Operative treatment had now been restricted to those lesions involving dentine, in line with a new understanding of the ability to reverse early carious lesions. As a result, restorations were reduced by 55 percent from 1976 to 1981. In 1980, a new measure, restorations in permanent teeth per child, was used as an evaluation measure. Retrospective evaluation indicated that this had fallen 64 percent between 1976 and 1981, from 2.55 permanent restorations per child per year to 0.91. The mean DMFT in 1981 was 4.5, much improved from the 10.7 DMFT of the Canterbury children in the 1973 International Collaborative Study. An analysis of expenditures indicated that annual treatment for children in fluoridated areas cost $17.90 (N.Z.), and in nonfluoridated areas, $22.77 (N.Z.)—a 38 percent difference.

De Liefide (**1988**) followed the 1982 sample of Hunter to determine their oral health status at age 16 after having had the opportunity to participate in the Dental Benefits Scheme for adolescents. In 1983, at least nine months after ceasing care by the School Dental Service, 810 of the 1,045 children in the sample (78 percent) had attended for treatment in the Dental Benefits Scheme. Of the 810 children, 546 (67 percent) did not require operative treatment at their first examination. Most of the 246 children requiring treatment required one restoration. Of the sample 748 (72 percent) continued to receive care to age 16, with an average of 5.4 visits. No operative treatment was required for 25 percent who continued care until 16. The mean DMFT at 16 for these 748 was 6.0. There was a higher percentage of European children in the sample participating in the Dental Benefits Scheme (78 percent) than children of other racial groups (45 percent).

An important component of the Dunedin Multidisciplinary Health and Development Study (DMHDS) is the investigation of oral health. The DMHDS is an ongoing, longitudinal study of the health, development and well-being of a large sample of young New Zealanders. Study members are the 1,037 babies born in Dunedin, New Zealand, between April 1, 1972, and March 31, 1973, at the

Queen Mary Maternity Hospital. They were studied at birth (1972-73), followed up and assessed at the age of 3, then every two years until the age of 15, then at ages 18 (1990-91), 21 (1993-94), 26 (1998-99), 32 (2003-05) and 38 (2010-2012). It is planned to next see the study members at age 44, then again at age 50, and beyond. Very few of these members have been lost to the study; at age 32, 96 percent of living members were assessed. The significance of this study internationally is reflected in the funding support from such sources as the United States National Institute for Dental and Craniofacial Health, and the United Kingdom Medical Research Council **(Silva, Stanton, 1996).**

One publication from the study (**Evans, Beck, Silva, Brown, 1982a**) found that more than half of the sample had enrolled with the School Dental Service by age 3, and 90 percent by age 5. The study found that in participants there were small but significant trends of decreasing oral hygiene (OHI) and dmft index with increased frequency of tooth brushing. There were no significant differences in OHI and dmft indexes between children enrolling at an earlier age and those enrolling later, which the authors stated emphasized that effective preventive measures need to be sought and applied if the strategic advantage of achieving early enrollments is not to be lost. "Parents were extremely well informed upon the status and needs of their children and there was a strong positive correlation between parents' assessment of their own dental status and the status of their children's teeth. Children of parents who had dentures or who graded their oral health as below average had a higher carious prevalence compared with the rest of the sample." Further research from Evans, Beck, Brown and Silva **(1984b)** revealed that the 5- year-old children living in fluoridated areas had significantly lower dmft scores than those living in nonfluoridated areas, and there was a marked socioeconomic gradient in caries experience, which was greater for those living in the nonfluoridated areas.

The utilization of preschool dental services was examined prospectively in a birth cohort of 4-year-old children in Christchurch (**Beautrais, Fergusson, Shannon, 1982**). This study also found that preschool enrolment in the School Dental Service was high, with just under one child in six failing to receive dental care by the age of 4. However, this study concluded that "There were highly significant associations between non-utilisation of dental care services and a series of measures of family social background and the quality of care provided to the child. Factors associated with increased risks of non-utilisaton of dental services included: mother of non- European ethnic origin; low gross family income; single parent family; non-attendance at preschool education facilities; failure to attend community nurse services and a lower utilization of routine child health care services including immunisations and routine postnatal check. The implications of the non-utilisation of preschool dental care are discussed in the context of the more general problem of providing an adequate and equitable standard of health care for children."

The announcement of the impending closure of the Auckland and Christchurch Schools for Dental Nurses prompted an editorial in the New Zealand Dental Journal (**1981**). The editorial cited improved dental health of children, longer working lives of dental nurses and falling school enrollments as reasons for a steady reduction of the number of young women entering training, from 272 in 1966 to 90 in 1980, and suggested that this justified the closures, as one school could manage the training of the required number of nurses. However, the editorial noted that the dental nurses perceived the closures as an attack on the School Dental Service. The concerns of the nurses were viewed as understandable as the changes in the environment had come about so rapidly. The number of nurses employed had fallen by 193 nurses in five years, or 14 percent of the number employed in 1975. Even more dramatic, the editorial suggested was the changing role of the dental nurse from an operating role to one as a preventive dental therapist, with duties weighted away from repair to dental health promotion. The stress of the circumstance had led some dental nurses to voice their concerns directly to the public through demonstrations and pamphlets. The editorial expressed concern that this unfortunate "confrontation" could direct attention away from the main issue, which was expressed as "What type of dental health service do we need, now and in the future for the children of New Zealand?" The editorial said that any attempt to abandon the School Dental Service would be a step backward. Changes had been made to the service in the past and changes would be necessary in the future. The view was expressed that changes in the service were too important to be made politically, but rather must be subjected to careful analysis against the background of present trends in dental health and the overall health needs of children.

Jones (**1984**) reported that New Zealand Dental Service had undergone more change in the 1972-82 period than at any time in its history. In 1972 the training schools were graduating 200 dental nurses per year from three different schools. In 1983, only 30 students were graduated from the one remaining school. He cited the declining birth rate and the decline in dental caries and the resultant treatment need as factors. The decline in caries was attributed to the fluoridation of the community water supplies in the 1960s and '70s. In 1983, 64 percent of the population was served by optimally fluoridated water supplies. Additionally noted was the increased use of fluoride dentifrices. Treatment needs of children were reported to have been reduced by 69 percent in 11 years. In the fluoridated city of Timaru, the DMFT in 8-to-9-year-olds fell from 3.16 in 1973 to 0.89 in 1981 (**Hunter, Henderson, 1982**). Additionally, 59 percent of these children were caries-free (**Hunter, 1982**). Caries prevalence in 5-year-olds fell 30 percent between 1977 and 1982 (**Hunter, 1984a**). Jones noted that a preventive appointment with a parent present had been emphasized since 1976 (**Hollis, 1976**). Modifications in diagnostic criteria had also changed from "when in doubt, fill" to "when doubt, watch and fluoride" (**De Liefde, 1982**).

Other reviews of the New Zealand School Dental Service during this period compared the service to those of other countries and looked at dental health education within the service. An article by James and Nora Dunning (**1978**) in the American Journal of Public Health found that in countries where dental care is provided to children in their schools, such as in New Zealand, Australia and Sweden, good quality care was accessible. They reported that in the United States, school-based clinics "are infrequent, poorly financed, and poorly equipped; generally looked down upon as part of a national philosophy which places the work of the private sector above that of any government service." The system in the United States, the Dunnings argued, placed residents in low-income areas of the inner city and rural areas at a serious disadvantage in accessing care, as dentists concentrated their offices in more affluent districts and in the suburbs of cities. Transportation was more difficult for those in low-income and rural areas. Working parents had to accompany their children to care, taking time off their jobs without reimbursement. They advanced school-based dental clinics as a way to resolve this issue. In doing so, they produced a list of 10 advantages of school-based dental clinics:

1. *School-based clinics can bring comprehensive care to school children. Higher utilization of services has been obtained by this method than any other.*
2. *School-based clinics are less threatening to children than are private offices, since children are in familiar surroundings.*
3. *School-based clinics facilitate dental health education.*
4. *School-based clinics providing care at government expense helps enable low income populations to afford private dental care when specialized treatment is required.*
5. *School-based clinics permit frequent examinations of children thus stimulating a demand for care above that being able to be provided thus promoting increased referral to private dentists.*
6. *School-based clinics provide an ideal setting for use of expanded duty dental auxiliaries, whether of the "reversible operations only" type as in the U.S. or the dental therapist/dental nurse type as in New Zealand and Australia.*
7. *School-based clinics provide an opportunity for part-time or full-time employment for dentists; a good way for young dentists to get a start.*
8. *School-based clinics can reduce the cost of care.*
9. *School-based clinics can facilitate peer review.*
10. *School-based clinics, when associated with medical clinics can facilitate consultation.*

The authors concluded by stating that the demand for dental care in the adult years could be heightened because of an increased awareness of the value of dental care instilled through exceptional facilities of a school-based dental care program.

Dental health education in the schools was the topic of an article by Kelly (**1978**). She summarized the philosophies underpinning dental health education in the New Zealand schools as being:

- *Belief that health education is a process which helps people to achieve health through their own actions and efforts.*
- *Belief in the uniqueness of the individual.*
- *Belief that all individuals are capable of change.*
- *Belief that lasting behavioral change is more likely to be achieved through intrinsic, not extrinsic, motivation.*
- *Belief that dental health is an integral part of general health and the total well-being of the individual.*
- *Belief that all health education material should reflect present day knowledge with scientific accuracy.*

Based on these philosophical assumptions, she identified four objectives of the program in the schools: 1) To develop attitudes consistent with retaining natural teeth for life; 2) To encourage a positive attitude to dental health practices by establishing a good relationship between children and dental personnel; 3) To establish, as habits, sound dental practices and promote an understanding of the principles underlying these practices; and 4) To encourage the maximum use of existing services and resources.

Dental health education in schools was channeled into two activities: the individual counseling of children in the clinic, and group work in the classroom. Dental nurses were taught in their training the futility of telling patients what to do and then expecting them to do it. She learned that an individual will change behavior only if the change is a means of satisfying the individual's own needs or goals. Kelly raised the issue of the lack of dental health education for adolescents—as well as for the larger community, including parents—and the need to strengthen those efforts.

Bagramian (**1979**) reviewed the school-based program in the United States and in other countries of the world. In that context, he stated, "The New Zealand dental nurse program has been reviewed many times over the years with positive conclusions." He pointed out that school-based programs can result in high utilization rates, citing statistics from New Zealand that 60 percent of preschool children and 95 percent of elementary schoolchildren received routine dental care from school dental nurses in school clinics. He concluded by stating, "It is time for a commitment by the profession and the nation [the United States] to establish school-based dental programs for the health and welfare of our children."

In 1988, New Zealand carried out a second national oral health survey. This was the 1988 WHO Study of Oral Health Outcomes (SOHO), which was the New

Zealand section of the nine-country WHO Second International Collaborative Study. This was undertaken by the New Zealand Department of Health and involved children ages 12 to 13 and adults ages 20 to 24, 35 to 44, and 65 to 74. The survey found that there was a much-improved level in oral health since 1976, with a low level of treatment need. The work achieved since the previous oral health surveys had been successful in improving oral health in New Zealand. However, this survey also showed that Maori and Pacific Island children (ages 12 to 13) had poorer oral health than other children and that their oral health was also dependent on socioeconomic status **(NZMH, 2010).**

The 1988 Dental Act of New Zealand became law in January 1989. Section 7 of the act permitted the practice of dentistry by school dental nurses employed by the School Dental Service, hospital boards or Area Health Boards (**New Zealand Government, 1988**). As there was no restriction on the age of patients dental nurses treated, in some regions dental nurses treated adolescents and adults within the public sector.

Section 11 of the act permitted the legal practice of hygienists and operating auxiliaries. The act made provision for any person: a) removing deposits from the teeth; b) applying material to the teeth for the purpose of preventing disease; c) giving advice on oral health; or d) carrying out any other similar work, under the direction of a dentist who is present on the premises when the work is carried out. These workers were known as Section 11 workers and included hygienists with formal training, former school dental nurses employed by dentists in this capacity (operating auxiliaries), and any person dentists wanted to employ and train for this role (**Pack, Bradley, Kennedy, 1991**).

The members of the New Zealand Dental Association were surveyed in 1991. Dentists were asked to respond as to what type of auxiliary they wished to employ in their practices, based on the changed Dental Act of 1988 (**Pack, Bradley, Kennedy, 1991**). At the time of the survey, 6 percent were employing hygienists and 10 percent operating auxiliaries. (NZDA Operating Auxiliary was the term subsequently used by the New Zealand Dental Association for individuals working under the terms of the Act who had formerly been school dental nurses and had received further training in dental hygiene practice.) Altogether, 42 percent were employing or wished to employ auxiliaries, 22 percent hygienists, and 19 percent operating auxiliaries. Sixty percent said that hygienists should be trained in New Zealand at the School of Dentistry in a program of 18 to 24 months. Eighty-one percent said that former school dental nurses should be required to have additional training before qualifying as operating auxiliaries.

The decade from 1983 to 1993 saw the gradual establishment of 14 Area Health Boards in New Zealand, funded by a population-based formula. Between 1993 and 2001, the New Zealand health system underwent three further

major structural transformations. For the School Dental Service, this meant a change from a national service administered by the Department of Health to a regionalized service, under first the Area Health Boards (until 1993), then the Regional Health Authorities and Crown Health Enterprises (from 1993 to 1997), the Health Funding Authority and Hospital and Health Services (1998-2001), and finally the District Health Boards (from 2001) (**New Zealand Parliament, 2009**). The 1990s saw the School Dental Service differ from region to region in terms of the care offered to children, a change to variable recall of children based on caries risk, and a reduction in the number of dental therapists (name change from School Dental Nurse occurred in 1991).

The president of the New Zealand Dental Association was quoted in an editorial in the New Zealand Dental Journal as expressing concern in his presidential address on August 15, 1991, that "there are numerous signs that the School Dental Service is beginning to founder" (**NZDJ, 1992**). The editorial indicated that the basis for his comment was the reduction in the number of dental therapists that has occurred in Area Health Boards in order "to make each [management] unit more cost-effective in a tendering marketplace." The president expressed a perceived threat to the viability of the service, that once below a critical mass, dental therapists may be "obliged to compromise their professional standards to provide even the basic services that they now do so well." The president of the Otago branch of the New Zealand Dental Therapists' Association was quoted as saying it was essential to have a "mean, lean team" in place to cope with potential competition, reflecting the view of the general manager of her Area Health Board. The editorial indicated that while New Zealand may not have a perfect scheme, it has had "one in which care was accessible and in recent years had become committed to a preventive approach to care, and has provided basic treatment to a high standard."

The editorial continued: "A feature of the School Dental Service has been the relatively harmonious relationship between therapists and dentists, and acceptance of and respect for their respective roles. The editorial concluded by saying, "it is a curious sign of the times when potential 'competitors,' represented by the past president of the New Zealand Dental Association and the Journal of the Association, seem to be more outspoken in their support of the Service than those within it appear to be."

Roddick used the imagery of J.D. Salinger's fictional character Holden Caulfield catching children in a field of rye to prevent them from falling over a cliff as an apt one for the dental public health dentistry (**1998**). He lamented changes in the health system in New Zealand that had resulted in adverse effects on dental public health. The expenditure on employing dentists to supervise dental therapists had become reduced. In 1996, the available time for public health dentists to supervise dental therapists averaged 63 minutes per week per dental therapist in two districts and 5.7 minutes per week per dental therapist in three districts. This was time

for consultations of medically compromised clients, reading and reporting on radiographs, clinical visits to consult on problems, dental therapists' continuing education, and service planning and development. Accompanying the changes was a reduction in the number of people seeking qualifications in dental public health.

Roddick proceeded to identify a number of additional problems that had accumulated as a result of health system changes and asked from where the leadership would come to address these problems. While identifying the Health Funding Authority (HFA) as the natural choice for leadership, he was unconvinced that it could provide the necessary leadership. Failing leadership from bodies such as the HFA would require those with stakes in the outcomes of public health dentistry to exert leadership themselves. Citing evidence of children in the poorest schools having the most dental caries, he stated that New Zealand required national leadership in dental public health.

Research continued to show inequalities in oral health between groups of New Zealand children. Thomson found that 5-year-old Maori children were three times more likely to have caries than non-Maori children and three times less likely to have been enrolled in the School Dental Service as preschoolers. They were also more likely to have had a general anesthesia for dental treatment. At age 12 to 13, Maori still had poorer oral health than non-Maori. The oral health of Pacific Island children in the study was better than that of Maori children but not as good as that of European children **(1993)**. Broughton observed that many Maori adults had poor oral health and were unlikely to have had dental treatment since they had left school. Broughton advocated making the delivery of dentistry culturally acceptable to Maori, and providing care that was accessible and appropriate for Maori **(1993)**. Treasure and Dever found that caries prevalence was lower in children living in fluoridated areas as compared to those in nonfluoridated areas, with the children of fluoridated Timaru having a significantly lower caries experience than those of nonfluoridated Oamaru. In the nonfluoridated sample, the less advantaged children had a higher mean dmft **(1992).**

Brown and Treasure reviewed and summarized dental disease and utilization data of various studies in New Zealand and concluded that there were inequities in oral health, with implications for the delivery of care and health promotion (**1992**). They stated that these inequities could be ignored, while acknowledging that overcoming barriers to the poor accessing oral health care is a complex challenge. They concluded that there is a need for oral health to be viewed within the context of inequity and disadvantage in society.

Thomson et al. (**2002**) asked the question: Were structural changes to the welfare state in the early 1990s associated with a measurable increase in oral health inequalities among children?

Between 1990 and 1992, the New Zealand government's structural reforms resulted in a steep increase in poverty, including cutting welfare benefits, increasing the cost of state housing, and the introduction of the Employment Contracts Act. Data from the School Dental Service for first dental appointment for 5-year-olds in the greater Wellington area were analyzed over the period 1995-2000. These clinical data were related to the socioeconomic indicator for the school. No increase in inequalities was identified; however, inequalities that had existed continued. The data did show that there was a worsening of the oral health of Maori children.

Hannah conducted a workforce analysis for the Dental Council of New Zealand that was published by the council in 1998 (**1998a**). An executive summary was published in the New Zealand Dental Journal (**1998b**). At the time of her report, consideration was being given to dental therapists being able to work in the private sector under the supervision and direction of a dentist. The dental therapy training program offered by Wellington Polytechnic was being reviewed with consideration being given to a degree course. The Faculty of Dentistry at the University of Otago was commencing a two-year training program for dental therapy (Diploma) and was starting discussions with Otago Polytechnic, which offered dental hygienist training, to explore the possibility of integrating the two programs. This was perceived as an important move leading to a more flexible dental health worker who could provide services to a wider client group.

Among the current workforce issues identified was access to dental health care by the Maori population; the question of the demand for dental services by the population in the future; the number of dentists immigrating to New Zealand to practice; the increasing number of women dentists, expected to reach 35 percent by 2010 and anticipated to work at 0.8 FTE; and the decreasing proportion of New Zealanders entering dental school, 42.5 percent in 1998.

Of the cohort of dentists graduating in the three years prior to 1998, only 56 percent were actively practicing. Fifty-seven percent of the dental therapists graduating in the past five years were active. However, the retention of dentists increased to 70 percent, 10 years after registration (licensure) for New Zealand graduates. The retention of dental therapists dropped sharply to 19 percent after five years and did not appear to recover. It was estimated that the current pattern of dental therapist supply and deployment would lead to a shortage of 76 (70 FTEs) by 2005; and would persist and increase slightly to 2010.

If utilization patterns remained unchanged, as well as the current patterns of training and retention, it was estimated that 1,435 (1,290 FTE) dentists would be required in 2005 and 1,500 (1,350 FTE) in 2010. The supply of dentists under these conditions would be 1,400 (1,260 FTE) in 2005 and 1,465 (1,320 FTE) in 2010. While it was suggested that a shortage of dentists could occur in the future, this could be averted by: increasing the retention of New Zealand graduates, increasing

participation of women dentists, and/or expanding the role of dental therapists and hygienists. Hannah stated the number of dental therapists in the workforce was decreasing and was below the generally accepted level of one dental therapist to 950 children.

The education of school dental therapists was the theme of a 1999 editorial in the New Zealand Dental Journal (**NZDJ, 1999**). The editorial was in response to the Wellington Polytechnic announcing that no new dental therapist students would be enrolled. Thus the training of dental therapists at the venerable Dominion Training School for Dental Nurses on Willis Street in Wellington, since 1991 the responsibility of the Wellington Polytechnic, would be no more. The editorial noted the corresponding establishment of a diploma in dental therapy at the University of Otago's Faculty of Dentistry, with its first class of 20 students having begun in February. While applauding this development, it was questioned as to whether the needs of staffing for the School Dental Service in the future could be met by a class size of 20. The editorial mentioned that the Minister of Health had recently announced the intention to open Section 7 of the Dental Act of 1988, which would allow wider employment opportunities for dental therapists, placing strain on the dental therapist workforce. The editorial acknowledged major changes in dental education over a short period. The School of Dentistry, where once only dentists were trained, had become the center for the education of dental hygienists, dental therapists, dental technicians and clinical dental technicians.

THE NEW MILLENNIUM AND SIGNIFICANT CHANGE

A forum titled "Improving the Oral Health of All New Zealanders" was organized by the Dental Council of New Zealand and the New Zealand Dental Association in May 2000, with the proceedings published in the New Zealand Dental Journal. The forum was conducted with the support of the Health Funding Authority, the Faculty of Dentistry, the University of Otago and the New Zealand Dental Therapists' Association (**New Zealand Forum, 2000).**

Conclusions of the forum were three:

1. The current workforce has an appropriate mix of technical skills to meet the present and foreseeable future oral health needs.
2. Innovative initiatives are being undertaken by Maori health groups to address oral health needs. Assessment of these should be well-supported financially.
3. Consumer participation is particularly effective at the policy-formulation stage and will be actively sought by the oral health sector.

Recommendations from the forum were summarized as:

- *Analysis of the dental therapist workforce indicates an urgent need to address training, employment, and operational issues.*
- *The provision of oral health care should be better integrated, particularly the interface between the child and adolescent services.*
- *A re-evaluation of priorities for State-funded oral health services is needed.*
- *Allied and inter-sector providers need to be trained to undertake oral health promotion. Diverse and focused delivery programmes to reflect the needs of specific population groups are needed.*
- *Proposed legislative change to provide more flexibility in the employment of oral health-care providers should be progressed urgently.*
- *An investigation of the possibility of establishing an independent consumers' "Health Issue Centre" will be undertaken.*
- *Selection criteria for entry into oral health training programmes should include a range of factors to promote the development of a work force that reflects the ethnicity mix of the communities it serves.*
- *A comprehensive website on oral health issues should be developed.*
- *The Oral Health Forum Steering Committee will develop recommendations for the establishment of an Oral Health Advisory Group, incorporating consumer representation, to provide leadership and advocacy in the oral health arena and to explore options for developing a National Centre for Oral Health Studies.*
- *Urgent priority should be given to the further development of provider groups to enter into contractual agreements for the provision of State-funded care.*
- *A third National Oral Health Survey, or series of focused surveys, is needed.*
- *Provider organisations will investigate the electronic collection of practice data which can effectively interface with the needs of oral health research and planning.*

In speaking at the forum, the minister of health, Annette King (a former dental therapist), identified oral health as a priority for the "New Zealand Health Strategy" (**King, 2000**). She identified the concerns of the ministry for the ability of certain segments of the population to access oral health services: preschool children, adolescents, Maori, Pacific Island people, people from lower socioeconomic groups, people with psychiatric or intellectual disabilities and new immigrants. She cited data that in the late 1980s, 70 percent of preschool children were enrolled in the School Dental Service; however, in 1997 the percentage had dropped to 56 percent. Similarly in the '80s, more than 80 percent of eligible teenagers were attending dentists for care under Dental Benefits; in 1998, the figure was 68 percent.

King made the point that "The optimum mix and utilization of different categories of dental workers (dental therapists, dental hygienists, chairside assistants, technicians, clinical dental technicians and dentists) within an oral health team are essential for any country if it is to achieve the most economic, yet adequate, oral

health care for the population. Future oral health care services have to be delivered in the most clinically appropriate and cost-effective way."

The minister identified six key initiatives for the oral health sector:

1. *Re-establish a nation-wide dental health system for children and adolescents.*
2. *Investigate greater access to assisted dental care for low-income adults.*
3. *Review the Dental Benefit Scheme.*
4. *Review the Dental Act.*
5. *Allow dental therapists to perform a greater range of services.*
6. *Upgrade training of and introduce registration of dental therapists.*

At the Forum 2000, Robin Whyman of the New Zealand Dental Association stated that the dental service delivery system was not in crisis, but that further development and improvement was needed (**Whyman, 2000**). Four priority issues were identified:

1. "Pre- and primary school dental services need to be redeveloped, with less emphasis on a school base for much of the dental care. Mobile clinics attending schools could provide examinations and simple, medium-volume dental care. A redeveloped system should incorporate dentists working alongside dental therapists, and the development of larger, community-based clinics to cater for some treatment needs of young children…."
2. "Adolescent dental services should focus on developing regular attendance patterns, and on the transition from community-based, publicly funded services to providers of adult dental services…."
3. "Independent private dental practitioners should be the providers of most adult dental services…" Public funding should target people with health and disability problems.
4. "Innovation in the development of dental service delivery systems should include the development of a 'dental team.' "

Claire Caddie, the president of the New Zealand Dental Therapist's Association also spoke at Forum 2000 (**Caddie, 2000**). She lamented the lack of leadership for issues associated with the School Dental Service. She suggested that the dental therapist workforce was aging and expressed concerns that it would not be able to deliver necessary services in the future.

Additionally, the groups most in need of services were Maori, Pacific Islanders, and in some areas, Asian. Yet, the ethnicity of practicing dental therapists and current students did not reflect this diversity. The proposed dental therapist training school at Auckland University of Technology (AUT) was seen as a positive development by the New Zealand Dental Therapists' Association.

Broughton discussed Maori oral health and services and stated that "Maori do not enjoy the same dental health as non-Maori across all age groups" (**2003**). Barriers to care for Maori included affordability, as Maori tended to be in the lower socioeconomic groups; transport issues; accessibility; and lack of information about free services. Broughton believed that, in order to reduce disparities in oral health status between Maori and non-Maori, there had to be a partnership approach between the dental profession and the Maori iwi. He proposed an 'Oranga Niho' service for Maori operated under "Kaupapa Maori"—that is, the Maori philosophy or way of doing things, and under Maori ownership and control.

To aid in implementing the New Zealand Health Strategy 2000, the Ministry of Health produced toolkits to assist district health boards to implement priority health population health objectives. The "Executive Summary of the DHB Toolkit to Improve Oral Health" stated (**NZ Health Strategy, 2001**):

> *The current pattern of dental disease in New Zealand has three noteworthy characteristics. First, tooth decay has reduced due to water fluoridation and the use of fluorides in other forms. Second, a concurrent attitudinal change has meant that more people choose to keep their teeth. Third, even though disease has fallen, large groups in the community still have high levels of disease.*
>
> *District Health Boards (DHB) need to work proactively with their communities and local councils to support the introduction of water fluoridation to those communities that do not currently have fluoridated water.*
>
> *The oral health of all New Zealanders, and of children in particular, would be enhanced with the implementation of appropriate preventive strategies.*
>
> *Treatment services will never successfully tackle the underlying cause of oral disease. Oral health inequalities will only be reduced through effective preventive strategies and the implementation of effective and appropriate oral health promotion policies. A health promotion approach that recognizes the importance of tackling the underlying social and environmental determinants of oral health is needed.*
>
> *To be effective, individual prevention strategies also need to be delivered in ways appropriate to the priority groups of Maori, Pacific peoples, and families with low socioeconomic status.*
>
> *DHBs must begin improving access to the school dental service. A major focus is needed in enrolment, identification and more intensive care of children at higher risk of developing dental caries. Guidelines have been developed for the school dental service to improve preventive, diagnostic and treatment services and to make them more equitable.*

> *Publicly funded oral health care has been extended to adolescents up to the age of 18 years. DHBs must work with oral health providers to increase the proportion of adolescents who access oral health services.*
>
> *One of the key themes of the New Zealand Health Strategy is that of reducing inequalities in health. This theme is reflected throughout this Toolkit and additional information on reducing inequalities is also available.*

The toolkit contained a set of "School Dental Service Guidelines" to further guide School Dental Services to work toward improving oral health. Guidelines included enrollment, consent, and privacy of information; risk assessment and recall intervals; medically compromised patients; dental therapist-to-client ratio; oral health promotion; use of fluorides, fissure sealants and radiography; occlusal caries management in permanent teeth; and clinical supervision of dental therapists (**NZ Health Strategy, 2004**).

In 2001, a "stocktake" of the health care workforce was published by the Ministry of Health (**NZMH, 2001**) in which the dental health workforce was reviewed. At that time there were 140 dental hygienists, 315 dental technicians, 569 dental therapists (5.7 percent Maori) and 1591 dentists (1.5 percent Maori). All education was at the University of Otago. The Auckland University of Technology (AUT) began offering dental therapy training in 2002. The report stated the workforce ethnicity did not match population ethnicity; there was a need to increase the number of Maori and Pacific Peoples entering the dental workforce.

Among key issues identified in the stocktake was that the expected development of publicly funded oral health would have workforce implications for the number of dental therapists required. This aging workforce would require an increase in training number, development of career pathways and improved remuneration. In 1998 the dental therapist-to-target population ratio (2½-to-12½-year-olds) was 1 to 1120, down from 1 to 647 in 1990. Almost 46 percent of dental therapists in 1998 were over age 45.

New Zealand's Public Health Advisory Committee commissioned a background paper to explore child health inequalities, which was published in 2003 (**Thomson, Ayers, Broughton, 2003**). Routinely collected School Dental Service data reported that 53 percent of 5-year-old children were caries-free, with a mean mft of 1.8. At 12 to 13 years, 42 percent were caries-free, with a mean MFT of 1.6. Caries rates in New Zealand children decreased steadily from 1980 to the early 1990s, but had remained static or increased slightly since that time.

Overall, regions with the highest percentage of children receiving fluoridated water had the lowest overall caries rate as well as lower socioeconomic and ethnic differentials. Maori and Pacific Island children and adolescents had a higher

prevalence and severity of dental caries. Groups with lower SES had higher caries rates than those with higher SES. Children born to younger and less well-educated mothers, or children who lived in rural areas, had poorer oral health. Children with disabilities tended to have impaired oral health. The utilization of dental services by schoolchildren was very high; however, the preschool uptake of services was variable and considerably lower among Maori, Pacific Peoples and those from lower socioeconomic groups. Uptake of dental services by adolescents was also lower than desirable.

Data from the Dunedin Multidisciplinary Health and Development study showed that socioeconomic differences in dental caries were experienced in early childhood, but that their magnitude was reduced during the early school years due to the free dental care offered by the School Dental Service. By age 26, the socioeconomic differences in caries occurrence re-emerged. These findings suggested that a major component of adult oral health inequalities is their childhood origin.

Thomson et al. suggested oral health inequalities could be reduced by improving socioeconomic conditions; increasing water fluoridation; using topical fluorides; reducing the use of refined carbohydrates; and improving oral health services.

Based on the background paper of Thomson et al., the Public Health Advisory Committee sent a report to the minister of health listing ways to improve children's oral health and reduce the inequalities among children (**NZ National Health Committee, 2003**). The committee made the following recommendations:

Influencing socioeconomic determinants

- *Invites [the minister of health's] parliamentary colleagues to require policy makers to work collaboratively to improve child oral health.*
- *Recognizes the value of health impact assessment tools in assessing the impact of social and economic policy proposal on child oral health and promotes Public Health Advisory Committee's health impact assessment tools widely among her parliamentary colleagues, once this work is completed.*

Improving Maori oral health status

- *Directs the Ministry of Health to fund evaluation of current Maori oral health initiatives.*
- *Requires the Ministry of Health to continue to evaluate and monitor mainstream oral health services for their impact on Maori oral health.*
- *Encourages District Health Boards to make further funding available to improve Maori oral health status.*

Fluoridation

- *Urges the local authorities to fluoridate community water supplies and requires the Ministry of Health to monitor the effectiveness of fluoridation in reducing oral health inequalities.*
- *Requests the Ministry of Health and District Health Boards to actively encourage non-fluoridated communities to make applications to the Sanitary Subsidy Scheme.*
- *Requests the District Health Boards and local authorities to work collaboratively to promote fluoridation of community water supplies.*
- *Requires the Ministry of Health to promote research into the most cost-effective and appropriate alternatives to water fluoridation in communities were water fluoridation is not feasible.*

Reorienting Oral Health Services

- *Asks the Ministry of Health to actively promote research into effective strategies for improving preschool uptake of dental services, especially among Maori, Pacific, rural, transient children and children from low socioeconomic groups.*
- *Requests the Ministry of Health to examine enhancing the national school-based dental service with linkage into preschool and adolescent settings.*
- *Requests the Oral Health Advisory Group to monitor the actions taken on the recommendations in this Public Health Advisory Committee report.*

A Responsive and Skilled Workforce

- *Asks the Oral Health Advisory Group to report on the progress that has been made on the directions of the dental health workforce as outline in the 1998 report of the Dental Council of New Zealand.*
- *Asks the Oral Health Advisory Group to report on strategies to develop the Maori and Pacific Peoples oral health workforce.*

Better Information about Child Oral Health and Inequalities

- *Requires the Ministry of Health and District Health Boards to systematically re-examine child oral health data collection in order to improve data collection.*
- *Urges the Ministry of Health and District Health Boards to collect data on child health at unit record level for 5 year old and Year 8 children.*
- *Asks the Oral Health Advisory Group to prioritise information and research gaps identified in the background paper and propose a plan for auctioning these.*

Using Child Oral Health as an Indicator of Health Inequalities

- *Requests that the Ministry of Health use dental health data on 5 year olds as an indicator of health inequalities.*

In 2004, Lee and Dennison addressed claims that the effectiveness of water fluoridation In New Zealand had reduced due to the availability of other sources of fluoride. They analyzed routinely collected School Dental Service data for

5- and 12-year-olds in Wellington (fluoridated) and the Canterbury province (nonfluoridated). Children living in fluoridated areas had significantly better oral health than those living in nonfluoridated areas. The differences were greater for Maori and Pacific children and children of lower socioeconomic status. The authors concluded that the study demonstrated very real differences in oral health associated with water fluoridation and that "water fluoridation reduces oral health inequalities among children of different ethnic and socioeconomic backgrounds."

Also in 2004, Mauri Ora Associates prepared a report entitled Review of Maori Child Oral Health Services for the Ministry of Health (**NZMH, 2004a)**. All 16 Maori providers at the time were reviewed to evaluate their operations and experiences in delivering "oranga niho" services (oral health care for children and adolescents). As a result, 12 recommendations were made to the ministry concerning the need for support and funding for oral health services for Maori children and adolescents. Recommendations were also made on working closely with other oral health providers, providing accessible services appropriate for Maori and developing a Maori workforce.

Broughton's Ph.D. thesis also reviewed the provision of Maori Oral Health Services using a kaupapa Maori methodology **(Broughton, 2006)**. Although there have been barriers to implementing kaupapa Maori oral health services in New Zealand, Maori providers have overcome these barriers by establishing relationships with the health sector and the Maori community, and through their passion and commitment for good oral health for all Maori. Broughton concluded, "Whilst there is a diversity in the provision of Maori oral health services, kaupapa Maori services have been developed that are appropriate, effective, accessible and affordable. They must have the opportunity to flourish."

Tane's research for the Master of Public Health degree reviewed the role of the dental therapist in New Zealand's public health system (**2003**). The results of her research were also published in the New Zealand Dental Journal (**Tane, 2009**). She conducted structured interviews of a number of leaders in dentistry and public health, surveyed all 530 members of the New Zealand Dental Therapists' Association, a random sample of 530 members of the New Zealand Dental Association and all 150 of the current members of the Maori Dental Association. Tane concluded:

> *The findings show that the dental therapist has not always been utilized and developed using sound epidemiological evidence. Elements of professional protection by the dental profession coupled with depleted health funding rather than dental need have appeared as driving factors. Furthermore, the dental therapy profession has remained in a sub-ordinate role to the dental profession. The findings of this study show that a large number of the current dental therapy workforce do not feel that they are ready to provide dental care autonomously. Information in the thesis*

argues that past legislation and subordination to the dental profession has largely affected the development of dental therapy, and whether this has always assisted in improving the oral health for the New Zealander population is questioned in this work. With a depleted number in the workforce, the role has become focused on a reparative form of care, not one that promotes and improves oral health. This is not acceptable in a publicly funded system.

The 2003 School Dental Service Technical Advisory Group drafted a School Dental Service Facilities Discussion Document for the Ministry of Health (**NZMH, 2003a**). Challenges facing the School Dental Service at that time were aging facilities and equipment, difficulties in access for some population groups, and the division of responsibilities between the health and education sectors, which was causing problems in terms of who was responsible for upgrading facilities. In addition, clinics were generally small, which meant that dental therapists often worked alone, there was no room for dental assistants, and there were issues with adequate space for infection control and patient privacy. The purpose of the Facilities Discussion document was to provide advice on the development of a framework to assist District Health Boards to identify cost- effective, flexible and efficient ways of providing school dental services to improve the oral health of their populations incorporating the principles of the Treaty Waitangi.

Key recommendations of the Advisory Group were that:

1. District Health Boards (DHBs) examine their current school dental clinic stock to identify which school clinics should be retained and make decisions about other settings where services might be provided, such as mobile clinics or central bases. This includes the DHBs examining the cost of equipping and maintaining their current dental facilities infrastructure as well as dental clinics being equipped with modern dental equipment appropriate to the performance of quality dental care.
2. Where boards of trustees cannot address their responsibilities under the current Memorandum of Understanding, consideration should be given to temporarily ceasing services until the condition has been rectified.
3. DHBs address the issue of sole practitioners in conjunction with dental facility requirements.
4. DHBs review the utilization level of their current clinic stock and associated fixed and variable costs including equipment.
5. DHBs ensure that when clinics are relocated or rebuilt, the new facility meets all legislative and regulatory requirements, including those related to security and personal safety.
6. DHBs have a joint obligation to provide and operate dental clinics that meet current national service delivery standards for infection control.
7. DHBs audit their clinic facilities in relation to compliance with the requirements of the Privacy Act 1993 and Health Information Privacy Code 1994.

At the time of the drafting of the Discussion Document, there were 1,190 dental clinics in New Zealand schools, with a replacement value of $60 million (New Zealand Dollars). The mean utilization of the school clinics, based on 1998 data, was 79 days a year, or 39 percent of the 200 school days.

A second Dental Therapy Technical Advisory Group was formed in 2003 to advise the Ministry of Health on the recruitment and practice of dental therapists (**NZMH, 2004b**). The recommendations of the group follow:

The Dental Therapy Technical Advisory Group recommends that the Dental Therapist Board [of the DCNZ]:

- *Produce a New Zealand Dental Therapy Conditions of Practice document which recognizes New Zealand's unique cultural and ethnic mix, and to this end should include a description of cultural competencies and be developed in consultation with Te Ao Marama and other relevant groups.*
- *Commission the setting of a national exam to assess the competence of dental personnel wishing to practice dental therapy in New Zealand.*
- *Include a communications skill test in the Dental Therapy Registration Examination to ensure communication skill levels are appropriate for managing a wide range of patients, in particular children and adolescents, and are appropriate for implementing informed consent requirements.*
- *Develop effective data collection systems, which include identifying annually the number of practicing dental therapists by gender, age, ethnicity, type of practice, region of practice and hours of practice.*

The Dental Therapy Technical Advisory Group recommends that the Dental Council:

- *Adopt the draft scope and code of practice as proposed by the New Zealand Dental Therapists' Association, with additional changes made by the due process within the DCNZ, with the following provisions:*
  - *That the term 'clinical guide' is omitted with reference to the relationship between dentists and dental therapists and, further that any reference to a named person being responsible for oversight of a dental therapist be deleted.*
  - *That the wording 'in the interest of patient safety a dental therapist should seek advice and guidance from the appropriate health professional' be included in the scope of practice.*
  - *That dental therapist patient groups should not be restricted by source of funding.*

The Dental Therapy Technical Advisory Group recommends that the Ministry of Health:

- *Together with DHBs, direct a review of dental therapy salaries and working conditions within the public sector.*
- *Together with the New Zealand Dental Therapists Association and Te Ao Marama, develop a strategy to build the capacity of Maori and Pacific dental therapy workforce.*

- *Determine a mechanism to identify the optimum number of dental therapists required annually, so that educational institutions can be advised of the industry needs.*

The Dental Therapy Technical Advisory Group recommends that tertiary educational institutions and the joint Australian Dental Council and DCNZ Accreditation Committee:

- *Recognize the changing educational and clinical requirements of dental therapists with respect to scope of practice, and give immediate consideration to removing the diploma programme so that minimum dental therapy education and training be a degree programme at bachelor level.*
- *Explore the suitability of dental therapy and dental hygiene education and training.*

The Dental Therapy Technical Advisory Group recommends to DHBs and other employers that:

- *Dental therapists should not treat patients when working as sole operators.*
- *When developing workforce strategies for the recruitment and retention of dental therapists they take into account the barriers and incentives that contribute to the attractiveness of dental therapy as a career.*
- *They support dental therapists to further their education by implementing strategies such as study leave, scholarships, and recognition of educational advancement.*

New Zealand passed the Health Practitioners Competence Assurance Act in September 2003, and it was enacted in 2004. All New Zealand dentists, dental therapists, dental hygienists and dental clinicians were now registered by the Dental Council of New Zealand, the statutory body responsible for promoting and protecting the public interest by ensuring that all oral health practitioners (including dentists and dental specialists) are safe and competent to practice (**NZMH, 2003b**). Subsequently, the Dental Council of New Zealand issued a Notice of Scopes of Practice and Prescribed Qualifications pursuant to the act (**DCNZ, 2005**). Relative to dental therapists, the council outlined:

Scope of General Dental Therapy Practice

Dental therapy practice is a subset of the practice of dentistry, and is commensurate with a dental therapist's approved education, training and competence. Dental therapists provide oral health assessment, treatment, management and prevention services for children and adults up to age 18. Disease prevention and oral health promotion and maintenance are core activities. Dental therapists have a consultative working relationship, which is documented in a written professional agreement between parties.

Detailed Scope of Practice for Dental Therapy Practice

In collaboration with dentists and other health care professionals, and in partnership with individuals, whanau and communities, dental therapists provide oral health assessment, treatment, management and prevention services for children and adolescents up to age 19. Disease prevention and oral health promotion and maintenance are core activities.

Dental Therapy Practice Involves:

- *Obtaining medical histories and consulting with other health practitioners as appropriate.*
- *Examination of oral tissues, diagnosis of dental caries and recognition of abnormalities.*
- *Preparation of an oral care plan.*
- *Informed consent procedures.*
- *Administration of local anesthesia using dento-alveolar infiltration, inferior dental nerve block, and topical local anesthetic techniques.*
- *Preparation of cavities and restoration of primary and permanent teeth using direct placement of appropriate dental materials.*
- *Extraction of primary teeth.*
- *Pulp capping in primary and permanent teeth.*
- *Preventive dentistry including cleaning, polishing and scaling (to remove deposits in association with gingivitis), fissure sealants, and fluoride applications.*
- *Oral health education and promotion.*
- *Referral as necessary to appropriate practitioner/agency.*

Dental therapy practice includes teaching, research and management, given than such roles influence clinical practice and public safety.

Prescribed Qualifications for Practice are:

- *Certificate of Dental Therapy issued by the Department of Health or a New Zealand educational institution, and approved experience in the provision of dental therapy services within the scope of practice; or*
- *Diploma in Dental Therapy issued by a New Zealand educational institution; or*
- *Bachelor of Health Sciences (Endorsement in Dental Therapy), University of Otago; or*
- *Bachelor of Health Science (Oral Health), Auckland University of Technology; or*
- *Undergraduate dental therapy or diploma from an Australian Dental Council accredited educational program; or*
- *Undergraduate dental therapy degree or diploma, or an undergraduate dental degree; and a pass in the DCNZ Dental Therapy Registration Examination.*

The Dental Council's Scopes of Dental Therapy Practice continued by specifying additional scopes of practice and qualifications for: performing pulpotomies, taking periapicals and bitewing radiographs, taking and interpreting periapicals

> *and bitewing radiographs, preparing teeth for and placing stainless steel crowns of primary teeth, and adult care in dental therapy practice. In these instances, additional training by dental therapists in programs approved by the Dental Council were required. To date, no training program for adult care has been approved. The Scopes of Practice were further amended in 2011 with pulpotomies, stainless steel crowns and radiography becoming part of the General Dental Therapy Scope of Practice while Adult Care remains an additional scope.*

The New Zealand Dental Council also issued "Competency Standard and Performance Measures for Dental Therapists" (**2003**). The document states that a competent dental therapist is one who applies knowledge, skills, attitudes, communication and judgment to the delivery of appropriate oral health care in accordance with the scope of practice within which they are registered.

The Dental Council of New Zealand publishes current policies and codes of practice relating to the practice of dental therapy in New Zealand. Of particular relevance to dental therapy is the "Code of Practice: The Professional Relationships Associated with the Practice of Dental Therapy." While dental therapists practice independently (for children and adolescents under 18 years), they practice within a consultative relationship with a dentist which is supported by a written professional agreement. The code details the nature of the relationship and provides a template for the professional agreement (**Dental Council of New Zealand, 2004**).

The implementation of the new regulations under the Health Practitioners Competence Assurance Act on Sept. 18, 2004, prompted an editorial in the New Zealand Dental Journal (**Roddick, 2004**). Roddick stated that one of the most difficult issues in the Dental Council's response to the act was the relationship between dentists and dental therapists, in particular the proposition that dental therapists should be regarded as "independent clinicians." He reviewed some of the history of the work of dental therapists, pointing out that the great majority have always worked for state-funded organizations (the School Dental Service), under the "direction and supervision" of a Principal Dental Officer (PDO), being required to follow "standing instructions" and "protocols." Most worked alone, sometimes in clinics several hours drive from the district office and the PDO. But, Roddick asked, were the dental nurses thereby "independent" clinicians?

It was suggested that the health reforms of the past 10 years had an effect on the School Dental Service. The number of PDOs had been reduced; dentists in private practice had become less supportive of dental therapists, as well as the publicly funded system in general; and in many parts of the country, dental therapists and the public could no longer count on the Special Dental Benefit services. Roddick, a Principal Dental Officer, concluded that the issue may not be "independence" for

the dental therapist, but rather to what extent New Zealand has entrusted the care of children's dentistry to dental therapists. He asked, "In the pursuit of low-cost children's dental care, have we also neglected the need for therapists to have more support from dentists, not less?"

The "National School Dental Service Review: Final Report" was published by the Dental Health Boards of New Zealand (**NZMH, 2004c**).

The vision for the child oral health services proposed by the DHBs envisaged:

- *A highly trained and motivated workforce that is well regarded in the community.*
- *Working in safe and modern and functional premises.*
- *Providing a range of preventative and treatment services to preschool and school children including health education and promotion.*
- *A variety of service delivery models that are configured to best meet the needs of the local population. These include the co-location of school dental clinics with Primary Health Organisations (PHOs) thus further reinforcing the vision of the Primary Health Care Strategy.*
- *An adequately funded national service.*
- *School dental therapists as part of the Primary Health Team involved in integrated health promotion strategies.*

The report indicated the School Dental Service faced the following strategic issues:

- Service structure issues—education and health
- Inequalities in oral health
- Access issues
- Dental therapist workforce recruitment and retention problems
- Low preschool enrollment rates
- Inadequate and unsafe facilities
- Lack of education and health promotion
- Fluoridation variances

While the proposed DHB service models were tailored to meet the needs of specific population groups, from a national perspective some common reconfiguration themes had emerged:

- National decision at the ministerial level regarding ownership of current fixed school-based clinics
- Reconfiguration and redesign of fixed school-based clinics
- Clinics located in "communities of interest"—high-risk areas
- Review of the recall process for high-risk (6 to 12 months); decrease for low-risk (12 to 18 months)

- Transport support for families
- Increase hours of clinic operation
- Focus of preschool enrollment
- Dental therapist recruitment drive and promotion
- Increase dental therapist scope of practice
- Oral health educators and promoters
- Tendency toward community-based clinics supported by an outreach model ("Hub and Spokes"), that is, not fixed school clinics
- Fluoridation

Forty-one recommendations were made by the DHBNZ in the areas of: 1) Service; Structure; 2) Addressing Inequalities; 3) Access; 4) Dental Therapist Recruitment and Retention; 5) Low Preschool Enrolment Rates; 6) Facility Costs; 7) Information Technology; and 8) Fluoridation.

Fitzgerald et al. (**2004**) investigated the views of Otago, New Zealand, adolescents on oral health and oral health care. Indicating their disdain, the adolescents said attending the dentist for oral health care "is just so gay." The authors indicated that the findings of the study support that of the international literature on the use/nonuse of dental services even when financial barriers had been removed. They concluded that increasing the use of the free dental services offered to adolescents would require innovative approaches.

"Good Oral Health for All, for Life" was the title of the strategic vision for Oral Health published by the Ministry of Health in 2006 (**NZMH, 2006**). The vision stated that over the next 10 years the ministry would work with the Dental Health Boards (DHBs) and other providers of oral health services toward:

- An environment that promotes oral health.
- Oral health services that promote, improve, maintain and restore oral health throughout the life course.
- Publicly funded services that are accessible, appropriate, and proactively address the needs of those at greatest risk for poor oral health.
- Publicly funded oral health services that are part of the community.

The vision statement differed from that which currently existed in the following ways:

NOW	FUTURE
An emphasis on treatment	An emphasis on prevention and early intervention
A division between oral health and general health	Oral health is integrated into general health framework
DHBs provide service	Mix of service providers
School-based dental services for children	Community-based dental services for children, with the potential to expand to adolescents and low-income adults
Separate funding for child and adolescent oral health services	Funding that allows flexibility of service program design
An emphasis on primary school years	An emphasis on preschool and early primary years
Clinicians work in isolation	A team-based approach to oral health—dentists, dental therapists and dental assistants work together
A small Maori and Pacific oral health workforce	A workforce more representative of ethnic diversity of New Zealand
Pressure on secondary services	Greater capability at the primary care level, with secondary services focused on patients who cannot be managed by primary care

Of particular note in the context of dental therapists and their traditional role in the school-based care for children was the statement in the vision: "The most visible element of re-oriented services will be the Community Oral Health Service (COHS), which will replace the School Dental Service, to reflect the greater role services will have for children, and potentially adolescents outside of the primary school range."

The New Zealand Dental Association published a report of a workforce analysis conducted by the association in 2006 (**NZDA, 2006**). No discussion of dental therapists in the workforce was included. However, the report did address the problem of the aging and declining numbers of public health dentists in the workforce. Other than aging, the main causes were identified as remuneration levels and a lack of a defined career structure in the public sector.

The working practices and career satisfaction of dental therapists were investigated by Ayers et al. (**2007**). Implementation of the Health Practitioners Competence Assurance Act in 2004 resulted in changes in the provision of dental services in New Zealand. The act provided for an increase in the scope of practice of dental therapists, and enabled them to move into private practice for the first

time. Using a previously developed and utilized career satisfaction scale, the investigators surveyed 711 dental therapists (**Gibbons et al., 2000; Naidu et al., 2002**). Ninety percent were currently working with 98 percent of those working in the School Dental Service. The mean career satisfaction was 7.1 on a 10-point scale, with the median value being 8. (Gibbons and colleagues found that dental therapists in the United Kingdom was 7.3; Naidu and colleagues found a much lower degree of satisfaction of 5.2 in Trinidad and Tobago.) Dental therapists who felt they were valued members of the dental community always or most of the time had more than four times the odds of having a higher overall score. The authors concluded that career satisfaction and remuneration were major contributors to the recruitment and retention of a dental therapist workforce. They indicated the issues were critical for the School Dental Service, as more than 50 percent of the workforce planned to retire within 10 years.

Ayers' (**2009**) dissertation research investigated key trends in New Zealand's dental workforce and compared the working practices and career satisfaction of dental therapists, dental hygienists and dentists. The dentist workforce was analyzed further in terms of changes to the workforce over time, stress and coping strategies of dentists, occupational health of dentists and the experience of immigrant dentists.

The first of four annual workforce analyses was conducted by the Dental Council of New Zealand in 2005 (**DCNZ, 2006**). It was reported that there were 1,852 dentists practicing in New Zealand, with another 361 being registered but not in practice. No analysis was provided of dental therapists in the workforce.

The dental therapist was included in the 2006 workforce analysis conducted by the Dental Council (**DCNZ, 2007**). In the analysis the dental therapist workforce was reported to be comprised of 650 aging, predominantly Pakeha females (Non-Maori/Non-Polynesian), of whom more than half were age 50 or over. (There were 683 registered dental therapists in the country.) Only 20 percent of the dental therapists were under 40 years of age. Almost 75 percent worked full time, with essentially all employed by Dental Health Boards. Thirty dental therapists (4.6 percent) were involved in post-graduate training. General dental therapy practice was the scope of practice of 607 (93.4 percent) of the individuals; 367 (56.5 percent) had credentials in diagnostic radiography; 182 (28.0 percent) in pulpotomies; 55 (8.5 percent) in stainless steel crowns; and 15 (2.3 percent) in adult dental care.

The 2006 workforce report indicated an increasing number of non-European New Zealanders in the dental therapist workforce, 14.5 percent (**DCNZ, 2007**). The report also indicated a variation in the dental therapist/population ratio, with it being highest in the Northland and Bay of Plenty and lowest in the Greater Wellington region and in South Canterbury.

The 2007 workforce report (**DCNZ, 2008**) indicated that the representation of non-European ethnic groups continued to increase, with 16.7 percent reporting their ethnicity to be something other than New Zealand European—an increase of 2 percent from the previous year. The proportion of dental therapists working full time had dropped to 69.0 percent from 73.9 percent the previous year. There were 15 male dental therapists (1.4 percent) in the workforce. Full-time practice was reported by 447 dental therapists (69.0 percent, down from 73.9 percent the previous year).

The numbers of dental therapists registered in the various scopes of practice were: 648 (100 percent) in general dental therapy practice; 458 (70.7 percent) in diagnostic radiography (up from 59.9 percent in 2007); 237 (36.6 percent) in pulpotomies in dental therapy practice; 122 (18.8 percent) in stainless steel crowns in dental therapy practice; and 13 (2 percent) in adult dental care in dental therapy practice. There remained considerable variation across the Dental Health Boards in dental therapists' scopes of practice. For example, only two of 34 dental therapists in Hawke's Bay were able to perform pulpotomies, and only one had the use of stainless steel crowns in her scope of practice. However, in Otago, more than half were able to do so.

The workforce analysis in 2008 (**DCNZ, 2009**) suggested little change had occurred in the dental therapist workforce, with the number of dental therapists working full time remaining approximately 70 percent. While almost all of the dental therapists continued to work for the District Health Boards, an increasing proportion were employed in other sectors. An increasing number of dental therapists were adding diagnostic radiography to their scope of practice—four in five, up from three in four previously.

New Zealand has also conducted a National Children's Nutrition Survey (**NZMH, 2002**). Data obtained from the survey were analyzed to evaluate children's use of dental services (**Jamieson, Koopu, 2007**). Of the 3,275 children in the survey, 37.4 percent were Maori, 32.3 percent Pacific Islander, and 30.3 percent European/Other. The analysis demonstrated that the use of dental services and receipt of dental treatment were associated with sociodemographic, household, physical and lifestyle, dietary, food security and other oral health characteristics at a bi-variate level. Ethnicity was associated with all three of the dental dimensions explored, with Maori children having a higher prevalence of having received a restoration and Pacific Islander children being more likely to not attend for regular dental care or to have received an extraction. It was proposed that the findings of the study may enable policy makers to plan and implement oral health strategies that more specifically target New Zealand children's needs, backgrounds and culture, and encourage oral health promoting and culturally acceptable food choices and lifestyles.

"A Portrait of Health" was the title of a 2006-07 New Zealand Health Survey (**NZMH, 2008a**). The survey asked parents of 1-to-14-year-olds if their child had ever had a tooth extracted due to decay, abscess, infection or gum disease; ever had a filling; ever experienced oral pain that kept them awake at night; and the number of times the child had brushed his or her teeth yesterday. Half of the children, 50.9 percent, had never had a filling; 11.3 percent had one or more teeth removed due to decay, abscess, infection or gum disease; 2 percent of the children ages 2 to 4 had a tooth removed for one of these reasons.

The Murdoch Children's Research Institute (**2008**) was commissioned to conduct a systematic review of the literature on early childhood caries for the New Zealand Ministry of Health. Based on the systematic review, the Institute recommended to the Ministry of Health:

1. *Quality, well-funded research in the New Zealand environment is required to fill the information gaps in the current evidence base.*
2. *Evidence indicates that by five years nearly 50 percent of New Zealand children have dental caries. Establishing a routine oral health surveillance for this group would provide baseline data against which effectiveness of interventions could be measured.*
3. *All expectant mothers should be targeted for oral health promotion, but additional resources should be made available to develop supportive health promoting programs for disadvantaged women and those from high risk populations.*
4. *Given that women in the target group are likely to have significant levels of untreated dental disease, the effectiveness of such strategies in isolation from access to primary dental care is likely to be diminished. In the New Zealand context therefore, access to primary dental care, particularly for women most at risk for oral disease should be considered.*
5. *Any proposed oral health promotion plan for improving infant oral health should be evaluated.*
6. *The involvement of community educators together with child and health care workers is likely to be beneficial. If culturally appropriate and acceptable to the community in the New Zealand, home visits can be supportive.*
7. *Primary prevention approaches that focus on low technology such as plaque control through brushing with fluoride toothpaste, and the provision of dental care services should be core to any intervention.*

A toolkit, "Early Childhood Oral Health," was later produced for District Health Boards, primary health care and public health providers, and oral health services relating to infant and preschool oral health. Its key objective was to suggest a strategy to improve early childhood oral health by targeting those at risk and directing resources to those most in need **(NZMH, 2008b)**.

"Healthy Smile, Healthy Child" is an oral health guide produced by the New Zealand Dental Association and the Ministry of Health. This guide was produced to aid Well Child/Tamariki Ora Providers, including New Zealand's Plunket Nurses (who have specific training in child health) to provide early anticipatory guidance about the prevention of Early Childhood Caries. "The Guide will enable Well Child Services to raise awareness, educate and promote oral health by providing clear and consistent oral health messages" **(NZDA, 2008).**

"Promoting Oral Health" was published as a toolkit to assist in the development, planning, implementation and evaluation of oral health promotion by the Ministry of Health (**NZMH, 2008c**). The kit identified promoting oral health as one of the seven key action areas of the ministry's strategic vision published in 2006, "Good Oral Health for All for Life." The kit was designed as a practical guide for the design, delivery and evaluation of programs that promote oral health. The toolkit works through the steps involved in developing a comprehensive oral health promotion program, from understanding the strategic context through researching and selecting interventions, analyzing resources, planning implementation and ultimately evaluating the final program.

Moffat, Coates and Meldrum (**2009**) reported that since 2007, all students graduating from Oral Health (dental therapy/dental hygiene) programs with a bachelor's degree are able to register in both scopes of practice. Graduates would enter the workforce as dual-registered dental therapist/dental hygienists from both the Auckland University of Technology (AUT) and the University of Otago, in 2009 and 2010 respectively**.** These dual-trained individuals would be able to work in both public and private practice. This would include the School Dental Service, hospital dental departments, universities, orthodontic practices, private practices, Maori health providers and health education/promotion. When treating patients up to age 18, they would typically be working as dental therapists and would be able to work independently to "provide oral health assessment, treatment, management and prevention services."

The authors indicated that when providing care for adults, these individuals would typically be working as dental hygienists and, as such, must work under the clinical guidance of a dentist. An additional scope of practice does exist for dental therapists treating adults; however, as the authors indicated, there were at that time no accredited training programs.

The Journal of Dental Education published an article on the education of dental therapists and dental hygienists for New Zealand in 2009 (**Coates, Kardos, Moffat, Kardos, 2009**). This article provided an overview of development of the curriculum for the Bachelor of Oral Health degree at Otago.

Publication of Oral Health Therapy Programs in Australia and New Zealand marked the outcome from throughout Australasia of changes in educational philosophy away from training in stand-alone schools and towards research-based education, within a university setting, of dental therapists **(Tsang, 2010).**

The Auckland University of Technology (AUT) had challenges to address that were not an issue at Otago, where the country's only dental school is sited. Chapter 11 continues the New Zealand story in Auckland. Here the clinics for students were located in the Waitemata District Health Board facilities throughout the Auckland region. However, by 2005 AUT also had its own campus clinic. Both Otago and AUT now have fully implemented bachelor programs accredited by the Combined Dental Councils of Australia and New Zealand, enabling their graduates to register as dental therapists and dental hygienists in both New Zealand and Australia.

The importance of the media's coverage of oral health care was brought to the attention of the profession by an article with the intriguing title of "The Media and the Murder House" (**Cartwright, 2010**). She stated that among the many factors contributing to dental anxiety are media reports that reinforce negative attitudes. The "murder house" label did not exist in the 1920s, but is today widely used to portray oral health practitioners as sadists. Cartwright reported that 17 of 21 articles included in the archive from the 2000s either used "murder house" in title or in the text. Quotes taken from the articles are examples of the media portrayal of the oral health profession in the 2000s. They would be comical were they not so sad:

"It is hard to feel any sadness at news of the demise of the murder house. In years gone by the school dental clinic was where bullies were reduced to tears and the meek exposed."

"In the New Zealand of the 1960s, dental dinosaurs walked the Earth. Armed with agonizing low-speed rotary drills, poorly trained dental nurses lurked like institutional torturers on the grounds of the nation's schools. The kids back then had a name for the school dental clinic: 'The Murder House.'"

"One sacred patient, former Prime Minister David Lange said it was mandatory for dental nurses to hurt children whether they needed it or not."

Cartwright concluded that the "murder house" label may have been warranted in the days before local anesthesia for restorations and modern preventive materials and procedures were available, but its continued use and the portrayal of dental professionals as sadistic is not helpful for the promotion of oral health in the community. "The perpetuation of the 'murder house' mentality by the media is detrimental to the improvement of oral health in New Zealand."

The firm Workforce Information prepared a report for the Allied Workforce Strategy Group, Workforce Forecast Dental Therapists (**NZ Allied Information Strategy Group, 2009**). As a result of continued loss of dental therapists from the workforce in the 1990s, and a minimal supply of new graduates, the average age of the workforce had increased to 49, compared with the New Zealand average working age of 42.8.

The Health Practitioners Competence Assurance Act (**2003**) removed restrictions on the employment of dental therapists to the public sector only. Thus, for the first time since school dental nurses were introduced in New Zealand, there was competition from the private sector for the dental therapy workforce. The analysis was related specifically to the need for the ability of dental therapists in the public sector to be able to expand their care for children beyond the traditional preschool to Year 8 (ages 12 to 13) age range to include adolescents ages 13 to 17.

The workforce analysis was based on three productivity scenarios: 10.9 appointments per day (the national average at the time), plus 12 and 15 appointments per day. Gender, ethnicity and distribution were not considered in the analysis. Five supply rate scenarios were considered:

1. Addition of 30 dental therapists/year; loss of 20/year (Base Scenario)
2. Addition of 38 dental therapists/year; loss of 25/year
3. Addition of 23 dental therapists/year; loss of 15/year
4. Addition of 38 dental therapists/year; loss of 15/year
5. Addition of 23 dental therapists/year; loss of 25/year

Results indicated:

- There would be an insufficient number of dental therapists to fully expand the service to the 13-to-17 age group in the base scenario. However, there would be an excess of dental therapists if limited to the 0-to-13 age range.
- Under the base scenario, and with all of the productivity and all partial uptake of adolescent services, a greater supply than demand of dental therapists will exist, but with the 10.9 productivity lever the excess supply is modest.
- The scenario modeling suggested that the workforce's stability is more sensitive to variability in the number of permanent departures each year, than variability of the number of new recruits. The number of recruits into the workforce needs to be close to 30, if the number of departures is between 25 and 20 per year.
- If supply scenarios that involve loss of dental therapists at a rate of 25 per annum, undersupply of the workforce appears almost certain, but is dependent upon the visit rate productivity scenario. Undersupply may result even with supply of new registrations at 38 per annum and will result by 2013 if there is net annual undersupply of two dental therapists per annum regardless of productivity scenario.

The New Zealand Ministry of Health conducted a national oral health survey in 2009 (**NZMH, 2010**). Titled "Our Oral Health," its key findings were as follows:

Children and Adolescents

There were large improvements in the oral health of children and adolescents since the 1980s, with the proportion of 12-to-13-year-olds who were caries-free almost doubling between 1988 (28.5 percent) and 2009 (51.6 percent). The average DMFT for the group had significantly decreased from 2.4 to 1.3.

- Four of five (79.9 percent) of 2-to-4-year-olds were caries-free in the primary dentition; one in seven (14.9 percent) had untreated coronal decay in at least one primary tooth, with an average dmf of 0.8.
- One in two of 5-to-11-year-olds were caries-free in their primary dentition, and the majority (77.5 percent) were caries-free in their permanent dentition; one in six (17.3 percent) had untreated coronal decay in at least one primary molar, while only a very small proportion (2.7 percent) had untreated decay in one or more permanent teeth; the age group had 1.9 dmft and 0.5 DMFT.
- Adolescents ages 12 to 17 had worse oral health than the younger age groups; two in five (44.7 percent were caries-free; 12.7 percent had untreated coronal decay on at least one permanent molar; the average DMFT was 1.9.)
- One in six (16 percent) children and adolescents ages 7 to 17 had experienced trauma to one or more of their upper six front permanent teeth.
- 63.5 percent of children and adolescents 2 to 17 brushed their teeth at least twice a day; however, only 43 percent used a fluoride toothpaste.
- The proportion of children who had visited a dental professional in the last year was highest among 5-to-11-year-olds (90.3 percent); the proportion was lower among adolescents (7.9 percent) and lowest for preschool children ages 2 to 4 (59.7 percent).
- Significant disparities existed in oral health status and access to care, particularly those of Maori or Pacific ethnicity. Maori and Pacific children were less likely to have accessed oral health services in the previous year; less likely to have caries-free primary teeth; and less likely to meet brushing recommendations.
- Children and adolescents in the most deprived areas were less likely to meet toothbrushing recommendations and had more missing primary teeth due to decay. However, past year access to oral health services did not differ by neighborhood deprivation.

Adults

Oral health in New Zealand adults continued to improve over time, with particularly dramatic improvements since 1988.

- The prevalence of edentulism (total tooth loss) declined, particularly in 38-to-44-year-olds, 12.8 percent in 1988, compared with 1.7 percent in 2009; and for 65-to-74-year-olds from 61.6 percent in 1988 to 29.6 percent in 2009.
- Prevalence of one or more missing teeth in 20-to-24-year-olds and 35-to-44-year-olds was halved between 1988 and 2009, as was the experience of decay.
- One in three (35.3 percent) of adults had untreated coronal decay. One in 11 (9.5 percent) had one or more decayed root surfaces.
- The overall lifetime experience of dental decay (DMFT) was 13.9 with 0.8 decayed, 4.6 missing, and 8.5 filled.

In February 2011, Dr. Robyn Haisman, chief dental officer of the Ministry of Health, responded to the Oral Health Survey in a report to the Oral Health Workforce Executive Forum (**NZMH, 2011a**). In doing so, she reviewed the major findings of the survey, several of which are delineated above. In concluding her review, she commented on the dental therapy / dental hygiene workforce. Her report stated that District Health Boards (DHBs) were beginning to encounter challenges in managing a workforce that increasingly comprises dual-qualified dental therapy / dental hygiene graduates.

Dual-qualification degrees in dental therapy / dental hygiene were introduced by the tertiary sector (higher education), the University of Otago and Auckland University of Technology in 2008, replacing the single-qualification degrees. The universities introduced these Oral Health degrees without consulting the DHBs. Historical evidence, the report stated, shows that the demand for dental hygiene services (and thereby employment opportunities) waxes and wanes with the general availability of discretionary income. The recent economic downturn was reported to have seen Oral Health graduates seeking employment in the public sector as dental therapists; however, this situation could revert when an economic upturn occurs, thus reducing the availability of graduates to fill dental therapist vacancies. It was projected that 40 positions would need to be filled in 2011. There were 66 final-year dental therapy students at the two universities: 39 at Otago and 27 at Auckland.

Although dual-qualification degrees enable, in theory, the creation of supply of a flexibly skilled workforce, the lack of a public sector presence in the dental hygiene market, which is targeted for adults, poses practical challenges for DHBs as the major employer of dental therapists. DHBs report that increasingly more dual-qualification graduates are requesting to work half of their time as dental hygienists in order to retain dental competency. Such requests are difficult to accommodate as DHBs do not generally offer basic community-based oral health services to adults. Some DHBs are offering flexible contracts to permit dual-qualified individuals to work part-time in the private sector as dental hygienists. The report cited the 2009 workforce analysis of dental therapists (**NZ Allied Information Strategy Group, 2009)** in concluding that the DHBS will need to adopt a pragmatic approach in dealing with expanding adolescent care by dental therapists to avoid an under or over supply in the public workforce.

The California Dental Association Journal published an article from a dentist who serves as an adviser to the Northland District Health Board titled, "A Letter From New Zealand: Improving Access to High Quality Dental Services for Children" (**Croucher, 2011**). Dr. Croucher indicated that he had practiced in both the United Kingdom and in New Zealand. He reported that in 2010 in the United Kingdom, 69.95 of children ages newborn to 17 received free care through the National Health Service and that the restorative care index, F/DMFT (Walsh's Care Index) was 14 percent for 5-year-old children and 47 percent for 12-year-old children. This means that considerable decay has not been treated. While not providing specifics, he indicated that a restorative Care Index for New Zealand would likely be 75 percent. Another report (**Thomson, Ayers, Broughton, 2003**) suggested that it approximates 100 percent.

In discussing the New Zealand model, Croucher reviewed the changes in the past several years from school-based clinics to the "hub and spoke" model and indicated that he had no doubt that "the New Zealand dental facility and service model eliminates almost all the physical and financial barriers that exist for children accessing care." He validated the comment by citing data from the 2009 oral health survey, reviewed above (**NZMH, 2010)**.

Croucher indicated that a weakness of the New Zealand system was that while children receive care in their schools, the parents of children have to access care in a private dental office, thus not embracing the desirable concept of a whole family accessing care together. But he followed that with the question, "Which would you rather have, a service delivery model that reaches more than 90 percent of New Zealand children or a service delivery model that means only those children who access a private dental practice model will benefit?"

The article concluded by considering the costs of a delivery model using dental therapists versus one of dentists. In U.S. figures, dental therapists in New Zealand earn $30,000 to $45,000 a year; a community dentist's salary is between $75,000 and $120,000; and most private practicing dentists earn $120,000 to $150,000. "With 90 percent of basic dental care for children being provided by dental therapists it is clear that this workforce model is more cost effective than a dentist only workforce model."

The attitudes of New Zealand dentists, dental specialists and dental students toward employing dual-trained "oral heath therapists" has been explored (**Moffat, Coates, 2011a**). While there was some limitation of understanding of the scopes of practice of oral health therapists, the investigators found that 59 percent of dentists and 53 percent of specialists would consider employing dually qualified dental therapists/dental hygienists in their practices. The main reason given for not employing a graduate was insufficient physical space in the practice. The

authors concluded that knowledge of dentists of scopes of practice will improve as more oral health therapists graduate, and that oral health therapists have the potential to make a valuable addition to the dental team.

Moffat and Coates surveyed the Oral Health students at Otago and Auckland in order to aid in the recruitment of students, to determine the extent of the students' professional knowledge, and to determine their employment preferences (**Moffat, Coates, 2011b**). Students were found to be likely to return to work in the type of community from which they came. Most, 90.3 percent, would consider working in private practice, while 56.4 percent would consider working in the School Dental Service; 49.7 percent would consider working in both environments.

Both Otago and AUT students experience clinical placements within the School Dental Service and with Māori Health Providers while students. In a master's degree thesis submitted to the Auckland University of Technology for a Master of Health Science degree, a qualitative study examined the experiences of oral health therapist students on their clinical placement (**Smith, 2011**). In the study, five oral health therapist students were interviewed using van Manen's thematic analysis method. Three core themes emerged in the study: 1) relationships matter; 2) the leap to real situation is huge; and 3) students do become confident and skilled. Relationships were important to student learning, with clinical educators being the main source of learning, though peers were identified as providing practical and emotional support, as well as being a valuable source of informal learning. Students experienced a range of emotions during transition; initially anxious and fearful of hurting or harming patients, they acquired skill and confidence through time. They were found to "care about," not just to "care for," the children they treated. Time and opportunity to practice skills resulted in the need for the clinical educator to provide less information and the students became more autonomous in their work.

The New Zealand Ministry of Health recently published a report detailing future directions for a Maori dental therapist workforce (**NZMH, 2011b**). The report documented the oral health status of Maori 5-year-olds and Māori in Year 8 (12-year-olds), who had a higher severity of dental caries than their non-Maori/ Pacific peers in 2002 through 2009. Those children in fluoridated areas had better oral health status than those in nonfluoridated areas. The report indicated that Maori consumer awareness and expectations of the oral health of newborn-to-17-year-olds should increase over the next eight years, given the emphasis on oral health promotion and the priority being given to Maori oral health. As a consequence, the report said that "urgent attention is required to increase the capacity of the Maori dental therapy workforce so that it can contribute to improving the oral health of Maori children and young people."

In 2006, 65 (10 percent) of the 650 dental therapists were Maori. This is well below the 130 Maori dental therapists that would have been needed for the proportion of Maori dental therapists in the workforce to be aligned with the proportion of Maori newborn-to-17-year-olds in the 2006 population. When productivity was taken into account, a further increase to between 178 and 222 Maori dental therapists would have been needed in 2006 to provide optimal oral health care to Maori newborn-to-17-year-olds.

The report indicated that the recruitment of Maori into dental therapy programs remains an issue, as few Maori students entered Oral Health programs during the past four years. The number of Maori training to be dental therapists needs to increase. Both the University of Otago and Auckland University of Technology need to actively recruit Maori students. Each program needs to commit to enrolling at least eight to 10 Maori dental therapy students each year for the next six years if the 2018 dental therapy workforce is going to have a representative number of Maori dental therapists proportionate to the newborn-to-17-year-old Maori population in 2018.

The report went on to indicate that the pay parity that dental therapists had in the 1990s with teachers had disappeared, with dental therapists salaries falling behind equivalent teacher salaries by $10,000 (New Zealand Dollars). This was viewed as a risk to retaining dental therapists in the workforce, and possibly to the recruitment of Maori into the dental therapists workforce.

In 2012, New Zealand Ministry of Health data indicated that $64 million (U.S.) was spent in fiscal year 2010-2011 to provide comprehensive care by dental therapists in the School Dental Service for 624,700 children newborn to 12 years of age. This represented caring for 96 percent of New Zealand's 5-to-12-year-olds and 49 percent of newborn-to-4-year-olds. This was at a cost of $99.11 (U.S.) per child. The ministry reported three private practice fees in New Zealand for that year to demonstrate the cost-effectiveness of care in the SDS. In the private sector, an examination, radiographs and cleaning was $102 (U.S.); a one surface amalgam restoration was $99 (U.S.); a fissure sealant was $47 (U.S.) (**NZMH, 2012**).

A March 6, 2011, article in the New Zealand Herald stated: "The dental health of young children continues to be among the worst in the developed world, figures reveal. Forty-four percent of 5 year olds have at least one decayed, missing or filled tooth, a school dental services report has found. The Government has spent $417 million on the problem since 2007 but the figures have shown little improvement. In 2000, 48 per cent of 5 year olds had cavities, and the figure has not dropped below 43 per cent since. New Zealand rates are worse than the UK, US and Australia" (**New Zealand Herald, 2011**).

The New Zealand Ministry of Health (**2012**) acknowledged that these data reflect the need to continue to focus on prevention in the care of preschool children in New Zealand, on which there has been an increased emphasis for some time (**NZMH, 2008**). Since 2000, the number of caries-free preschoolers has increased from 52 percent to 57 percent.

Dye et al. (**2007**) found that 28 percent of children ages 2 to 5 in the United States had experienced dental caries, having increased from 1988-94 to 1999-2004. In 2-to-5-year-old children living at 200 percent of poverty or less, the index was predominately carious teeth versus filled teeth. The prevalence of untreated dental caries increased from 18 percent to 24 percent during the period.

Beltrán-Aguilar et al. (**2005**) found that 41 percent of 2-to-11-year-olds in the United States had experienced dental caries in their primary teeth, with a mean dft of 1.4. Dye and colleagues (**2007**) found that the mean number of decayed and filled primary teeth in 2-to-11-year-olds had increased from 1.39 in 1988-94 to 1.58 dft in 1999-2004. Beltrán-Aguilar and colleagues found approximately 21 percent of children ages 2 to 11 in the United States had untreated tooth decay.

The mean dft for the 2-to-11 age group in New Zealand was 1.6. dft. Of this, 0.3 was due to decay, with 1.3 due to filled teeth. This indicates the effectiveness of treating disease once it has occurred. While acknowledging the need to focus on prevention, the Ministry of Health has also acknowledged that a focus of the child oral health services in New Zealand is to ensure that children are pain-free and sepsis-free (**NZMH, 2012**).

In New Zealand in 2010, more than 60 percent of children ages 2 to 4 were enrolled in and used the publicly funded child oral health services; 98 percent of 5-to-12/13-year-olds were enrolled. As the 2003 data indicated, essentially all carious teeth of 5-to-12/13-year-olds had been restored or extracted by the end of a school year (**NZNHC**, **2003**). Using 1988-1994 data, the percentage of carious primary teeth that had been restored in the United States was 63.3 percent; for the permanent teeth it was 74 percent through age 14. The percentages dropped 48.7 percent for primary teeth for children at 100 percent of the federal poverty level; and 72.3 percent of permanent teeth of children at that socioeconomic level (**Vargas, Crall, Schneider, 1998**). Mouradian and colleagues (**2003**) reported that only 22 percent of all children in the United States under age 6 had received any dental care.

Section 5

AUSTRALIA

Australia is a stable, culturally diverse and democratic society with a skilled workforce and a strong, competitive economy. With a population of more than 22.3 million people, Australia is the only nation to govern an entire continent. It is the Earth's largest island and the sixth-largest country in the world in land area; at more than 2,485 miles wide and 1,864 miles north to south, with a land area of 2,967,900 square miles, it is about the size of the U.S. mainland.

Australia has the 13th-largest overall economy in the world as measured by GDP. In 2011 the Australian economy was the fastest growing advanced economy in the world. It is the sixth-oldest continuously functioning democracy in the world. Australia ranks 19th in the global marketplace in exports, which are a mix of minerals and energy, manufacturing, rural products and services.

Australia's population includes more than 550, 000 Aboriginal and Torres Strait Islander peoples and migrants from some 200 countries. In more than 60 years of planned post-war migration, Australia has welcomed more than 6.5 million immigrants, including more than 660,000 refugees. During this time, the population has tripled from about 7 million. About 65 percent of Australians live in the state capital cities.

Immigrants have brought with them language skills and other capabilities that are valuable in today's global economy and workforce. Although English is the national language of Australia, more than 3 million Australians speak a language other than English at home. Australia is one of the few countries belonging to the Organisation for Economic Co-operation and Development where general government net debt has been eliminated. In 2011, the average middle aged adult had a net worth of $350,000 making Australians among the world's wealthiest. Living standards have steadily improved since the start of the 1990s and now surpass those of all the industrialized nations that form the Group of Eight, except the United States.

Australia has a well-developed education system with participation rates among the highest in the world. Health care is subsidized through a universal health insurance scheme (Medicare) collected through taxation that provides "free" and affordable basic health services through public hospitals and medical practitioners. Many Australians augment this through the purchase of private health insurance; this excludes dental care.

DENTAL CARE

Dental care in Australia is provided mainly through private dental practice, funded by the individual patient. Australia has a technologically advanced and highly trained private dental care delivery system. Private-practice dentists work primarily in solo or small group practices, while public dental care is provided at a mixture of larger clinics or dental hospitals, as well as small community dental clinics, all of which employ dentists, specialists, dental therapists and hygienists, prosthetists, technicians and dental assistants. State and territory public dental services provide subsidized dental care, primarily targeted to people of low income for adults, and universal school dental services for children and adolescents (**Slade, Spencer, Roberts-Thompson, 2007**). Dental therapists have served as a core provider in the public dental services for more than 40 years, being responsible for care delivered by the School Dental Service, thus providing the majority of dental care to children and adolescents (**Dooland, 1992; De Vries, 2007**).

This review of the literature on dental therapy in Australia is constrained by the weaknesses inherent in attempting to retrieve and report developments and published documents in eight separate state and territories, each with their own government, policy processes and service delivery systems. While documentation may favor one or other of the states through some convenience sampling (driven by availability of material), the snapshot provided is indicative of the development and practices of the dental therapists in Australia.

SCOPE OF PRACTICE

Dental therapists in Australia operate in a primary care role, carrying out routine dental care and health promotion, referring patients to dentists for services that are beyond their scope of practice. Until July 2000, dental therapists in most states of Australia were limited to public sector employment with School Dental Services, providing care to children and adolescents in collaborative and referral relationships with dentists and with the chairside assistance of a dental nurse. (Note: In Australia and the United Kingdom, "dental nurse" is equivalent to the U.S. "dental assistant.") Dental therapists' skills include examination, diagnosis and treatment planning; radiology; preparation of cavities and their restoration with amalgam and plastic filling materials in permanent and deciduous teeth; pulp therapies and extractions of deciduous teeth; clinical preventive services such as prophylaxis and scaling, fissure sealants, fluoride therapies, and diet counseling; and oral health education and promotion.

Scopes of practice differ slightly among jurisdictions, but may also include the fabrication of mouth guards, orthodontic procedures on the advice of a dentist or orthodontist, extra-oral radiography, placement of stainless steel crowns,

incisal edge restorations, pulp therapies in permanent teeth and permanent tooth extractions. The age limit of people treated by dental therapists has traditionally been capped at 18, although in Victoria the upper limit is now 25 (and without limits in orthodontic practices). In Western Australia, dental therapists in private settings have provided care for all ages under prescription from a dentist for many years. Age limits on patient groups have traditionally been defined by the service policies of state and territory school dental programs; however, wider employment settings and nationally based regulation have generated a more generic approach based on educational preparation (**Dental Board of Australia (DBA), 2011; Australian Dental Council (ADC), 2011**).

HISTORY AND THE DEVELOPMENT OF DENTAL THERAPISTS

The 1850s gold rushes in Australia brought dentists from overseas who provided services through solo private practices and, around the turn of the 20th century, the establishment of dental hospitals, odontological societies and legislative frameworks for practice. The first university dentistry programs began in Sydney in 1901 and Melbourne in 1904, followed by South Australia, Queensland and Western Australia, thus replacing the indenture training schemes (**Robertson, 1989**). After state dental hospitals, School Dental Services have been the longest running public dental services in Australia.

At the beginning of the 20th century, concerns about the nation's fitness for war, the generational impact of health conditions and the future of society, "a collective middle class guilt over the social conditions of the working class" focused the attention of medical practitioners and dentists on the health and welfare of children. The "flood of caries in children" generated momentum for the inclusion of dentists in government health authorities relating to the welfare of children and pressure to establish school-based services for children (**Robertson, 1989**).

In Australia, many states established rudimentary School Dental Schemes in the years after the First World War arising out of concerns about the poor state of child oral health. This fed discussions at the federal level during the 1940s about a nationalized dental scheme to be incorporated into the proposed national health scheme of the Chifley Labour Government (**Robertson, 1989; Gardner, 1995**). This proposal was overturned through a change of government, which also established through referendum a constitutional amendment granting the Commonwealth powers for the "provision of maternity allowances, sickness and hospital benefits, medical and dental services," but not the power to nationalize health services (**Commonwealth of Australia, 1995**). However, concern persisted about the state of oral health in the community. Poor resourcing, lucrative private practice and the small pool of dentists available, particularly during the Second World War, meant that these School Dental Services were never really universally effective (**Robertson, 1989; Sendziuck, 2007**).

The origin of dental therapy has been variously attributed to both New Zealand and Great Britain in the early years of the 20th century; however, it was New Zealand's School Dental Nurse scheme, established in 1921, that led to the system that exists in Australia and around the world today. As early as 1919, a Melbourne dentist advocated a state dental service that would primarily have educational and other preventive functions. He drew on the concept of the British model of "dental dressers" for a new Victorian oral hygienist who would provide much of the care under the supervision of a dentist (**Robertson, 1989**). In 1923, in order to make recommendations to the Victorian Cabinet for the extension of dental treatment for children, the acting director of education for the State of Victoria wrote to the Principal Dental Officer for New Zealand's School Dental Service expressing interest in the scheme to train young women as dental assistants for work in schools. Clearly, concern for child oral health was significant, but the threat of the development of another layer of practitioner, when the dentists were "fending off the demands of recorded men, twilighters and mechanics," was too great for dentists (**Robertson, 1989**). Likewise, in New South Wales (NSW) during the 1930s and '40s, similar proposals were made, including a proposal by the Federal Labour Government in 1943 to introduce "oral hygienists" to deal with the problem of unmet dental needs, particularly among children, but similar political activity prevented their implementation (**Franki, 1997**). These hygienists were described in terms that would more closely fit the model of the New Zealand school dental nurse (dental therapist) rather than the U.S. model (**Robertson, 1989; Gardner, 1992; Franki, 1997**).

The need to improve the dental health of children remained of great concern, particularly after the Second World War, and in 1946 a fact-finding mission was established to look into the New Zealand scheme. In the 1950s, it was the private practicing dentists who strove for the establishment of the School Dental Service, but who then blocked the establishment of lesser-trained "auxiliaries" for fear of threat to their professional position by the dental mechanics (**Robertson, 1989; Gardner, 1992**). It was not until the 1950s and '60s that the severity of the dental problem in children finally resulted in action. In 1965, the National Health and Medical Research Council's (NHMRC) Dental Health Committee made the recommendation that any instrumentality responsible for the dental care of Australian children "should now give consideration to the utilization of dental auxiliary personnel in the form of the school dental nurse" (**National Health and Medical Research Council (NHMRC), 1965**). The NHMRC noted the success of such schemes in other countries and, in particular, the 98 percent participation rate and social acceptance attached to the New Zealand scheme and the reluctance of the dental profession to support the concept of operative dental auxiliaries in Australia. It made recommendations that demanded systematic and regulated non-university training,[1] the complementary (rather than substitute) nature of

1 The NHMRC (1965) noted several times in its report that auxiliary personnel should be trained in an appropriate government instrumentality—"that this is not a matter for the University Dental Schools."

dental auxiliary practice, the need to define the range of skills they could practice, and the need for direction and control of their services by a registered dentist. It stressed the need for administration by a dentist of such services and for each state to train sufficient auxiliaries for their own needs to engender allegiance in its staff and to reduce the demands for reciprocity and the risks of competitive salaries and other "undesirable developments." Courses of training should be as short as possible in order to maintain the cost-effectiveness of the auxiliary while ensuring competence. It also suggested that such school dental nurses should be female and have their employment restricted to the government service (**NHMRC, 1965**). The outcome of these recommendations was that between 1964 and 1975, dental therapy practice and education was established to enable expansion of School Dental Services in all Australian states and territories.

In 1964, the Australian state of New South Wales passed legislation amending its Dentists Act to allow for dental therapy practice, but could not generate sufficient support for funding to establish a training program (**Franki, 1997**). Tasmania and South Australia thus established the first dental therapy schools to train dental therapists for their state's dental programs in 1966 and 1967, respectively (**Dunning, 1972; Roder 1972; Gussy, 2001**). These courses were established in purpose-run Schools of Dental Therapy, operated in most cases by state health departments. When the Whitlam Federal Labour Government offered conditional block grants to expand the School Dental Scheme in 1973 to encourage the development of dental therapist based school dental programs, all of the other states took the extra funding, with New South Wales establishing schools at Westmead and Shoalhaven in 1974, Queensland (at Yeronga) also in 1974, Sylvania in 1975, and Victoria (Melbourne) in 1976 (**Gussy, 2001; Satur, Moffat, in Tsang, 2010**). Western Australia, which began training dental therapists in 1971, was unique in using the tertiary sector for training in a world-first program run at the Western Australian Institute of Technology (later Curtin University), graduating dental therapists who could work in both the private sector under prescription and, like the other states, autonomously in the School Dental Services. Its School Dental Service operated like those of the other states, with dental therapists providing examinations, radiography, diagnosis and treatment planning, and dental treatment, including fillings, extraction of deciduous and permanent teeth, local anesthesia, preventive services and health promotion to school-aged children under the off-site, general supervision of a dentist.

Prior to the establishment of the Australian dental therapy schools, many young women were also sent to New Zealand, to both the Christchurch and Wellington schools, to receive training as school dental nurses, returning to complete a period of bonded service as dental therapists in their home-state school dental services. Additionally, New Zealand-trained dental nurse tutors were engaged to support training in Australia (**Currie, in Tsang, 2010; Roder, 1972**).

Qualification for practice as a dental therapist at that time required a 1,500- to 2,100-hour tertiary course of education over two years and university level entrance requirements generally with prerequisite studies in English and biology, with some very limited pathways open to experienced dental chairside assistants. Many of these programs awarded certificate level qualifications, which transitioned to diploma and associate degree level when external accreditation was achieved.

In a paper published in 1974, Blaikie describes the vocational nature of the South Australian Dental Therapy training program, its focus on School Dental Service needs, and its position in the tertiary education system separate from dentistry training in university, which was mirrored in the other states. Course content was structured in three themes: social sciences and preventive dentistry, biological and dental sciences, and clinical practice. Practical clinical experience was undertaken in School Dental Service clinics, and dental therapists were trained to be as clinically competent as recently graduated dentists in the range of services they provided. This clinical competence was assessed by external examiners from the Australian Dental Association and the University of Adelaide Dental School, which commended the outcomes. Prevention and the establishment of positive relationships to motivate oral health improvement were emphasized as important attributes of graduates in the objective of improving the oral health of children (**Blaikie, 1974**).

By 1979, Australian schools were graduating a combined total of about 280 all-female students per year (**Commonwealth Department of Health, 1979**). The mid-1990s saw the gradual demise of government-sponsored dental therapy schools, as each state and territory government questioned its role in providing tertiary education and, indeed, the roles of the dental therapists. One by one, the dental therapy training programs were transitioned into the university sector, beginning in Victoria in 1996, often with the addition of dental hygiene content to establish oral health therapy graduates. The closure of the Westmead College of Dental Therapy in NSW in 2004 saw the end of an era of dental therapy training by state governments in Australia and New Zealand, with the move to a university-educated dental therapist with a bachelor's degree qualification.

Australia's first dental therapy professional associations were formed in Western Australia and New South Wales in 1973, with the other states and territories following soon after (**Dental Therapy Association of Western Australia (DTA WA), 2007; Currie, 2010**). In 1987, through an affiliation of the state and territory associations, the Australian Dental Therapists Association was formed (**Australia Dental Therapy Association (ADTA), 2001**). In 2003, the ADTA changed its name and focus to reflect the changes in education occurring around the country to form the Australian Dental and Oral Health Therapists Association. This change was also reflected by the state associations, although the Dental Therapy and Hygiene Association of Western Australian had set this new direction some 10 years earlier in 1996.

DENTAL HYGIENE IN AUSTRALIA

South Australia was the first state to introduce dental hygienists (after the U.S. model) in 1971, when enabling legislation was passed by the South Australian state government, following lobbying by a group of dentists who had worked with dental hygienists while undertaking postgraduate studies in the United States of America and the United Kingdom (**Satur, Moffat, in Tsang, 2010**). The first dental hygienists to work in South Australia were trained overseas, mainly from the United Kingdom, United States and Canada—some of whom were previously dental assistants from Adelaide who had undertaken dental hygiene training in the United Kingdom before returning to work in Adelaide. In 1974, the first dental hygiene training program was established in an initiative between the Department of Further Education, the University of Adelaide, Department of Dentistry and the Adelaide Dental Hospital, taking its first group of students into a 12-month course in May 1975.

Dental hygiene is a relatively new profession in Australia, with only one other state, Western Australia, following South Australia's lead by legalizing practice in 1973. Practice was much more recently legalized in the rest of the country beginning with ACT and Queensland in 1987, Victoria in 1989, NSW in 1990, in the Northern Territory in 1996. It was not permitted in Tasmania until 2001 (**Dental Hygienists' Association of Australia, 2002**).

The first dental hygienists association was formed and incorporated in South Australia in 1977, and in 1985 the National Dental Hygienists Association of Australia was formed, becoming a member of the International Dental Hygienists' Federation in June 1986 (**Dental Hygienists' Association, South Australian Branch, 2005**).

As a consequence, dental therapists were the more numerous and widespread complimentary dental profession in Australia, although confined to work in the public sector until 2000.

REGULATORY FRAMEWORKS—ESTABLISHMENT YEARS, 1965-1990S

In Australia, dental therapists were initially licensed by, or practiced under exemption from, Dentists Acts, and they worked under regulation, requiring the control, direction or supervision of a dentist. At the initiation of the programs, each state and territory developed its own regulatory framework and legislation for practice, although all were based on the New Zealand School Dental Nurse model. At the time of the establishment of dental therapy, there were generally three mechanisms of regulation applied to practice. Licensing by the boards prescribed

the entry levels (qualifications required) for practice, practice regulation defined the areas or scope of practice, and the requirement for supervision or control by a dentist provided a third layer. Title, however, was generally not protected under the acts. The exception was that in Australia, dentists (designated as dental officers) were employed directly by the School Dental Services to provide clinical support, referral pathways and oversight of practice.

Practice definition relied on prescribed delegation of tasks to dental therapists and was tightly defined under legislation in each state of Australia. While the core concepts were the same, the technical definition of the range of services and patient groups they could provide differed slightly among jurisdictions, and so, in consequence, did their training. Legislation did not rely on educational preparation or competency, but rather on prescriptive lists of services to determine practice boundaries. Dental therapists and hygienists crossing state boundaries were subject to de-skilling or re-skilling in order to comply with local regulations, regardless of practice experience or competence (**Victorian Dental Therapists Association (VDTA), 1998**). Without exception, all states and territories have regulated dental therapists and hygienists under the same piece of legislation as dentists. In some states, dental therapists practiced under exemption from the Dentists Acts (Tasmania, South Australia, New South Wales, Queensland), and in Victoria and Western Australia they were licensed by the Dental Acts to practice, with regulations (subordinate legislation) defining conditions and the list of services they could provide (**Satur, 2002**).

Legislation at that time limited the employment of dental therapists to government-run public dental services, specifically school dental programs. Legislation also limited their patient groups to schoolchildren, although this was applied differently in each state, with some states limiting patients to those attending school and others with more liberal interpretations ranging from newborn to 18 years. Administration of the various Dental Acts was by state and territory dental boards, comprising dentists almost exclusively; dental therapists had no opportunity at that time to participate in the regulation or policy-making environment related to their own practice (**VDTA, 1998; Satur, 2002**).

During the initiation of the dental therapy programs, there had been some debate about the need for diagnosis and prescription of care by dentists, as had occurred in England. This was in contrast to the New Zealand model, where the school dental nurse practiced relatively autonomously with oversight by a dentist responsible for up to 400 dental nurses who referred children in need of additional care to private dental practices locally (**Leslie, 1971; Roder, 1972**). It was determined in Australia that:

> *the nurses (therapists) must be able to detect conditions beyond their therapeutic scope for referral to a dentist … that those dentists who argue for keeping all*

> *diagnosis and planning of treatment for the dentist are being needlessly over-cautious because New Zealand's experience has proven them wrong. The degree of supervision of the school dental nurses, and the checking of each completed patient by a dentist, now appears not only unnecessary and wasteful of dental manpower, but may serve as a dispiriting activity for the nurse* (**Roder, 1972**).

Legislation was to be drafted incorporating requirements for direction, supervision or control by a dentist; however, in practice, since their inception, dental therapists have provided care in autonomous dental therapist-led and -managed clinics; a dentist would be available by telephone for consultation and would generally attend a dental therapist's clinic weekly or fortnightly for half a day to undertake clinical procedures not performed by dental therapists (**Riordan, 1997; VDTA, 1998; NSW DTA, 2000; Martin, 2002**). In addition, South Australia and Queensland have required their dental officers to provide periodic examinations and treatment to participating children. In more remote and rural locations, on-site dentist support has been generally more sporadic; advice would be provided on management of complex cases by telephone, or medical practitioners would be consulted, for example, to provide antibiotic prescriptions where required. The overwhelming majority of dental care for children in Australia since the 1970s has been provided by dental therapists alone, without on-site supervision of practice (**Dental Health Service, Victoria (DHSV), 1991; Dooland, 1992; VDTA, 1998; NSW DTA, 1999; Satur, 2002**).

EARLY EVALUATIONS

As South Australia was one of the earliest states to establish dental therapy practice, the earliest evaluations of practice occurred there. The stated aims of the school dental program were to improve dental health among children through treatment of existing dental problems and prevention of further disease through fluoride applications and dental health education of children (**Roder, 1979**). The health department that established the program also established standardized data collection and an evaluation and health education unit to support its work.

In 1971, Roder undertook a study of children in rural areas of South Australia, reporting that "dental disease is progressing relatively unchecked…" but that the situation in areas where school dental services (utilizing dental therapists and dentists) had been active was substantially better, although not as good as in New Zealand (**Roder, 1971**). A subsequent study of matched secondary school students to compare those who had received School Dental Services (SDS) at primary school (test group) and those who had not (control), showed that decay rates were lower (average 3.56 carious teeth with 89.2 percent prevalence) compared to those not treated (average 6.33 carious teeth with 96.4 percent prevalence). Further, the Filled-to-DMF ratios among those treated were 0.51, compared with 0.26 for those

not treated by the SDS. The quality of restorations was found to be good, but there was little apparent impact from preventive care (fluoride treatments), although knowledge of good oral health practices was greater among the treated group. Unsatisfactory restorations were found in 1.8 percent of the test group and 2.8 percent of students in the control group. Of concern, though, was the finding that while 59 percent of high school students without a history of previous SDS care had visited a dentist since leaving primary school, only 36 percent of students with a history of school dental care had done so. Roder concluded that over time, results could be expected to improve, as dental health education approaches were refined and service delivery became more established (**Roder, 1973**).

In 1974, Roder examined the ability of dental therapists to reliably examine, diagnose and plan treatment, collect data and refer appropriate cases to dentists. Ten regional SDS dentists, eight Dental Therapy School staff dentists and 47 dental therapists were involved in blind examinations of the same 470 children, and the findings from each of the three practitioner groups were compared for agreement. It was found that there was an average variation between the practitioners in the order of 1.3 percent of restorative decisions, 0.2 percent of extraction decisions and 1.5 percent of "other" treatment decisions, and a range of difference in the perceived need for referral (conditions) of 1.3 percent; none of these differences was statistically significant, although there were greater variations in the treatment decisions on a tooth level and between individual practitioners. The study concluded that these dental therapists were competent to recognize caries and other conditions, plan treatment and gather statistical data, although differences did occur with decisions about the need for referrals for individual patients in the order of 20 percent, which supported the recommendation that the SDS regional dentists should continue to review dental therapists treatment decisions periodically (**Roder, 1974**).

In 1976, Roder again assessed the impact of the SDS on 2,000 secondary schoolchildren and found that those who had received care during primary school had less carious teeth (approximately 2 percent to 3 percent) and more restored teeth. This group also had better oral health knowledge and in some, better oral hygiene practices, but fewer had attended private dentists since leaving the care of SDS (**Roder, 1976**). This may be because they had better self-perceived oral health, or because of the cost of private treatment, or because they were reliant on SDS care. Nonetheless, this issue of continuity of care remained a concern for the program.

Roder and Sundrum also examined the use of fissure sealants placed by dental therapists in 1976; patient selection and moisture control techniques used at the time explain the 30 percent retention rate achieved (**Roder, Sundrum, 1976**).

Roder and colleagues also evaluated the impact of a three-week, dental therapist-delivered dental health education program at a suburban secondary school for 15-to-17-year-olds. The study showed that plaque levels and oral hygiene practices

were improved among the participants when compared with a nonintervention control group, but again, demand for dental care was greater among the control group. The authors observed that teachers were the most appropriate providers of education and that dental therapists should be involved as initiators of programs and resource support (**Roder et al., 1977**).

Blaikie and Wiedenhofer undertook to evaluate the cost of school dental care delivery under its current model, with the costs of delivering the same care on a hypothetical fee-for-service basis using Department of Veterans Affairs' scale of fees (which is lower than private practice fees). The study used cost-benefit and cost-effectiveness analysis, which excluded the cost of training for dentists and dental therapists, and showed that the school dental program was an economically acceptable method of delivering school dental care, with a fee-for-service alternative costing 20 percent more to deliver the same service (**Blaikie, Weidenhofer, 1978**).

Blaikie also describes the dental health education activities undertaken by dental therapists as part of SDS programs. He notes the potential benefits of including parents in such programs and the improvements in oral hygiene and gingival scores achieved in the short term (**Blaikie, 1976**). Roder (**1979**) noted that dental therapists were spending 25 percent to 30 percent of their time on dental health education activity. He noted the difficulty of evaluating large-scale school dental health programs but asserted the importance of doing so. In 1979, he reported that there had been improvement in untreated disease levels since the inception of the SDS in 1969. In 1969, children averaged three untreated decayed teeth in nonfluoridated areas and two untreated teeth in fluoridated areas; in 1979 the average in nonfluoridated areas was 0.8 and in fluoridated areas 0.5. There was also evidence to show that oral hygiene and gingival health had improved consistently with the number of years a child had received school dental care. He noted that some of this improvement could have arisen from dental health education activity, but that isolating the effects in an integrated program was difficult to achieve.

Blaikie and Dooland, in a presentation of evidence available to inform school dental service treatment priorities and decision-making, asserted that contemporary evidence at the time was not strongly supportive of dental health education activities, with the exception of peer models of school-based health education and dental therapists' work to improve school canteen menus to eliminate sweets (**Blaikie, Dooland, 1979**). This began a discussion in a number of states about the most effective way to work with oral health behaviors and habits at a public health level to improve oral health that had far-reaching effects on service models for school dental services.

In 1981, Barnard described the Australian dental workforce in terms of active practitioners and training numbers. In 1972 there were 112 school dental therapists working; by 1976, this had increased to 471. These data include

21 dental therapists employed in the private sector in Western Australia but exclude the School Dental Therapists employed in the Western Australian School Dental Service, who at that time were not required to be registered by the Dental Board. By 1979, there were 1,041 active dental therapists in the workforce. In the same period, numbers of dentists in the workforce increased from 4,174 in 1971 to 5,220 in 1976 and 5,776 in 1978. Barnard calculated that in 1976, only 12.9 percent of dentists were working in government services and dentist-to-population ratios were 1 to 2,690 in metropolitan areas and 1 to 4,187 in rural areas (**Barnard, 1981**).

There was a culture of concern about dental workforce supply and demand expressed in the literature around 1980-81 that was neatly summed up in the Australian Dental Association Journal. The authors, the executive director and the president of the ADA, respectively, expressed concern about the discrepancies in workforce estimates by the Federal Health Ministers' Standing Committee on Health and the experiences of their members referring to a "firm consensus … that there is an over-supply in the dental workforce … that there are too many persons providing dental services relative to both the demand expressed by the community for those services and the positions available for dentist employment" (**Wall, Hession, 1981**).

Despite some difficulties in defining the degree of oversupply through a lack of information, the ADA cited Barmes (**1980**), who had concluded that in New South Wales that there was a mild to moderate oversupply of dental manpower, and the South Australian Health Commission and ADA working party on Dental Manpower (1980) findings that there was a 10.8 percent oversupply of dentists. In Queensland, however, a manpower survey found there was a good balance of positions available and dentists to fill these positions. In Victoria, 50 percent of dentists considered there "were more than enough dentists in their area, while 43 percent thought the number was about right." The ADA also used information from dental supply companies to support the notion that dental practice "busyness" had been declining for some time, and that most new practices were "doomed to bankruptcy." The paper reports that growth rates in dentist numbers had been 7.6 percent since 1973 and presented data that showed a population to provider ratio of 1 to 1,953 when all providers (dentists, dental therapists, dental hygienists and denturists) were included, although dentists still made up 85 percent of all practitioners. Contractions in disease experience among children were noted, along with the impact of improved technologies on demand.

The authors concluded by recommending, among other things, that where a choice needed to be made about type of provider, favoring dentist-based systems of care delivery at the expense of auxiliary-based systems should be accorded priority. They also recommended limiting workforce growth by limiting (in this order):

1. numbers of dentists allowed to immigrate into Australia;
2. numbers of auxiliaries entering training programs;
3. numbers of first-year students entering dental schools in Australian universities.

The paper also noted the importance of consultation with the ADA (**Wall, Hession, 1981**). Of interest in this analysis is the lack of attention given to unmet needs for dental care in the assessment of demand and the emphasis on private-sector delivery as the indicative predictor of need for dental services.

Anderson (**1982**) described the delivery of dental services in the Northern Territory, which is a large (520,902 square miles, or 17.5 percent of Australia's land mass) and remote self-administered territory. Aboriginal people made up 30 percent of the population, and the majority of people were classed as either rural or remote-dwelling, living mostly in small settlements, mining communities, aboriginal communities and cattle stations. He noted the scarcity of dental practitioners and described the services to the community through the Darwin hospital clinic and mobile dental clinics operating from the Air Medical Services. In 1973, the School Dental Program commenced with the employment of a New Zealand-trained school dental therapist and the training of a local Darwin resident at the Dental Therapy School in Hobart. In 1981, 21 dental therapists (trained interstate or in New Zealand) were providing services to all urban and 80 percent of rural children operating from 30 School clinics and as part of mobile teams. This study also reports the training, beginning in 1972, of Aboriginal Health Workers (AHWs), who work as primary health care enablers in Aboriginal communities. Dental content was included in this program from 1979, with training in preventive dental care and relief of pain (sedative dressings and uncomplicated extractions, usually periodontally involved teeth) for those AHWs with an interest in this area.

L.M. Carr, a dental services adviser to the Commonwealth Government, evaluated the impact of the commonwealth-funded School Dental programs at the time that special purpose funding ceased in June 1981. (Under the original scheme, states and territories were obliged to continue operating the school dental programs under general revenue grants beyond the life of the special purpose grants.) This paper summarized the findings of the "Commonwealth Department of Health School Dental Scheme: Evaluation and Statistical Data 1977-80." Data were collected by 1,285 dental therapists as part of routine dental care provided, and due to the similar conditions of training, equipment and "supervision" under which they worked, standardization was not undertaken, as the variation between examiners was considered minimized.

The study used 245,144 examinations conducted in 1977, 415,803 from 1978, 547,907 from 1979 and 649,585 from 1980. Data were weighted according to relative populations of children ages 4 to 13 to enable accurate comparisons between states and territories and from year to year (weightings are reported).

From the data covering almost 2 million examinations, a fall in the DMF index for children ages 6 to 13 was noted in the order of 26.9 percent. Considerable data are presented to support this finding; in 1977, DIMF was 2.97 and in 1980 it was 2.17. The effect of fluoridation has played a major part, but not the whole role, in this improvement; the DIMF indexes for children ages 6 to 13 in Queensland, where only 6 percent of people use fluoridated water, were 3.09 in 1977 and 2.29 in 1980, representing an average reduction of 7.6 percent per year. This pattern held across the states and territories. Improvements in oral debris scores were also noted in the order of 21 percent.

The authors considered that while it was impossible to determine and quantify the reasons for the improvements, clearly treatment provided by the school dental services would have reduced the number of decayed teeth and extractions required. They considered that the factors contributing to the reductions were:

1. The work of the school dental services in preventive dentistry, dental health education and promotion;
2. The use of fluoridated water and fluoride supplements;
3. The growing emphasis placed by the dental profession on the prevention of oral diseases;
4. A gradually increasing appreciation by the community of the desirability for good dental health.

These findings support the notion that school dental services, among other benefits, contribute to a positive culture in communities around oral health and are enabling factors value in prevention and treatment of periodontal disease and in high needs areas such as in improving child oral health (**Carr, 1982**).

McIntyre (**1982**) wrote about the role of dental hygienists, as they were poorly understood in Australian dental practice. He reviewed their roles internationally and their geriatric care, domiciliary services and care of the handicapped. He noted that in the United States, there had been discussion about extension of their scope into restorative areas, noting that in Australia there may be benefit for hygienists to undergo retraining and become school dental therapists rather than simply extend their scope into restorative duties in private practices.

In 1983, David Barmes, then chief of the Oral Health Unit of the World Health Organization, undertook a review of the South Australian School Dental Service (SADS) to examine and report on the:

- appropriateness of the School Dental Service to continue the provision of dental care to children in SA;
- quality of care provided;
- effectiveness and efficiency;

- management with regard to resource planning and administration;
- financial implications of recommendations and any other matters.

His evaluation used literature and document reviews, surveys of children using and not using SDS, interviews and observations. Barmes reported that he found widespread support for the service in its current form and the widely held view that it should continue to expand. He observed conflict between private and public dental sectors as dental status has improved and success of school dental services has been demonstrated; private-practice dentists being in support of the SDS but not of its expansion into secondary schools and having concerns about supervision levels of dental therapists. Barmes found the quality of care provided was excellent, clinically and socially, and the ability of dental therapists to maintain that quality is evident with an ideal mix of dentists and dental therapists. The SDS was effective and efficient, compared well with other Australian services, and shows a cost advantage over privately delivered care based on fee-for-service data.

"The SDS appears to be even more effective and, one would expect, efficient in creating an excellent preventive and treatment blend within the school environment and in promoting better oral health attitudes and behavior…."

Barmes considered that the SADS evaluation and quality assurance methods work well to maintain quality and prevent over servicing. The report predicts a reduction in workforce needs over time and articulates a need for a shift to more primary care models with dental therapists and dental hygienists in primary care roles, reserving dentists' skills for more specialized work. The report's recommendations were as follows:

- *Emphatic that public and private dentistry work together (to create a more integrated and holistically planned approach to dental care in SA);*
  - S*ADS continue with existing public dental services including the SDS; Services be extended to secondary schools and include unemployed;*
  - *Private sector dentists be included in the schemes and funded on capitation to provide public dental services;*
  - *Quality control measures in place be maintained;*
  - *Dentists in SDS to be up-skilled to specialist roles and generalist/specialist policies reviewed;*
- *Roles of dental therapist and dental hygienists be blended and utilized across public and private sectors;*
- *Data collection be improved across whole population*
- *School dental clinics become school health clinics, staffed by blended DT/DH extend to secondary schools and broaden roles to general health;*
- *All oral health personnel to be trained together at the dental hospital site* **(Barmes, 1983)**.

CONSOLIDATING AND REFINING THE SCHOOL DENTAL SERVICE PROGRAMS—THE 1980S

The ongoing concerns in South Australia about poor attendance for dental visits among secondary schoolchildren were addressed with a new direct referral program. By 1981, all eligible children in South Australia were receiving school dental care from dental therapists and dentists operating from 120 dental clinics on school grounds and in mobile units. Beginning in 1979, parents of children in their final year of primary school received a letter from the SDS referring them to a dentist of their choice. Dooland and Carr (**1983**) evaluated this program and found that a questionnaire survey of 9,953 secondary school students indicated that a greater proportion of ex-school dental patients continued to seek dental care than has been reported previously. Attendance figures had improved to 56.7 percent for ex-school dental service patients (up from 36 percent) and to 67.9 for nonschool dental service patients (up from 59 percent in 1973). However, problems associated with comparison groups between patients and with previous surveys means it was difficult to directly attribute the changes to the intervention.

McKenna and Grundy (**1983**) evaluated fissure sealant placement by dental therapy students and found that the 93 percent and 82.5 percent retention after six and 12 months, respectively, was comparable with retention of Bis-GMA resin sealants in other studies.

As indicated earlier, school dental services began in Western Australia in 1977 and, in 1978, baseline data were collected from 1038 Year 10 (15-year-old) students who had not received SDS care to enable future evaluation of the program. Data were collected on dental caries, oral hygiene, gingivitis and calculus. This data collection was repeated in 1981 with 1093 Year 10 students, 79 percent of whom had received school dental care in their final years of primary school. Average DMFS in 1979 was 9.64 and in 1981, 7.46. Reductions in untreated caries were shown to have occurred, along with reductions in tooth loss, gingivitis and calculus scores. The authors concluded that school dental services had played a part in the improvements in oral health alongside water fluoridation and other services across the whole student population (**Medcalf, 1983**).

In 1983, a study was commissioned by the Western Australian Branch of the Australian Dental Association to examine practice profiles for its membership, including "busyness," employment profiles and auxiliary utilization. A survey was conducted in 258 practices, 50 of which employed a dental therapist and 228 a chairside assistant. Of these, 52 percent were working solely as dental therapists, 20 percent as hygienists and 24 percent in a variety of roles. Where practices were fully booked, 26 percent of them employed a dental therapist; this figure dropped to 5 percent where there was unused dentists' time identified. When compared with chairside assistants, dental therapists were found to be more vulnerable to

redundancy where dentists were less "economically satisfied," as dental therapists were considered substitute providers who could free up a dentist's time, whereas chairside assistants, whose pay was only 32 percent less, were complementary and potentially adaptable to other roles (**Stewart, D'Amelio, 1983**).

Following almost 20 years of School Dental Service provision in South Australia, the state government decided to extend services to students up to age 16. In 1987, a study was conducted to collect baseline data on oral health and habits from 510 Year 10 (15-year-old) students randomly selected from across a range of socioeconomic status (SES) schools, and included students from local as well as immigrant backgrounds. Of these students, 75.7 percent had received dental care within the previous 12 months and only 1.5 percent had not had dental care in the previous five years, and this was linked to socioeconomic status. Average DMFT was 3.3, with caries found in 14.5 percent of students; caries prevalence and mean number of teeth affected were found to be lowest in the higher SES school groups; gingival bleeding and calculus was widespread and periodontal pockets, while uncommon, were found to be more prevalent in lower SES students. This represented a marked decrease over the preceding decade (see **Roder, 1973**). This was attributed to the combination of water fluoridation and toothpaste use, increased awareness of better dietary and oral health practices, and the care given by the SDS (**Sikrandi, 1987**).

In 1989, Spencer and Lewis argued that there was a gap between decision-making around supply of practitioners and an evidence-based analysis of population demand for services in terms of numbers of graduates and mix of practitioner types (occupational and specialty). They examined the supply of, and demand for, dental services in Victoria with the aim of modeling quantified projections to inform workforce planning. They found that the supply of dental services had decreased slightly over time due to balanced attrition and supplementation, and subtle age and sex ratio changes among dentists and an increase in higher technology (more time-consuming) treatments being provided. Demand for services was found to have increased per capita and through population growth resulting in a market excess (undersupply), in contrast to the perceived market shortage at the beginning of the 1980s.

There had also been some transfer of service provision to dental therapists, which may reduce demand over time if this increased. Reducing edentulism and increasing retention of teeth into older age was predictive of increasing demand. Reducing disease levels in children also raised the issue of changing demand for preventive services and it was predicted that there would be a need for 12.5 percent more dental visits in 1996. The authors acknowledged the contribution of dental therapists to supply of services and noted the opportunity to shape future service provision by reshaping the workforce. They also noted the need "to minimize the risk of underused, but expensively educated and maintained

dentists; to maximize the effectiveness and efficiency of dental practice; to optimize the balance between prevention and curative/reparative services; and, to maintain a flexibility in occupational and specialty distribution for reaction to the unforeseen future of dentistry...." (**Spencer, Lewis, 1989**). In 1985, at Commonwealth Government level, the National Health and Medical Research Council recommended that a national survey of oral health be undertaken to inform workforce and service planning. Data were collected in 1987-88 and, while not published until 1993, they are reported here for fluency. Stratified random sampling was used to provide a spread of geographic and socioeconomic status populations and representative age group distribution across the population. Interviews were conducted with 16,897 participants over age 5, and 14,432 of those participants received clinical examinations.

The survey found that among 5-to-14-year-olds, 80 percent had a dental visit within the previous 12 months. Dental caries among children was at a low level when compared with international standards and with data collected in 1979; dmft was found to be 1.5 in 6-year-olds (3.0 in 1977) with 58 percent caries-free, and DMFT in 12-year-olds, 1.8 with 39 percent caries-free. Throughout Australia, there was a backlog of 0.9 primary tooth surfaces requiring treatment among 5-to-9-year-old children. Among 10-to-14-year-olds, examiners considered that 23 percent were in need of treatment, with 4 percent requiring extractions and 0.5 teeth per child requiring fissure sealants; 70 percent of teeth affected by caries had been filled and only 0.5 teeth required restoration in 23 percent of the age group. Among 15-to-19-year-olds, only 57 percent were using dental services, and DMFT was found to be 4.9 with a backlog of 1.0 teeth (1.5 surfaces) requiring restoration. The authors concluded that goals set by the NHMRC (35 percent or less 5-to-6-year-old children with caries, and DMFT of less than 1 among 12-year-olds) were achievable by the year 2000 (**Barnard, 1993**).

At about the same time, a Melbourne dentist wrote a thesis for a master's degree in which he examined the conflict between the striving of registered dentists to be the sole providers of dental treatment and the consequences this has had for alternative, essentially public dental services. He noted the genuine desire of dentists to help the needy in society in tension with the profession's need to do nothing to jeopardize the viability of private dental practice. In an interesting discussion of the history of the professionalization of dentistry in Victoria, he notes the opposition of dentists to the notion that "non-university trained people [would be] permitted to treat patients…"; however, "the dentists feared the mechanics more than young women." He contends that it has been dentists' fear of the unfettered access to patients by "mechanics" (denturists) that has clouded their attitudes and judgments, "particularly the introduction of auxiliaries and school dental clinics…." (**Robertson, 1989**).

Instruction manuals for dental therapists and dentists employed in Victoria's School Dental Service in 1991 indicate that universal coverage of primary schools had only been achieved in that state in 1983. Services were offered only to children in grades Prep to 4 (ages 5 to 10) and for disadvantaged children in grades 5 and 6 (11- and 12-year-olds) every two years; and for high-needs children, there was a recall program operating on a 12-month basis. The service used mobile and fixed clinics and employed 136.9 dental therapists and 32.4 dentists who, along with 110 dental assistants, provide care for 138,288 children in the 1990-91 financial year (**Dental Health Services HDV, 1991**). These documents are reflective of the variation in delivery of services between states and territories, often arising from differential uptake of funding from the Commonwealth Government, which has seen resources stretched in many states and territories, and universal coverage never really reaching that achieved in New Zealand. Riordan and colleagues (**1991**) reported that 93 percent of Western Australian children between ages 6 and 14 were treated in 1991. Coverage in Tasmania was as good, with 85 percent of primary, 30 percent of preschoolers and 50 percent of secondary schoolchildren receiving care from 90 dental therapists by 1989 (**Merhulik, Dever, 1997**).

Riordan, Espelid and Bjorg Tveit (**1991**) evaluated the radiographic treatment decisions made by dental therapists and dentists in Western Australia and compared them with those made in Norway and the Netherlands by dentists. Dental practitioners (dentists and dental therapists) working in the community dental programs in Western Australia were asked to complete a questionnaire assessing illustrated radiographs to diagnose caries and predict treatment decisions. Findings from this study indicated that 53 percent of all operators chose to restore a carious lesion while it was still (radiographically) in enamel; this compared with 55 percent of Norwegian and 65 percent of Dutch dentists, which the authors found surprising, given the water fluoridation coverage in Western Australia. It was found that, in general, dental therapists would restore lesions earlier than dentists and considered that caries progressed faster than the European dentists. Western Australian practitioners took radiographs less frequently than their European counterparts; about 6.6 intra-oral radiographs were taken per 100 children, and there was little difference between dentists and dental therapists' rates in this respect. The individual differences in treatment decisions were as great as those reported in Norway and the Netherlands. Calibration of radiographic treatment decisions for practitioners in the WA SDS was recommended (**Riordan, Espelid, Bjorg Tveit, 1991**).

This paper also demonstrated differences in dental therapist practice between jurisdictions. In WA, dental therapists were reported to have little training in radiographic interpretation and to generally take radiographs on prescription of dentists and to make treatment decisions arising from this on their advice. Queensland dental therapists practiced under similar regulations. In Victoria, dental therapists were trained to autonomously prescribe, expose and interpret intra-oral radiographs (**Satur, 2002**).

A second study using radiographs conducted by this group in 1993 demonstrated that, in general, WA dentists and dental therapists tended to "wait and see" more often than Norwegian dentists when a carious lesion was diagnosed. WA dental therapists were slightly less accurate in their diagnoses than both WA and Norwegian dentists, although treatment decisions arising from these diagnoses were similar between WA dentists and dental therapists. The authors explained the differences in terms of water fluoridation and thus caries progression experiences between countries (**Espelid, Bjorg Tveit, Riordan, 1994**).

POLICY DEVELOPMENT—THE 1990S

In the 1990s, the Commonwealth (Labour) Government undertook to reform the way health services were organized and delivered in Australia. It established the National Health Strategy to do the work of advising the reform and commissioned a series of background papers to drive the reform. A background paper on dental health was prepared following a workshop on dental services available to disadvantaged people, with participation from the public dental sector, research sector, community health, university dental and NHS staff. This paper noted the dramatic improvements in child oral health (1960s 8-9 dmft in 12-year-olds compared with 1.5 dmft in 1989), endorsing the continued use of dental therapists for the provision of these services, and noting that "the overwhelming majority of dental care for children in Australia is provided by dental therapists" and that "as long as children require dental examinations, targeted preventive services and restorations, dental therapists have the skills which match the treatment needs of children…."

The high levels of dental disease and treatment needs among adult and some child populations, particularly among the disadvantaged, were described. The paper proposed the development of a new dental program with federal funding to improve access to basic dental care for low-income people, which included participation of the private sector in delivery. It also recommended expansion of the School Dental Services and noted the potential for greater use of dental auxiliaries to provide some of the services currently provided by dentists at a reduced cost. The paper also recommended the potential economies to be gained from greater integration of dental therapy, dental hygiene and dentist education and noted the proposals for a combined skills dental auxiliary (**Dooland, 1992**).

This view was shared at the time by both the Australian Council of Social Services (ACOSS) and the Consumers Health Forum (CHF), who identified a five-point plan for a national dental program. This included the need to review the roles of dental workforce and more efficiently use the expertise of dental hygienists and dental therapists (**Australian Council of Social Services and Consumers Health Forum (ACOSS CHF), 1993**).

In January 1993, the Commonwealth Government announced the allocation of funds to support a dental program providing services to health card holders (low-income people) with appropriate structures to be established in each state to provide that service. The service became known as the Commonwealth Dental Health Program (CDHP) and included provision of services through private dental practices as well as expansion of public dental health services.

In 1992, after 20 years of practice, the Victorian Dental Regulations (subordinate legislation to the Victorian State Dentists Act) were reviewed. There were wording changes to contemporize the language; the word "supervision" was added to the existing wording ("direction and control") to describe the relationship between a dental therapist and a dentist. Changes to dental therapists' "list of duties" included the addition of chairside assisting, placement of pit and fissure sealants, and stainless steel crowns for deciduous teeth. Removal of sutures was deleted from the list, as was the extraction of permanent teeth (**Dentists' Regulations, 1972, 1979, State Government of Victoria**).

At the time the Dental Board, which advised state government on the review of this regulation, was made up of all dentists; dental therapists were not included in the consultations. Records about the decision-making processes by the Dental Board of Victoria appear to have been destroyed, leaving anecdotal explanations for the decisions. The addition of supervision is believed to have occurred to achieve consistency with dental hygiene, as the team relationships in the SDS for dental therapists and dentists did not change. Dental therapists still worked autonomously without a dentist on site and referred children to dentists when their needs were beyond their scope. The addition of the "duty" of chairside assisting was also for consistency with dental hygiene, as the training did not alter to include this skill; there was also a view that unemployed dental therapists would then be enabled to work as dental chairside assistants.

The removal of permanent teeth extractions occurred on the basis that need among children had been reduced and providing appropriate experience during training was problematic. Dental therapists were outraged by this as, overnight, people with existing experience (some up to 18 years) and competency in this skill were no longer allowed to perform this procedure. Dental therapists and others have spent the intervening years advocating for the restoration of extraction of permanent teeth to their scope of practice. NSW is alone in being the only Australian state to have retained this skill in dental therapists' scope of practice. Training for the application of stainless steel crowns was not offered for almost another 10 years in Victoria and was contentious in other states, although it is now a standard part of undergraduate preparation in most courses.

In 1993, the NHMRC, whose role was to advise the Australian community on the achievement and maintenance of the highest practicable standards of individual

and public health and to foster research to improve these standards, invited an expert panel to advise on the impact of change in oral health status on dental education, workforce, practices and standards in Australia. This work was situated amid the work of the National Health Strategy (**Dooland, 1992**) and two other NHMRC panels reporting on "Oral Health Care for Older Adults" and "Provision of Dental Services to Disadvantaged Adults."

The four-member panel took 35 public submissions (summarized in the appendixes) and used key research from Australian Institute of Health and Welfare (AIHW) Dental Statistics and Research Unit (DSRU) on changes in oral health status, dental workforce and service data for Australia. Dental disease was found to be diminishing in many, but not all, children but remained high among adults and the aging. The report describes projected caries needs and noted that there was not enough information available on periodontal needs.

The panel made wide-ranging commentary and recommendations across dentistry; however, the discussion here will be limited to the comments relating to dental therapy practice. The panel recognized the contribution dental therapists and dental hygienists made to the provision of dental services and suggested that discussion should occur regarding the establishment of a new combined dental therapist/hygienist auxiliary for all ages to create an opportunity for flexible approaches to occupational distribution. It reported that there was fragmentation of education of dental personnel and that dental therapists, hygienists and dental technicians tend not to work as part of the dental team. Despite the improvement in children's oral health, there remained a need for diagnostic and preventive services; there was also pressure for expansion into areas such as orthodontics.

The panel noted a policy vacuum with regard to dental auxiliaries and asserted that decisions about the number and type of auxiliary personnel would need active intervention if they were to feature strongly in the long-term delivery of dental services. There was most likely to be an increase in the requirement for some auxiliaries, notably dental hygienists, to work in aged, orthodontic and periodontic specialist care, and the panel supported an expansion of dental hygienist numbers in practice. It also gave support to the continued involvement of an auxiliary such as the dental therapist rather than a dentist in the delivery of basic dental services to children.

Recommendations included the need to maintain workforce data collection that includes dental therapists, hygienists and technicians. Any changes in dental care for children needed to address oral health promotion and treatment. There was a need for a national level discussion and agreement on the level of qualification, portability of credentials and articulation among dental auxiliaries. Research should be sponsored on the role and impact of dental auxiliaries, in particular the "extent to which each auxiliary might, under supervision and in relation to specific

services, compliment or substitute for a dentist..." (**National Health and Medical Research Council (HMRC), 1993**). This report was criticized at the time by public sector dental providers for lacking appropriate support and vision for the use of dental therapists.

In 1993, Atkinson, acknowledging that the attitudes of dentists to dental therapists would have a major bearing on their future role, examined the knowledge that dentists in Victoria had of dental therapists' skills and their attitudes toward current and future use of their skills. She noted that the current president of the Australian Dental Association, Victorian Branch (ADAVB), reflecting ADA policy in a number of editorials, had recommended that their training should cease, that those still remaining be retrained as dental hygienists, and that clinical treatment usually undertaken by dental therapists should henceforth be provided by dentists (**Australian Dental Association, Victorian Branch (ADAVB), 1992**). Data were collected by self-completed questionnaires from a stratified random sample of 200 dentists (taken from the telephone book; the response rate was 59 percent, of whom 77 percent were private and 9 percent public practicing dentists.

Findings showed that only 13 percent of dentists had contact with a dental therapist previously and only 4 percent correctly identified the complete range of duties of a dental therapist from a combined list of dental therapist's and hygienist's skills; however, many identified aspects within the full range of services. Dentists surveyed felt that dental therapists should perform educative, preventive and clinical roles in public health, and 75 percent felt they could provide services for preschool and disabled children (56 percent) and in community health clinics (42 percent) for geriatric services; 43 percent felt they could be used in private practices (**Atkinson, 1993**). This study showed that dentists' contact with dental therapists was poor and that their knowledge of dental therapy practice was not comprehensive, but that there was support among practicing dentists in Victoria for wider use of their skills.

EDUCATIONAL DEVELOPMENTS IN THE 1990S

In 1993 in Victoria, the state Department of Health determined that its role in a range of tertiary training programs was no longer appropriate and that these programs should be delivered in tertiary education settings. This decision meant that consideration had to be given to the future of the Dental Therapy School. This began a sequence of events that was to generate significant change locally and nationally in the education of dental therapists over the next 10 years.

The original Victorian Dental Therapy School program had been retrospectively accredited at Diploma level in 1988 by the Victorian Post-Secondary Accreditation Board, with recommendation that it be transferred to an appropriate tertiary

institution in the longer term. A departmental workforce review was established following a request from then-dean of the University of Melbourne, professor Pennington, to define the training needs into the future, which was to inform a decision by the department about which institution should auspice the course (**Department of Health and Community Services (DHCS), 1993**). Expressions of interest were subsequently called for and responded to by Royal Melbourne Institute of Technology (Dental Assistant and Technician Training Department), La Trobe University (Health Sciences Faculty) and the University of Melbourne (Dental School).

In 1994, the ADA, which had long opposed the role of dental therapists (**ADAVB, 1994**), applied political pressure to discontinue dental therapist training and initiate dental hygienist training. The government agreed, under pressure from the ADAVB, to initiate a Ministerial Dental Auxiliary Workforce Review focused on the workforce profile and skills of dental auxiliaries and the future treatment and workforce needs of the Victorian population. The role of dentists was not included in this review. The review was chaired by the Parliamentary Secretary to the Minister for Health, Robert Doyle, and included representatives of several stakeholder groups on the review panel, for the first time including a dental therapist and a dental hygienist among the nine-member panel.

The panel heard presentations from the Dental Statistics and Research Unit on dental disease patterns and trends and took submissions from interested agencies, organizations and individuals. Essentially, the Health Department, which had been delivering School Dental Services and the Dental Therapy Association, argued for the continuation of dental therapists' role and expansion into adult populations (**VDTA, 1995; DHCS, 1994**). The ADA argued for the cessation of their training and establishment of training locally for dental hygienists (**ADAVB, 1994**). The review reported in March 1995 and recommended that dental therapists should continue to work with children and that a pilot program should be initiated to examine the feasibility of auxiliaries offering dental services to adult health card holders. It further recommended that "a new category of dental auxiliary should be introduced within Victoria effectively combining and replacing the categories of dental therapist and hygienist …" and that appropriate tertiary training for this role should be carried out in a university (**DHCS, 1995a**).

A new course was subsequently developed at the University of Melbourne following the School of Dental Science's successful bid to auspice the existing dental therapy program. A transition working party was established in 1995 comprising Health Department, Dental Therapy School, Dental Board and Dental Therapy and Hygiene professional association members. The ADA Victoria Branch was invited but declined on the basis that it did "not support a course that will produce an auxiliary with the combined skills of a dental therapist and dental hygienist…."

The report describes the structure and content of the two-year diploma with a common first year and separate second-year streams in either dental therapy or dental hygiene, with the ability to add the other stream with additional training, entry, selection and registration (**DHCS, 1995b**). In 1996, the first students were admitted to undertake the Diploma in Oral Health Therapy in either dental therapy or dental hygiene, in the first-ever program in Australia to situate dental hygiene and dental therapy alongside dentistry education in a university setting. Graduates could add the other auxiliary skills by undertaking a one-year, fee-paying program with lateral entry into the second year of the diploma program and graduate with two Diplomas in Oral Health Therapy, thus meeting the DAWR recommendation for combined skills, while continuing to allow specialization in either category.

At a similar time in NSW, the Westmead College of Dental Therapy, the last remaining dental therapy program still operating in NSW, finally achieved diploma-level accreditation for its government-sponsored course (**Currie, in Tsang, 2010**). By this time, the first dental therapy training school established in Tasmania had closed (in 1989) after producing 288 dental therapists over 23 years (**Merhulik, 1993**); the dental therapy program in Adelaide had been auspiced by the University of Adelaide (**Miller, in Tsang, 2010**); and the Western Australian Dental Therapy School had closed in 1983 and moved to the Curtin Institute of Technology as a diploma program, prior to being phased out in 1995 (**Nevin, Raheb, in Tsang, 2010**).

This was the result of a ministerial review of dental workforce training and numbers that had determined that changing patterns of dental disease and demographics in Western Australia meant that the type of dental auxiliary required to meet future needs was the dental hygienist, and that restorative skills were not required. In accordance with the review recommendations, the associate diploma in dental therapy was phased out and the associate degree in dental hygiene was established. To meet the small ongoing need for dental therapy skills in the School Dental Service, the review recommended that additional training after the dental hygiene qualification could be achieved with the completion of a graduate certificate in dental therapy (**Neesham, 1994; Nevin, Raheb, in Tsang, 2010**). This program was established in 1995 and could not meet the demand for school dental therapists from the SDS. In 2000, an associate degree in dental therapy was established at Curtin University of Technology alongside its dental hygiene course, with clinical training remaining the province of the WA School Dental Service (**Nevin, Raheb, in Tsang, 2010**).

In 1994, amid pressures to formalize the dental therapy qualification into a bachelor's degree program, the Yeronga School in Queensland was the subject of a review on the future of education and training of school dental therapists (**Wright, 1995**). The Wright Review produced recommendations that the training of dental therapy and dental hygiene ought to be combined to produce oral

health therapists who would also have preparation in oral health promotion. The University of Queensland and the Queensland University of Technology formed a consortium to deliver the program using their specialties of dentistry and public health, respectively, with the first intake in 1998 (**Seymour, in Tsang, 2010**).

Visser and Straker measured the discomfort of dental therapists and dental assistants at work in WA in 1994, finding that the stresses of providing dental services manifested in musculoskeletal problems in the back, neck and shoulders, and that problems were greater for dental therapists than dental assistants (**Visser, Straker 1994**).

A number of studies during this period evaluated the fissure sealants applied by dental therapists and found the retention rates to be equivalent to those applied by dentists and hygienists using contemporary materials and techniques (**Arrow, Riordan, 1995; Brearley Messer, Calache, Morgan, 1997; Manton, 1992**).

Barnard (**1966**) reported that the 200 dental therapists employed in NSW had been "the backbone of the School Dental Services" and that recently their services had reached more children than the NSW "Save Our Kids Smiles" program. SOKS had moved from universally provided care to screening and triage services in all schools and referral for treatment for those in greatest need. He predicted that their numbers would not increase in the SDS but that recent proposals, if approved, would allow them to also work in private dental practices and provide services to adults in both sectors.

THE AUSTRALIAN HEALTH MINISTERS ADVISORY COUNCIL'S ADULT SCOPE AGENDA

At the Commonwealth level, in 1994, government representatives on the National Community Services and Health Industry Training Advisory Board facilitated a national meeting of directors of state public health dental programs. The meeting considered the skill and training issues influencing the delivery of quality, and cost effective and accessible public dental services. The following issues were identified:

1. Despite the introduction of the Commonwealth Dental Health Program (CDHP), a growing proportion of the population including groups generally regarded as disadvantaged were not receiving adequate dental care. High costs were considered to be limiting access to dental services for many public sector clients, especially from rural, remote and dispersed communities.
2. There was difficulty experienced in attracting dentists to work in the public sector and, in particular, to areas with high numbers of disadvantaged people most at risk of dental diseases.

3. Dentists, whose training equipped them with competencies to undertake complex functions, were spending a significant amount of time undertaking low-level technology functions.
4. Inflexible work structures in public dental teams prevented some team members from fully using the skills they possessed and there was a need to minimize costs through maximal use of auxiliary skills.

The dental directors concluded that it was imperative to explore the concept of translating the successful use of dental therapists and dental hygienists to develop a new auxiliary to meet the needs of the public sector. They developed a proposal to put to the Australian Health Ministers Advisory Council (AHMAC) to establish a pilot program. The program was to test whether a dental auxiliary with additional training could provide a specified range of dental care services to adults in a more cost-effective manner while maintaining standards of care consistent with existing service provision. The proposal was accepted by AHMAC in 1995 and jointly funded by both AHMAC and state and territory Health Departments (**Australian Health Minister's Advisory Council (AHMAC), 1996**).

The project commenced in March 1996, with the appointment of one of the public dental directors as chair and a project management committee with membership drawn from the various dental professional associations, representatives of the State Dental Directors Group, the Australian Council of Trade Unions and the NCHITAB. There were three parts to the project:

1. To undertake consultation in order to develop options for roles and training.
2. To train for and trial the role (with Victoria and NSW as pilot sites).
3. To evaluate and report on the project (**AHMAC, 1996**).

From the outset, the project was vigorously opposed by organized dentists (the Australian Dental Association—ADA), which ran media and advocacy campaigns designed to prevent its implementation.[2, 3] Their members wrote letters to parliamentarians (**ADAVB, 1996**) and directly to members of the project

2 For example, "Non-dentists to treat poor patients," by Helen Carter, Herald Sun, Feb. 19, 1997; "Should non-dentists be used as a cost cutting measure to provide [dental] treatment to the disadvantaged? Patients could die if the role of dental therapists was extended, dentists claimed yesterday; Death fear in dental row," by Helen Carter, Herald Sun, Feb. 20, 1997; "Pull the other one", editorial comment, Herald Sun, Feb. 20, 1997.

3 Sample rhetoric: "The use of this mini-dentist poses a more serious threat to dentistry and the dental health of the public than the partial denture issue ever did," from the ADAVB Newsletter, March 1996; "This is an assault on one of the pillars of our profession and we have to maintain a steadfast resistance to any move that has the potential of undermining the quality of care for the people of Victoria … the Association wonders why the Minister is listening to non-practicing dentists and bureaucrats who do not understand the clinical shortcomings of the proposed program,"from the ADAVB Newsletter, April 1996; "The Branch believes that there is absolutely no need to have a pilot project to test the obvious (people don't put their hands in a flame to see if it will burn). Unless of course there is another agenda…. The idea of using dental therapists who don't know what they don't know for initial patient contact is a sham," in the ADAVB newsletter, February 1996 (Vol. 42, No. 7).

management committee[4] and their advocates spoke publicly against the program, sometimes using less than accurate language.[5] In September 1996, a project officer was appointed to develop the pilot program, after arguments from the ADA that it should not be an ex-dental therapist from within the staff of AHMAC (**ADA, 1996**). In March 1997, an options paper dealing with the first stage, the competencies required and training options was produced. Five options were proposed to meet the identified needs:

1. Dental therapy for adults – direct translation of skill set to adults – dentist to examine and prescribe care.
2. Dental therapy + minimal dental hygiene – consultation and referral to a dentist where required, scaling but not root planning, no emergency care.
3. Combined dental therapy and hygiene with consultation and referral to a dentist where required.
4. Dental hygiene + modified dental therapy – dentist to examine and prescribe care, no extractions or cavity preparation.
5. Oral health promotion; dental therapy + dental hygiene – dentist to examine and prescribe care, increased emphasis on oral health promotion and integrated primary health care role (**AHMAC, 1997**).

The ADA criticized the project for lack of consultation and for taking "shortcuts driven by some sort of cost-cutting agenda…" (**Australian Dental Association (ADA), 1997**). By June 1997, the project had stalled, overtly for lack of recurrent funding (**ADA, 1997**), and was relegated to inactive status on the AHMAC agenda.

In November 1997, following the withdrawal of federal funding of the Commonwealth Dental Health Program, a review of the Tasmanian Dental Services was commissioned to consider the delivery of dental services in the state "in the context of national best practice." The authors noted that in 1997, Tasmanian 12-year-old children had an average DMFT of 0.87 and that more than 55 percent of children under age 12 were caries-free. However, the review noted that there were very significant challenges in meeting the needs of the adult population. This review recommended that legislation be amended to allow for the practice of dental hygienists in Tasmania, dental therapists in the private sector

4 Letter from Anne-Marie Vincent, president of the ADAVB, to Sue Loftes, ADTA representative to the AHMAC Pilot Project PMC, outlining the ADA's objections to the project, October 1996.

5 For example, an ADAVB Media Release dated Feb. 18, 1997, titled "Experimental Dental Program," stated, "An experiment will commence shortly to provide … as little as 19 hours training for non-dentists to undertake injections, fillings, tooth extractions…. In the trial pensioners, unemployed, low income earners will serve as guinea pigs for an experimental dental care program not seen before in developed countries…." See also the ADTA president's letter to ADTA members, November 1996.

and the introduction of a new "combined" dental auxiliary[6] to the public sector to provide treatment to adults (**Dever, 1997**).

To this end, in 1999 an amendment was made to the School Dental Therapy Service Act 1965 to create the conditions under which a dental therapist could provide services to people over the age of 16 years and to allow for the provision of additional training of dental therapists to enable a trial (**Government of Tasmania, Dental Amendment Regulations, 2000**). This came to be referred to as "the adult trial legislation." The trial was to test the use of dental therapists with adults in an effort to address adult public sector waiting lists as recommended by the Dever review (**Dever, 1997**). Under this legislation, dental therapists working under the direct supervision of a dentist could provide services prescribed or directed by a dentist. This legislation was to expire five years after its commencement. This legislation had been developed under contested conditions.[7] Dental therapists in Tasmania had not previously been required to work in this prescribed way. They had practiced under the School Dental Therapy Services Act 1965, which did not prescribe the relationship between a dental therapist and a dentist, nor a scope of practice for dental therapists. In fact, school dental service procedural policies had specifically instructed dentists not to interfere with the diagnosis and treatment planning of dental therapists, and had always allowed dental therapists to practice within the range of their training (**Tasmanian School Dental Service, 1965**). Dental therapists were unhappy with the demand for supervision and prescription under the "Adult Trial" amendments, while dentists were unhappy with the concept of dental therapists treating adults (**ADA TB, 1998**). To date, this trial has not been held, although the competencies required by dental therapists to provide adult services were identified, a project officer appointed, and a business case developed to invite tenders for the training portion of the project (**ADA TB, 2000**).

Slade, Spencer, Davies and Burrow (**1996**) examined the intra-oral caries patterns among a sample (n=9690) of 5-to-15-year-old children in South Australia. They found that deciduous tooth caries was more heterogeneous, while permanent tooth caries was largely confined to the pits and fissures of molars. They concluded that there was support for the continued provision of public sector preventive services for deciduous teeth and fissure sealants in permanent teeth.

6 "Legislation will be amended to enable the introduction of a dental auxiliary who combined the skills of a dental hygienist and a dental therapist. The auxiliary will only be able to practice in the public sector, on prescription and under the direct supervision of a registered dentist when treating patients 16 years and over." J.G. Dever (1997), Review of Publicly Funded Dental Services in Tasmania, November 1997. Dever was the director of Westmead Hospital Dental Clinical School in Sydney.

7 "Under plans presented to the Tasmanian Government, it is proposed that adults seeking dental care in the public sector will be treated by non-dentists in a callous disregard for the high dental standards enjoyed by the rest of the Australian community … described by [the federal] President of the ADA as "a brave but foolhardy experiment on the disadvantaged members of our community…" [and by the executive director of the ADA as a] "bizarre attempt at providing what will be second class dental treatment … in a misguided attempt to save money"… [and by] the president of the Tasmanian Branch of the ADA … who says he is "shocked to learn that the government would actually contemplate such a measure" (ADA TB, 1998).

A South Australian study conducted in 1996 comparing care provided by the private and public sectors,] found that children's oral health outcomes were better when they had received their dental care from the School Dental Service, where the majority of care is provided by dental therapists with off-site supervision. This Master of Public Health thesis reports a three-stage cross-sectional study over 18 months, completed in September 1994, describing the effects of sociodemographic characteristics of children and their choice of dental provider. There were 1,521 children in three groups in the study who received clinical examinations—those who had dental care through school dental services (SDS), that is, dental therapist care; private practices, that is, dentist-provided care; and a combination of SDS and private practices.

Analysis of data collected during this study showed that children treated by the SDS had better oral health than those seen by private dentists after controlling for sociodemographic characteristics. The number of filled surfaces were greater among the privately treated group (mean 1.93) compared with SDS (mean 1.36) and mixed (mean 0.92). Preventive measures (fissure sealants) were found to be higher among SDS children. The social disadvantages of SDS children did not exert a negative effect on their oral health outcomes. The findings may be regarded as an extremely positive indicator of performance of the SDS in South Australia and were the source of papers published in the peer reviewed literature by Gaugwhin et al. in 1999 and Brennan et al. in 2001 (**Gaughwin, Brennan, Spencer, Moss, 1996**).

REGULATION REVIEWS, 1990S-2005

Regulatory frameworks remained fairly stable until the reviews initiated by the federal government arising out of the application of the National Competition Policy in 1995. This policy agenda was driven at national level to encourage competition and the creation of a "level playing field" to better fit Australia into a global economy. Its application meant the simulation of a market for health to reduce the barriers to effective competition, such as monopolistic behaviors to stimulate more cost-effective outputs and amendments to the Trade Practices Act, including its application to the previously exempt health sector (**Millsteed, 1996**). In April 1995, at a meeting of the Council of Australian Governments (COAG), all states and territories agreed to unilaterally apply National Competition Policy to all areas of industry, including the health sector. As part of this agenda, the Industry Commission carried out a study of several professions and identified the restrictions in the various states' Dentists Acts as potentially anti-competitive. In particular, these were the restrictions applied to dental auxiliaries (numbers, limited duties and supervision) and the ownership and advertising restrictions (**Industry Commission, 1995**). As a result, each state and territory undertook a review of its dental legislation, generating the most significant changes seen in this area since the initiation of practice, with Victoria and Tasmania among the first to begin.

Millsteed (**1996**), in a study of the costs of anticompetitive behavior in the Australian dental industry, found that the 10 most commonly provided dental services to eligible veterans in 1993-94, comprising 60.09 percent of all dental services for that financial year, were treatment services and procedures currently being provided by dental therapists to primary and secondary school students in Australia. She made two estimates of the potential to make dental expenditure savings. The first was based on direct substitution of dental therapists for dentists in appropriate areas (public and private practices), showing a $238 million (Australian Dollars) saving representing 14.2 percent of recurrent national expenditure on dental services in 1992-93. The second model involved only the private sector and was calculated using Commonwealth Dental Health Program service data, showing that total CDHP service costs could be reduced by 19 percent or the equivalent of $223 million nationally. Spencer and colleagues (**1994**) found that the predominant work effort by general dental practitioners was of low to medium technology level, further confirming that dental therapists could be used in the provision of lower-cost basic dental procedures for wider client groups (**Millsteed, 1996**).

With regard to preschool services, she found that because of the restrictions on employment of dental therapists limited to working in the School Dental Service, Victorian local government Preschool Dental Programs had employed dentists to deliver their services. Of the 34,565 services provided to Victorian preschool children under this scheme in 1993-94 using fully qualified dentists, 60 percent were educative, 28 percent were diagnostic, and 8 percent restorative—most of which could have been delivered by a dental therapist at much lower cost. Analysis on the basis of salaries alone showed that costs were inappropriately high as a result of using dentists to deliver these low-technology dental services to preschool children. Under the Victorian Preschool Dental scheme in 1993-94, the average cost of a course of care was $265 (Australian Dollars); in South Australia, where dental therapists were used to provide these services, the average course of care cost $52.49 (Australian Dollars) (**Millsteed, 1996**).

Millsteed argued that the full application of the federal government's National Competition Policy ought to be made to the dental industry. Her study used Commonwealth Dental Health Program (CDHP) data to show that the use of dental therapists' services as substitutes for dentists' services could have resulted in national program savings of 19 percent over the four CDHP funding years—that is, about $53.83 million (Australian Dollars). She concluded that barriers to both horizontal competition, which limits the practice of dentistry to dental practitioners, and vertical competition, which prevents competition among dental practitioners by limiting aspects of dental practice to certain providers within the dental professions, required examination. She found that horizontal barriers to competition between professions are largely self-regulatory, whereas vertical barriers within professional areas are generally legislative in nature. Both imposed significant costs on the community in relation to its access to dental

services. Her view was that dentists had sought to maintain these barriers to protect their monopoly over the dental market, using quality-of-care arguments without empirical basis. Their control of regulatory procedures made it difficult for dental auxiliary professions to operate independently and competitively, and there had been a historical and collective resistance by the dental profession to reform (**Millsteed, 1996**).

In 1996, Lewis published her Ph.D. dissertation, which had examined the dental industry within a policy framework to understand why, in the face of considerable inequity in access to services and disease patterns, governments had been unable to change the service delivery models to improve public dental care. She, like Millsteed, found that challenges to the established service delivery methods and division of labor in dentistry were defended by broad and legitimized modes of governance and the interlocking set of interests and institutions in dentistry. She noted that the greatest opposition from the dentists had been experienced by those groups that compete with diagnosis and prescription of care—for example, dental therapists. She concluded that dentists had successfully maintained separation from the rest of health care in order to establish their dominance over the other, mostly female, dental occupational groups, the decision-making regarding the directions of dentistry, and the retention of their professional autonomy within the health system (**Lewis, 1996**).

Riordan's paper (**1997**) on the organization of dental care for children drew together existing evidence to address the issue of cost-effectiveness of dental therapists and their substitution for dentists as primary providers of services. He noted that the needs of child populations for dental care were mostly low to medium technology and that dental therapists were better and more cost-effective providers of care. He, too, argued that the most consistent barrier to the use of dental auxiliaries is dentists; that the outcomes of dental therapist care, as measured by caries experience and numbers of treated patients, were equivalent to or better than European dentist-based services and less costly.

Baltutis and Morgan (**1998**) endorsed this view in their paper published in the Australian Dental Journal, which reviewed dental disease patterns, service delivery, legislation, and the productivity and quality assurance issues around the contemporary use of dental therapists and hygienists. They argued that dentists should be focused more on high technology and complex procedures and allow dental therapists and hygienists to provide the low to medium technology services. They presented evidence to show that they could provide services at lower cost and equivalent quality to dentists, and in many cases higher quality in the lower technology services. Increases in productivity from 30 percent to 80 percent could be achieved with the addition of a dental auxiliary to an existing team. The delivery of preventive services can be increased and patient acceptance can be increased with dentist acceptance, and patients were willing to accept

more delegated procedures than dentists were willing to delegate. They argued for appropriate professional agreed standards of training, integrated with dentists' training and with accreditation and mutual recognition of qualifications between jurisdictions, appropriate salaries and career structures, so that skilled team members are recruited and remain in the workforce. The authors concluded that the challenges ahead lay in developing collaborative approaches so that all the skills available in a dental team were effectively used (**Baltutis, Morgan, 1998**).

In May 1998, the Australian Senate published its Community Affairs Reference Committee Report on Public Dental Services. This inquiry had been initiated through the considerable debate within the Senate over the Commonwealth budget process decision to cease funding for the Commonwealth Dental Health Program in 1996. The committee made recommendations for a dental intern program to assist with delivery of oral health services to people in rural and remote areas, and for programs to promote oral health in public and private settings to be developed. They also made a recommendation that the use of dental therapists and hygienists be expanded to cater to the needs of disadvantaged groups, that the states and territories should review their legislation restricting the employment of these practitioners, and that national oral health policy should prioritize oral health care reform, with an emphasis on preventive dentistry (**Senate Community Affairs Reference Committee, 1998**).

The Victorian provider of School Dental Services undertook a study of recruitment and retention issues for public sector dental practitioners in 1999. The findings relating to dental therapists were that, while they had great pride and satisfaction in the work they did, they were dissatisfied with their chosen careers because they felt substantially underpaid for the work they did. They felt trapped in their roles because of the limits on their employment to School Dental Services only, and felt that this limitation maintained the poor salaries and the lack of opportunity available to them. Inadequate career pathways and low professional status and profile also contributed to their dissatisfaction (**Dental Health Services, Victoria (DHSV), 1999**).

In Victoria, the state government formally announced its intention to review the Dentists and Dental Technicians Acts of 1972 in June 1997 and published a discussion paper to inform the debate in December 1997. Key stakeholders in the review process included the professional associations, public dental sector advocates and the regulatory Dental Board of Victoria. The dentists association (ADAVB) and the dental board made similar arguments that the status quo should be retained, while the public sector dental providers (DHSV) and the dental therapists association (VDTA) argued to reduce regulatory restrictions to allow broader use of dental therapists and hygienists (**Satur, 2002**).

A study carried out by the Victorian Dental Therapist Association (VDTA) in 1998, published in their submission to the review, using service data retrieved from insurance rebated services in private practices, estimated that regulatory restrictions could cost existing Victorian consumers of dental services somewhere between $10 million and $30 million per year. The VDTA argued that removing the employment and client group restrictions on dental therapists could lead to significant price falls for consumers and improved access to dental care, particularly for people on low incomes or those facing physical or geographical barriers to dental care. Reducing the cost of dental care could lead to an increase in preventive dental care through encouraging demand for price-sensitive services such as oral examinations or preventive services. These extra consultations would significantly improve the oral health status of the Victorian community. Reduced prices for dental care would mean engagement with a wider market because more people could get regular care. For people with limited amounts to spend on dental care, reduced prices would mean more services for the same spending, which would increase their access to preventive services. Increased capacity to access preventive services would result in better oral health status across the whole population in the long term (**VDTA, 1998**). They also argued that employment limits on their practice should be removed, that scope of practice should be defined by education, that direction and supervision should be replaced by words that respected their autonomy and skills, that registration and protection of title should be applied in legislation, that age limits of their patients should be removed, that they should be able to own practices, and that they should be able to participate in regulatory processes through representative roles on the Board (**VDTA, 1998**).

The ADA submission argued that only dentists should be allowed to own practices and sit on the dental boards. They opposed the unrestricted entry of "tooth cutting" auxiliaries into the market, sought the cessation of training of dental therapists and their conversion to dental hygienists, and opposed moves of dental therapists into adult practice and the creation of a "hybrid" or combined auxiliary. They argued to retain direction, supervision and control of auxiliaries by dentists and limits on numbers of operatives to prevent over-servicing (**ADAVB, 1998**).

Victoria was the first state to complete the process of legislation review and provided somewhat of a model for the others in terms of advocacy, but was more liberal in its application of the competition policy than some. Each state and territory reviewed its regulation in a similar fashion, with Tasmania, South Australia, Queensland and New South Wales passing new Dental Practice Acts in 2001. The Northern Territory and Australian Capital Territory passed omnibus legislation across their health sector with dental schedules in 2004, and Western Australia did not complete their review, although a dental bill was presented in Parliament in 2005 but was so contested that they remained governed by the Dental Act of 1939. The outcomes, in short, were that the new legislation governing dentistry included provision for the registration and protection of title

for dental therapists and hygienists and were established in combined Dental Practice Acts that regulated all dental providers (dentists, specialists, prosthetists, dental therapists and hygienists). The use of sanctions for unprofessional conduct applied equally to all registered under the new act, and professional indemnity insurance and continuing professional development requirements were put in place for all. Limits on practice ownership were also removed in some states. The Victorian Act also included, as an objective, the need to promote the community's access to dental care and contained a new offense: directing a person to provide dental services in a manner detrimental to patient welfare (**State Government of Victoria, Dental Practice Act 1999**). The limits on dental therapists' employment were removed, but they must continue to work in a team with a dentist; scope of practice was covered in subordinate regulation and was the subject of contested processes that were not to be completed for another two years.

These review processes were highly contested with many submissions written and published. Many of the arguments have parallels across each of the state and territory reviews, and fairly similar outcomes in broad terms. In Australia, following the legislation reviews, all states established mixed membership dental practitioner boards including membership from all the dental practitioner groups and consumers. Only Victoria and South Australia removed dentists' numerical dominance of the board (**Dental Practice Act Victoria, 1999; Dental Act South Australia, 2002**). While this seems a small change, the potential for wider reform of the industry has been created because a broader range of views now permeate the regulatory environment. The limitations, however, are that dentists still hold more seats on both boards than any other group, and the market-based model of service delivery was unchanged.

Tasmania produced the most liberal regulatory model that treated dental therapists and hygienists in the same way as dentists in regulation. They could practice independently and own their own practices as long as they established a documented agreement with a dentist to provide consultation and referral when required, and they were to practice in a scope that was defined by their educational preparation, competency and recent practice. There was no defined list of "duties"' or services (**Dental Board of Tasmania, 2001**). The NSW Dental Act was the only one to continue to limit dental therapists practice to the public sector following the reviews; in every other part of Australia they could work in both private and public practice settings.

The process and outcomes of these dental regulation reviews and their impact on access to care provided by dental therapists was the subject of doctoral research undertaken by Satur (**2002**). This study found that the regulation of dental therapists and hygienists was greater than that applied to dentists and other health professions, resulting in less flexible utilization of their skills. This study set out to investigate the process and outcomes of policy-making around dental auxiliary

practice in Victoria, interstate and internationally with a focus on the potential to increase access to dental care. The study examined the dental policy development process associated with the Review of the Dentists Act 1972 and the Dental Technicians Act of 1972 in Victoria. The associated legislative and regulatory dental policy reforms in the other states in Australia were tracked and variance assessed.

Finally, a comparative analysis of dental regulation in Australia and selected overseas countries was undertaken in relation to dental auxiliary practice. The study found that dental policy-making was dominated by the views of private-practice dentists under elitist models that largely protect dentist authority, autonomy and sovereignty. The influence of dentist professional dominance meant that governments have been reluctant to make sweeping changes. The study demonstrated alternative models of regulation for dental therapists and hygienists, which would allow wider use of their skills, more effective use of public sector funding, increased access to services and a greater focus on preventive care. In the light of these outcomes, the author concluded that there was a need to continue to advocate for changes that would increase the public health focus of oral health care.

Considerable policy activity followed the cessation of the CDHP, resulting in the organization of advocacy efforts. Lewis described the political activity in her paper, published in 2000, that recognized the efforts and alliances of "equal health advocates" around dentistry. This work generated a momentum that remains today around achieving better access to dental care for all Australians. Spencer, in work carried out for the Australian Health Policy Institute, published a paper titled, "What options do we have for organizing, providing and funding better public dental care?" It described the high levels of oral health and access to care for children in Australia, contrasted against the poor access many adults have to care. He noted the opportunity to increase the role of dental therapists in the provision of services and to develop the oral health therapist role (**Spencer, 2001**). This work, and the subsequent establishment of the National Advisory Committee on Oral Health (NACOH) as a subcommittee of AHMAC, led to the publication of the report, "National Planning for Oral Health Improvement" (2002). This document, which identified a growth in demand for dental services of 25 percent by 2010, contributed to progress toward developing a National Oral Health Plan, which will be discussed later (**AHMAC, 2002**).

In parallel with this national activity, the states and territories were embroiled in debate around the subordinate legislation governing dental therapist and hygienist practice (**NSW DTA 2000; VDTA, 2001; NSW, 2002; Lennon, 2004; Barker, 2006; Barker, 2008**). Tasmania had established a code of practice that covered all dental practitioners, generically treating its dental therapists the same as its dentists in terms of autonomy, and allowing sanctions for unprofessional conduct to deal with breaches of scope (**DBT, 2001**). In Victoria, the first codes of practice promulgated for dental therapists and hygienists removed the words "supervision, direction

and control" and replaced them with the requirement to work in a "consultative and referral relationship with a dentist" that had to be documented, but retaining the dentist as clinical team leader. The age limit of patients was extended to 18, and from 18 to 25, treatment could be provided on prescription of a dentist. In orthodontic practice there was no age limit (**DPBV, 2002**).

The Northern Territory also described the relationship as one of consultation and referral, and retained 18 as the upper age limit of patients unless dental therapists could "satisfy the Board that they have the requisite skills, knowledge, expertise and recent practise to do so...." However, it also removed the age limit for orthodontic practice (**DBNT, 2004**). New South Wales, the only state to have retained the limits on dental therapists' employment, required that they provide care for children under 18 and work under "practice oversight," which allowed autonomous practice on a day-to-day basis (**DB NSW, 2004; 2007**). In Queensland, an external consultant was engaged to inform the process. Supervision of practice was retained. However, the interpretive words stated that dental therapists could practice autonomously with a dentist "available," but for hygienists, prescription of care was required (**Price Waterhouse Coopers, 2000; Dental Board Queensland (DBQ), 2006**). South Australia in 2007 produced subregulation that required supervision of practice in the private sector and allowed autonomous practice in the public sector (**Dental Board South Australia (DBSA), 2007**). The Australian Capital Territory required "professional supervision" of dental therapists practice and a team approach to care, with dental therapists diagnosing and planning their own care within a consultative and referral relationship with a dentist (**Australian Capital Territory Dental Board, 2008**). Western Australia retained its limits and the distinctions between school dental therapists and those working in private practice (**Dental Bill, 2005**). In 2007, NSW removed the limits on employments for dental therapists, finally bringing them into line with the other states and territories and created, for the first time in Australia, a category of registration for oral health therapists (**NSW Center for Oral Health Strategy (NSW COHS), 2008**). In 2009, Victoria removed the requirement for prescribed care for those ages 18 to 25 and allowed dental therapists to diagnose and prescribe their own care autonomously within a documented consultative and referral relationship with a dentist for people up to the age of 25 . The list of skills was removed, with scope of practice to be defined by educational preparation, recent practice and competence (**DPBV, 2007; VDTA, 2007; DPBV, 2009**).

BUILDING ON THE SUCCESSES

The Australian Institute of Health and Welfare (**AIHW, 2000**) reported on the use of dental services by Australian children and adolescents from data collected on about 2,351 children ages 6 to 12 and 1,384 adolescents ages 13 to 16 during 1994-96 via a national telephone survey of their parents. The study showed that Australia-wide, 62 percent of 6-to-12-year-old children visited the school dental service at their last

visit and 38 percent visited a private practitioner with variations across the states. In NSW and Victoria, the SDS visit rates were only 40 percent. Nationally, only 33 percent of 13-to-16-year-olds had visited the SDS, which illustrates the variation arising from eligibility criteria across the jurisdictions. Data were analyzed against socioeconomic status with lower income equating with higher rates of participation. Overall, 5.6 percent of 6-to-12-year-olds had not visited in the previous two years (range 2 percent to 10 percent when analyzed by states); this figure was 9.6 percent for 13-to-16-year-olds (range 5 percent to 12 percent).

A client satisfaction survey carried out in Victoria in 1999 found that 93 percent of children's service users were satisfied with the dental treatment their children had received from the dental therapists and dentists working in the School Dental Service (**Dental Health Services Victoria (DHSV), 2000**).

Desai, Brearley, Messer and Calache (**2001**) examined 150 children aged between 9 and 13 attending special developmental schools in Melbourne. All of these children reported multiple disability or impairment, including learning disability, developmental delay or intellectual disability. Medical conditions were common and 44 percent were on medications, most commonly anti-epileptic therapies. Clinical examinations showed that the mean dmft+DMFT for these 9-to-13-year-old children with disabilities was 2.2, with a mean d+D component of 1.4. When compared to mean d+D of 0.4 in nondisabled 12-year-old children, it was evident that there were higher levels of untreated disease in the 41 percent of children requiring treatment; in addition, 90 percent of children had periodontal conditions requiring scaling, prophylaxis and oral hygiene attention. The authors concluded that, following assessment and treatment planning by a dentist, these children could be treated by trained dental auxiliaries.

In 2001, the NSW Health Department commissioned a series of reviews relating to the delivery of oral health services in that state. Among these was a review of dental education and training to enable the development of a workforce, consistent with the principles of the Higher Education Review (2002) published by the Commonwealth Government and the needs of the community for dental care. At that time, NSW had the lowest practicing ratio of dental therapists to population, 2.6 per 100,000 people, and did not have a dental hygiene training program. Data presented indicate that 63 percent of graduates from the Westmead College of Dental Therapy over the previous 7½ years were still employed as dental therapists, with 78 percent of those employed in NSW. Interestingly, 15 percent of graduates had, through additional studies, become dental hygienists; 5 percent were in full-time higher education, half of those doing dentistry; 4 percent were employed in other parts of the health sector; and 2.5 percent were employed as dental assistants. The review recognized the lack of recognition of qualifications, skill level and career pathways for existing dental auxiliary staff. The review recommended the development of three types of oral health care workers, with opportunities for articulation:

1. Diploma qualified Advanced Dental Assistant (two years part-time vocational)
2. Bachelor's Degree level Primary Oral Health Care worker (Clinical Preventive and Oral Health Promotion over two or three years);
3. Bachelor's Degree level Clinical Oral Health Care Worker (combined Dental Therapy and Hygiene clinician over four years, or No. 2 above, plus one year with credit) (**Coombes, 2002**).

At a similar time in Western Australia, an inquiry was underway to examine the adequacy and availability of dental services in regional, rural and remote Western Australia. The report noted the significant "striking cost effectiveness and ongoing success of the School Dental Service" and attributed much of the decline in dental disease to the preventive activities of the SDS. Cost estimates in 1994 in that state estimated the value of the services delivered per Australian dollar expenditure in real terms was $1.47, and in 2002 was about $2 for every dollar spent. The cost per child in 2000-01 was $65.70, which compared favorably with Scandinavia, where a different system was in place and the cost was estimated to be between $150 and $250 per child (**Martin, 2002**). In Western Australia (and nationally), DMFT among 12-year-old children had decreased from about 4.8 in 1977 to 0.89 in 1999, supporting the strong assertions of the success of these School Dental Programs (**Martin, 2002; Spencer, Armfield, 2008**).

The difficulty in attracting and retaining dental therapists had also become a problem in WA. This was attributed to the salary differences between public and private sectors and the lack of rural salary differentials, as noted by the WA review. The impact was the closing of 11 fixed or mobile clinics in rural and regional areas in 2000, causing disruption to services. Recommendations were that financial and other incentives should be offered to encourage dental therapists (and dentists) to accept regional postings. The review also noted the autonomy with which a school dental therapist practices: "generally the therapist runs the clinic and provides the whole treatment for a child." This led a recommendation that "dental therapists and school dental therapists can perform a wide range of procedures under supervision and following consultation with a dentist; however, in practice, the level of supervision and consultation may be minimal…." (**Martin, 2002**).

Teusner and Spencer (**2003**) from the Australian Research Centre for Population Oral Health published an analysis of their workforce data against community demand for dental services in order to estimate the future capacity of dental practitioners to supply dental visits in Australia. The data showed that dental therapists (98 percent female) in 2000 worked an average of 28.8 hours per week and 43.26 weeks per years, and at that rate had the capacity to supply 1,968.5 patient visits per year, although caution was urged in relation to sample sizes, as some predictions were based on dentist data where profession specific data was not available. They projected that in order to maintain the practicing ratio of 6.6 to 100,000 people and with no change in demand for their services, by 2015 an average

recruitment of 75 dental therapists per year would be required. They predicted the allied dental labor force (dental therapists, hygienists and prosthetists) would supply 13.4 percent of all dental visits, a reduction of 1.7 percent over 2000.

In several states, the perception was that the restrictions on employment of dental therapists, the low salaries, and the poorly recognized educational qualifications were contributing to poor retention and recruitment of dental therapists. Victoria's Department of Health initiated a workforce recruitment and planning report that identified issues of low profile, low salary and poor career structure as both recruitment and retention issues for the public sector that required action to sustain their ability to provide public dental services (**Workforce Planning Unit, Victorian Department of Human Services, 2004**).

In 2004, AHMAC published the National Oral Health Plan, which had been developed by the National Advisory Committee on Oral Health, a committee with membership from state and territory governments, public dental services, dental professional associations, and consumers' education and research settings (**AHMAC, 2004**). The National Oral Health Plan aimed to improve health and well-being across the Australian population by improving oral health status and reducing the burden of oral disease. The plan aimed to help all Australians retain as many of their teeth as possible throughout their lives, have good oral health as part of their general good health, and have access to affordable and quality oral health services. It was adopted by all state and territory governments and the Commonwealth, thereby becoming an agreed framework for the improvement of oral health nationally. It was developed in a context of a federal government that was committed to a policy of no additional funds for public dental services and high levels of unmet need for dental services.

Against a background of evidence, the plan identified seven action areas, five around at-risk populations, and two others, health promotion and workforce. Recommendations included the "use of the full team of oral health care providers [to] achieve effective and efficient use of resources to address oral health promotion and care needs," and that state and territory governments "ensure that regulatory impediments do not impose barriers to the full use of the skills of the whole dental team." It acknowledged the value of school-based dental services (dental therapist-led programs) in contributing to child oral health and advocated strengthening these services to make them more universal and more accessible to preschoolers and adolescents. The plan recommended the wider use of the dental therapist/hygienist workforce to increase the capacity for primary care and maintenance of oral health care and health promotion to enable a more preventive approach to oral health care.

Cane and Butler (**2004**) published a paper that described an NHMRC-funded pilot program to trial a new model of service delivery in the public sector in Tasmania, where dental workforce numbers are low and unmet dental needs are high. The program would pilot the use of clinical teams that combined the skills of the dentist and an expanded role for dual trained dental therapists/dental hygienists in the provision of care to adults. Educational preparation had been planned to deliver the competencies required and the program for delivery was described The plan was controversial but well supported in the public sector.

In her president's column in the Australian Dental and Oral Health Therapists Association Journal, Lennon (**2003**) weighed in on the debates about dental therapists providing care to adults. She claimed that the education, quality of care and preventively oriented practice of dental and oral health therapists would be of benefit to the many adults unable to access dental care. She noted that dental therapists had, over many years, managed children with complex medical conditions responsibly in collaboration with dentists and that these same skills would be applied to all their patients, and that their skills within their scope had been repeatedly shown to be at least equal to that of a dentist. She concluded by hoping "that the portion of ADA intent on denigrating the role of dental therapists looks beyond their own interests and takes into account the unmet need and ongoing suffering of that portion of the population who are unable to access dental care."

In his second paper for the Australian Policy Institute in 2004, Spencer described the social inequality in oral health and proposed some solutions, including revitalizing the School Dental Service, reforming public dental services to more adequately address high-needs individuals and groups, increasing the numbers of dental therapists and dentists to underpin "main street" and public dental services, increase university-educated dental therapists and hygienists to include oral health promotion, and establishing a new level of flexibility to encourage preventively oriented oral health practitioners who could work in nontraditional practice settings such as residential care settings, Aboriginal communities, hostels and detention centers. He noted that many of these suggestions had been included in Australia's National Oral Health Plan and that a recent quote from Mertz and O'Neil (**2002**) also applied in Australia: that the issues are wider than "simply more dentists," and that there was a poor fit between service models, disease patterns and the social issues around people needing care (**Spencer, 2004**).

Kruger and Tennant (**2004**) published the first of a series of papers designed to inform dental workforce planning for rural and remote service delivery. This paper described the rural and remote workforce in Western Australia using a self-completed postal survey. The authors found that, while the majority of rural dentists were male and middle-aged, the majority of dental therapists were female and in their 30s. Both types of practitioner were mostly married with children and trained in Western Australia. The attraction issues for those working in rural and

remote areas were identified as being lifestyle (82 percent), partner's work, the broad scope of work in a rural area and having a rural background (12 percent). For dental therapists, the reasons most likely to make them leave were children's education, better opportunities for employment, and the employment of a partner or spouse (**Kruger, Tennant, 2005**). These findings were similar to those of Hall and colleagues in the Northern Territory, who also identified the value in engaging new staff in the local social networks, as the sense of community was found to be important to managing stress and hence supporting longevity (**Hall et al., 2007**).

In 2004, a self-complete survey was posted to all dental therapists in Western Australia to collect data to describe the workforce characteristics; there were 253 responses. Dental therapists were almost exclusively female (98.8 percent), had an average age of 40 years, and had qualified on average 20 years ago; 27 percent worked in rural areas and 73 percent in urban areas. Of those sampled, 30.8 percent worked in private practices, 23.3 percent in public practices and 27.3 percent in both; almost 10 percent were no longer registered. Flexible working hours, helping others and working with children were the most commonly considered advantages of working in dental therapy, while inadequate pay, poor career and promotion opportunities, and low recognition of position were cited most commonly as disadvantages. Only 37 percent of respondents would recommend dental therapy as a career (**Kruger, Tennant, 2006**). Of the 28 percent who had ceased working as dental therapists (many had retained registration), the reasons cited most often for leaving the profession were family, career change, poor salaries, relocation, illness and injury, and stress. Respondents indicated that the most important issues for retention and recruitment of dental therapists in rural areas were increased salaries, living support and travel assistance, access to continuing education, recruitment of more rural students and more flexible working arrangements such as job sharing (**Kruger, Smith, Tennant, 2007**).

These studies by Kruger and Tennant were timely in terms of a study published by AIHW DSRU indicating that rural children's oral health was worse than their urban counterparts in terms of caries prevalence and experience, and remained so even after controlling for socioeconomic differences (**Australian Institute of Health and Welfare (AIHW), 2006**).

By 2005, an Australian national data collection found that there were 1,760 registered dental therapists in Australia, of which 1,521 or 86.4 percent were practicing. Their average age was 40.7 years, only 2.5 percent were male, and they worked on average 25 hours a week, with 56 percent working part time. Ratios of dental therapists to population were low, with a national average of 7.5 per 100,000 population. Rural and urban distributions differed, with 6.6 per 100,000 people in urban areas, 8.8 in inner regional areas, 10.9 in outer regional areas and 8.1 per 100,000 people in remote areas. Workforce maldistributions are a significant issue for the dental workforce in Australia; however, the distribution

of dental therapists in rural and remote areas was found to be more balanced than any other dental practitioner group (**AIHW, 2008**). This study also showed that in 2005 nationally, about 79 percent of dental therapists worked in the School Dental Service and 21 percent in private practice employment, although this picture has changed in more recent years (**Satur et al., 2009**).

Hopcraft and Sanduja analyzed and reported on the complaints made about dental care providers in Victoria from 2000 to 2004. In that period, of the 490 complaints made against a total of 2,757 registered dental practitioners, only three were about the 213 dental therapists. This represented 0.6 percent of the complaints for 6 percent of the registrants, compared with dentists, who comprise 66 percent of the registrants attracting 75.3 percent of complaints, and prosthetists, with 8.6 percent of registrants and 10.2 percent of the total complaints. Dental hygienists and oral health therapists did not attract any complaints in this time period (**Hopcraft, Saduja, 2006**).

Hopcraft and colleagues also investigated the rate of attendance at Continuing Professional Development (CPD) programs in 2005 from a random sample of 451 dental practitioners. CPD in Victoria had been mandated in regulation and had become a registration requirement in 2005. They found that there was a high level of support for mandatory CPD and participation, with 89 percent of dentists and 83 percent of dental therapists attending courses in 2004. Despite this, more than 50 percent of dentists and specialists, and 66 percent of dental therapists, hygienists and prosthetists, would fail to meet the new mandatory requirements (**Hopcraft, Marks, Manton, 2008**). The mandatory requirement for participation in self-directed CPD is a measure of the significant departure from the early vocational model of training in standardized programs for dental therapists described in the 1960 and 70s.

In 2006, the British dental team magazine Vital published a feature article on dental therapy practice in the Northern Territory, highlighting the valuable outreach work dental therapists were doing in remote Aboriginal Communities as part of the Northern Territory Dental Services (**Craig, 2006**). The NSW state government Legislative Council Standing Committee on Social Issues conducted a review of dental services in NSW, considering 365 submissions, holding eight days of hearings and making visits to assess rural and remote access issues. Their recommendations included the need to improve remuneration for dental practitioners in the public sector, including the award for dental therapists and dental hygienists, and remuneration levels to include recognition of the Bachelor of Oral Health degree from both the University of Newcastle and the University of Sydney. Incentives for oral health practitioners to practice in rural areas were required and a study of the impact of Bachelor of Oral Health graduates on the workforce should be undertaken.

In considering the removal of employment limits for dental therapists in NSW, the committee noted the experience in other states that "broader employment of dental therapists has improved the relationships between dentists and dental therapists as their skills have become more widely understood and trusted. This has led to better team relationships, more collegial approaches to dental policy issues and continuing professional development, and more collaborative approaches across the dental workforce..." (**NSW Legislative Council Standing Committee, 2006**).

In a similar vein, Tasmania's Department of Health commissioned a study to describe the allied and oral health workforce in Tasmania and to identify the interactive effects in their rural communities where practitioners form primary care teams and often work in both public and private sectors. Demographic information, service delivery, job satisfaction, recruitment and retention issues were all explored. This study showed that 31 percent of Tasmania's oral health workforce was planning to retire in the next 10 years, which creates significant issues of recruitment in a state with no dental schools (**Lowe, Keane, Smith, 2009**).

In 2006, the Australian Council of Social Service published a report, "Fair Dental Care for Low Income People," on the state of oral health and dental care needs of low-income people in Australia. They applauded the development of the National Oral Health plan but were critical of the progress in addressing the recommendations by the Commonwealth Government. A strong call for significant increases in funding and services was made and included the need to incorporate "private dentists and other oral health professionals into the provision of public dental care … increasing the utilisation of the dental therapist/hygienist workforce to increase the capacity for primary and maintenance oral health care, including health promotion..." (**Australian Council of Social Service (ACOSS), 2006**).

In 2008, the Commonwealth Government introduced the Teen Dental Plan to augment public dental services provided to adolescents through the private sector. Funding of up $150 (Australian Dollars) per year per person was provided for diagnostic and preventive services provided through private dental practices. Dental therapists and hygienists were able to provide the services on behalf of a dentist; however, the services were to be billed under the dentist's provider number (**Roxon, 2008**). This was the first time dental therapists' work was formally rebated through a private sector scheme.

Victoria had been the first state to remove employment restrictions and enable dental therapists to work in private as well as public practice. A study to examine the roles of dental therapists who worked in non-SDS practices between 2000 and 2006 was undertaken using self-complete questionnaires posted to all practitioners in this setting identified from the DPBV register (approximately

one-third of the total registered). Of the 76 respondents (RR=82 percent), 67 percent worked in urban areas, one-third worked in community health settings, one-third worked in private general practices, and one-third in specialist practices, mostly in orthodontics. Clinical services delivered by dental therapists varied by rural and metropolitan practice location but included high levels of diagnosis, treatment planning and restorations. The findings from this study indicate that there is a demonstrable role for dental therapist services in private practices (**Satur et al., 2009**).

In its 2002 Code of Practice for Dental Therapists and Hygienists, the Dental Practice Board of Victoria (DPBV) encouraged research to evaluate the capacity of dental therapists to provide care to persons over the age of 18 (DPBV 2002). A study was established to assess the capacity of dental therapists to provide direct coronal restorations for patients older than 25 on the prescription of a dentist. The project was carried out at the Melbourne dental hospital, with patients taken from the waiting list for public dental care (only low-income people are eligible). Seven dental therapists, from a range of training backgrounds, placed 356 restorations for 115 patients aged between 26 and 82, as prescribed by dentists. At six months post-treatment, patients were re-examined by dentists blinded to the intervention, finding that of the 258 restorations reviewed, 94.6 percent were successful. Both the patients and the dental therapists were satisfied with the experience, leading the authors to conclude that the standard of restorations placed by the dental therapists was at least that of a newly graduated dentist. This study showed that dental therapists could safely provide care prescribed by a dentist to adults (**Calache et al., 2009**).

In a follow-up study conducted in 2009 to evaluate whether dental therapists could translate their full scope of practice to the provision of care to adult patients, 10 dental therapists completed a short educational program, which resulted in their scope of practice being extended to adult care. The program consisted of 42 hours of lectures, 42 hours of supervised practice and 105 hours of mentored practice. Their practice with adults was assessed by the Dental Practice Board of Victoria using clinical, viva voce and written examinations prior to accreditation for practice. The evaluation of this program demonstrates that dental therapists with additional training can translate their scope of practice to treat adults, offering opportunities to enhance the flexibility of the dental team (**Calache, Hopcraft, 2011**). As an outcome, the age limit for dental therapist patients in Victoria was removed from regulation and this translated across to national regulation in 2010. Today in all states and territories, dental therapists with appropriate training may also provide care for adults, although to date there is only one accredited training program available (**DBA, 2011**).

NATIONAL REGULATION 2010

In 2009, the Commonwealth Government announced the intention to create a National Regulation and Accreditation Scheme. The scheme was to apply to the regulation of nine health professions under a single omnibus Health Practitioner Registration Act that would create nine profession-specific national boards to administer the act with standards applicable to their profession practice areas and a standardized approach to accreditation of health practitioner education programs and the assessment of overseas qualified practitioners. The purpose of this was to standardize approaches to regulation and remove barriers to portability of qualifications, thereby creating greater flexibility in health workforces.

In July 2010, the Dental Board of Australia (DBA) was established and began the work of developing processes and practice standards to regulate the provision of dental services in Australia. Dentists, specialists, dental therapists, hygienists and prosthetists were regulated by one Board with mixed membership. In July 2010, the DBA published a Scope of Practice Registration Standard for dental practitioners, which included the definition of practice scope boundaries through educational preparation in board-approved courses and competence. Dentists and prosthetists were defined as being independent practitioners who may practice without supervision. Section 6 defined dental hygienists, dental therapists and oral health therapists as those who "exercise autonomous decision making in those areas in which they have been formally educated and trained. They may only practice within a structured professional relationship with a dentist. They must not practice as independent practitioners. They may practice in a range of environments that are not limited to direct supervision…." (**DBA, 2010**).

Once again, this had been a much-contested process of policy development, and the outcome was that the dental and oral health therapists were unhappy with the creation of uncertainty about who held the responsibility for the care they provided. In a practical sense, they had never worked under supervision, and most of the regulations had acknowledged this in recent times, referring to their vertical relationships as one of consultation and referral (**Australian Oral Health Therapists Association (ADOHTA), 2010; ADOHTA, 2011**). Public sector organizations felt that the wording of the standard would reduce their ability to utilize dental and oral health therapists skills in sensible ways to provide services, and that these words and regulatory mechanisms did not fit with the thrust of dental advocacy or national health workforce agendas (**AHMAC, 2004; Health Workforce Australia, 2010**).

The outcome was that Health Workforce Australia was charged by AHMAC with the responsibility to review the standard and use evidence informed studies to advise on an appropriate approach (**Farmer, 2010**). Research conducted as part of the process found that the wording had generated confusion about the way dental therapists and hygienists could work and resulted in a contraction of their practice. The outcomes of the review are yet to be published.

THE EVOLUTION OF ORAL HEALTH THERAPISTS (DUAL DENTAL THERAPISTS/HYGIENISTS)

It is clear that there is significant overlap in the range of skills and approaches to care of dental therapists and hygienists. There had been proposals for the development of a "hybrid" dental auxiliary combining the skills of a dental therapist and dental hygienist for some time (**Barmes, 1983; WHO, 1990; Wright, 1991; Nuffield Foundation, 1993; Department of Health and Community Services, 1995; Wright, 1995**). A formal recommendation that the skills of dental therapists and hygienists be combined to develop the generalist "oral health therapist" arose from the 1993 Nuffield Inquiry conducted in the United Kingdom. This inquiry defined and described this practitioner as one who could adapt his or her generalist oral health training and education (a combination of hygiene and therapy scope) to provide services in areas of greatest need where access to care is limited and levels of disease highest. This inquiry also proposed that these practitioners be able to add skills in a modular way to meet particular specialized needs and to work in all types of practice settings, including both public and private sectors (**Nuffield, 1993**). Several Australian educators and policy-makers attended the presentation of the findings and they were subsequently influential in dental policy and educational development decisions in Australia around that time (**DHCS, 1995; Wright, 1995**).

Since 1971, in Western Australia however, there have been dental therapists working in the private sector providing both dental therapist and dental hygienist services under prescription of a dentist (**Gussy, 2001; DTHA WA, 2005**). Western Australia, which began training dental therapists in 1971, was unique in graduating dental therapists who could provide services for children and who had also completed a component dealing with the management of gingival health in adults; they could work in both the private sector under prescription and autonomously in the school dental services. These distinctions in title have remained in place in Western Australia, with School Dental Therapists able to examine, diagnose and plan treatment, and provide services to schoolchildren when employed in the School Dental Service, and provide treatment services under the prescription of a dentist to all age groups in private practices. Some dental therapists have also undertaken additional training in periodontal procedures to enable them to provide dental hygienist services in private practices (**DTH WA, 2003; DTH WA, 2007**).

Moreover, the Gillies Plains College of TAFE in South Australia has been offering a program since around 1980 enabling dental therapists to add the skills of dental hygiene. The universities of Melbourne and Queensland both commenced add-on programs in 1999 for eight and 26 students, respectively, although both ceased in 2004 (**Satur, Smythe, in Tsang, 2010**). The University of Melbourne at the time also offered the only bridging program to enable dental hygienists to add dental therapy skills.

CONTEMPORARY ORAL HEALTH THERAPISTS

In 1996, the University of Melbourne became the first university dental school in Australia to offer both dental therapy and dental hygiene education, appointing the first dental therapists and dental hygienists as academic staff. The Diploma in Oral Health Therapy was unique at the time in that it had a core first year in which dental therapists and hygienists studied the same units in shared classes, with separate streams in the second year to develop their profession-specific skills. This program was designed to establish the first steps toward developing the Oral Health Therapist in Australia.

In 1998, breaking new ground, the University of Queensland, in combination with Queensland University of Technology, offered the first Bachelor Degree program in Australia, which qualified graduates for registration as both dental therapist and hygienist, or oral health therapists. In 2002, the University of Adelaide followed and in 2005 the University of Melbourne's Bachelor of Oral Health program began. This was followed by the University of Sydney offering a Bachelor of Oral Health in 2006. In parallel, three new dental schools were established in Australia, the first at Griffith University on the Gold Coast in Queensland in 2004, at La Trobe University in Bendigo in rural Victoria in 2006, and Charles Sturt University at their Orange and Wagga Wagga campuses in rural NSW in 2008, all of whom established both Bachelor of Oral Health programs graduating oral health therapists, as well as dentistry programs.

In 2005, the University of Newcastle offered a Bachelor of Oral Health in Dental Hygiene, which is the only single outcome Bachelor program in Australia, and commenced the first post graduate program in 2010 dental therapy for dental hygienists, graduating its first cohort in that same year. Wallace, Cockrell and Taylor reported in 2010 that in their first BOH (Hygiene) cohort, 72.9 percent of their predominantly female students had previously worked as dental chairside assistants prior to entering the program (**Wallace, Cockrell, Taylor, 2010**). Torrens Valley TAFE in South Australia, now the oldest training setting, continues to offer a Diploma in Dental Hygiene.

In 2011, Griffith University Queensland ceased taking students into its Bachelor of Oral Health (BOH) program and the University of Central Queensland initiated planning to offer a BOH Oral Health Therapy program in 2012, thus shifting the spread of programs in that state. In 2011, Western Australia's Curtin University discontinued its Associate Degrees in Dental Therapy and in Dental Hygiene and had its first intake into a Bachelor of Oral Health program to graduate oral health therapists. In 2011, nine of 11 Australian programs educated oral health therapists with only the University of Newcastle and Torrens Valley TAFE offering single skill outcome programs (**Satur, Moffat, in Tsang 2010**).

Two studies have been undertaken to examine graduate outcomes for oral health therapists. Higgins used a self-completed questionnaire to collect baseline data from 11 graduates of the Bachelor of Oral Health (BOH) program at the University of Newcastle who had added dental hygiene to their existing dental therapy qualifications. After graduating, all participants were employed in the dental sector and half had more than one job with a mix of public and private practice (**Higgins, Cockrell, Wallace, 2009**). Setiawan and colleagues evaluated the graduate outcomes of 48 oral health therapists (OHTs) one to three years after graduation from the BOH programs at the University of Melbourne and La Trobe University between 2005 and 2008, both in Victoria. Of this group of respondents, 83.3 percent were female, reflecting a difference to earlier workforce studies. The majority of the participants were working in more than one job, 48 percent in the private sector and 21 percent in the public sector; 27 percent were working in both sectors. In all, 83 percent of graduates were working more than four days per week and 69 percent were employed as OHTs—that is, using both therapy and hygiene skills. Job satisfaction was high and remuneration rates were also reported. Service mix was self-reported and indicated that 80 percent of OHTs were undertaking diagnosis, treatment planning, fissure sealants and restorations on a daily basis, with less preventive services provided in rural public sector practice locations. Private sector practices used these skills less (59 percent) indicating that private practices are underusing OHT skills, or that their skills are not well understood by dentists. More than 90 percent reported performing scaling and root planning in private practice settings (**Setiawan et al., 2009**).

A study of dentists' knowledge of and attitudes toward OHTs was conducted in a sample of dentists in NSW in 2011, using self-complete questionnaires. Responses were received from 34 practitioners surveyed, 26 percent of whom indicated they had worked with a "therapist" before, and 38 percent indicated they would accommodate an OHT in their practice; 59 percent were aware of evidence that OHTs provided high-quality work, but more than half felt that a patient would not want to be treated by an OHT. In general, dentists surveyed responded as having positive attitudes towards oral health therapists, but many responses showed a lack of knowledge of their clinical skills and scopes of practice. This study provides evidence that the dental professionals surveyed are not fully informed of the role of oral health therapists, which could be a major barrier to their employment (**Edmunds, Tane, 2011**).

In line with developments in dentistry, contemporary oral health therapists (including dental therapists and dental hygienists) are more broadly educated professionals than their tightly regulated predecessors. Courses today require students to study across a wider range of areas, often integrated with dental students for various course components. They are educated to synthesize and apply knowledge to complex problems, understand and apply technology in more complex ways and to have well-developed research, communication and

cultural sensitivity skills in keeping with the contemporary health professional role. Courses encompass clinical practice, biological, health and social sciences, ethics and evidence-based practice necessary to contemporary health practice, and are accredited by the Australian and New Zealand Dental Councils. Today, qualification for practice in oral health therapy requires a Bachelor level tertiary course of education and training over three years with applicants to most courses requiring university level entrance and pre-requisite studies in English and Biology.

In 2012, the Australian Dental Council (ADC), which jointly with the New Zealand Dental Council accredits all Australian and New Zealand programs leading to registration as a dental practitioner, published a key document describing competencies for dental therapists, dental hygienists and oral health therapists. The competencies were described as being skill components necessarily integrated into the practice of providing good patient care and were defined at the level of a graduating OHT ready for autonomous practice. The document describes an oral health therapist in Australia as:

"a scientifically oriented, technically skilled, socially sensitive, professionally minded practitioner who adheres to high standards of professional conduct and ethics and who can function safely and effectively as a member of the health care system on graduation and throughout their professional career..." (**ADC, 2011**).

Oral health therapists' competencies were determined to be a sum of those of dental therapists and dental hygienists and this was reflected in each of the competency documents for the three professions. Domains described were similar to those of dentists but with different emphasis and are as follows:

- Professionalism
- Communication and Social Skills
- Critical Thinking
- Health Promotion and Education
- Scientific and Clinical Knowledge
- Patient Care, with sub-domains of Clinical Information Gathering, Diagnosis and
- Management Planning, Clinical Treatment and Evaluation (**ADC 2010**).

In a 2006 dental workforce data collection, there were 1,380 dental therapists and 410 oral health therapists in Australia (**Balasubramania, Teusner, 2011**) and since that time Australian BOH programs have been graduating approximately 250 to 300 graduates each year. In 2011, Australian universities graduated a combined total of 240 oral health therapists and an additional 76 dental hygienists in 2011. With two more programs emerging, an additional 50 OHTs are expected to graduate, for a combined output of about 360 oral health practitioners in 2015 (**Satur, 2011**). Given that there are now no programs training dental therapists, over time in Australia, dental therapist numbers will diminish as graduates of

BOH programs gradually replace them and their practice is absorbed into oral health therapy. Specialization in pediatric restorative dentistry remains a major component of their education preparation and practice and the addition of adult diagnosis and periodontal skills enables the translation of the success of the School Dental Services across other needy population groups.

The oral health therapists' key role is as primary oral health care providers who have a capacity to promote oral health for individuals and the community, diagnose and recognize oral conditions, plan and deliver clinical and preventive treatment, evaluate care and collaborate with other dental and general health practitioners to improve the oral health status of the community. They also have the ability to develop or add skills to address the oral health needs of underserved communities within a health-promoting paradigm, providing the capacity to increase access to dental care.

Section 6

THE UNITED KINGDOM

The United Kingdom has a surface area of 94,000 square miles and a population of approximately 62 million people, of whom about 52 million live in England. Scotland and Wales are more sparsely populated, meaning that some people have to travel further to health care facilities. The country comprises four nations—England, Wales, Scotland and Northern Ireland—and there has been increasing devolution of power from England to Wales, Scotland and Northern Ireland. The devolved nations set their own health policy, although the regulations relating to dental therapy are consistent across all four countries. The United Kingdom has the sixth-largest economy in the world.

BACKGROUND

Oral health in the United Kingdom shares a similar pattern as that in most of the developed world. The widespread use of fluoride toothpaste since the 1970s means that most children and young adults have relatively good oral health. The mean DMFT of 12-year-olds in Great Britain is 0.7. Naturally, this average figure masks significant major variations, so that English children have among the best oral health in the world, while disease rates are higher in the other countries. Even within countries, disease levels are high in some areas, especially in relation to deprivation. Only 6 percent of the population is now edentulous, but people who are middle-aged and older often have very heavily restored dentitions. Although they did have access to relatively inexpensive dental care, they did not have the benefits of fluoride toothpaste when they were younger, and only about 10 percent of the United Kingdom population receives fluoridated water. This distribution means that the dental treatment needs of young people tend to be rather straightforward, whereas those of older adults, sometimes referred to as the "heavy metal generation," are increasingly complex.

The vast majority of health care in the United Kingdom is provided by the National Health Service (NHS), which was set up in 1948 and is funded by the central government. NHS hospital and medical care is free at the point of delivery, although there are charges for prescriptions for outpatients, for eye tests and for spectacles. Children and people with low income or who receive benefits are often exempt from these charges. It should be noted that the NHS is subjected to frequent reorganizations by government, with frequent name changes of its constituent parts. For simplicity, these parts are sometimes referred to as "NHS organizations" in this document.

Most dental care is provided under the terms of the NHS, of which there are three arms. The smallest, the Hospital Dental Service, provides specialist care and can normally only be accessed via referral from a primary care practitioner. The Community Dental Service (formerly the School Dental Service) now provides specialist care in primary care, such as orthodontic treatment and care to patients with special dental needs, and acts as a safety net for people who would otherwise not be able to receive care. Both Hospital and Community Dental Service staff are employed directly and salaried by the NHS.

The General Dental Service (GDS) is by far the largest arm and comprises dentists who subcontract to the NHS. Dentists open offices, called practices in the United Kingdom, provide treatment and receive remuneration from the NHS and the patients. The vast majority of dentists are generalists, although there are a growing number of specialists. Typically, practices operate as small businesses with two or three dentists and several nurses, less often with a hygienist, and rarely with a dental therapist.

From the outset, dentists could open an NHS practice wherever they wanted, get their patients to sign a form indicating that they had received treatment and then obtain payment from the NHS on a fee-per-item basis. Due to very high demand and cost, patient charges were soon introduced for NHS dentistry. Successive governments increased these copayments from time to time, but the fee-per-item service remained essentially unchanged for 50 years. The organization of NHS general practice began to change in the 1990s with the introduction of capitation schemes for children. New dental contracts were taken up by some practices in the 2000s. These contracts were termed Personal Dental Services (PDS) contracts and paid practices according to capitation, with the intention of separating remuneration from the amount of treatment provided, so liberating dentists from a "treadmill" and allowing more imaginative ways of working. In 2006, an entirely new dental contract was introduced. Dentists could no longer set up a practice where they chose, but had to tender for or negotiate a contract in advance with their local NHS Primary Care Trust (PCT). PCTs were commission services according to local need. NHS dental practices are now principally paid via a contract currency called Units of Dental Activity (UDA) in which each practice is contracted to deliver a specified number of UDAs each year. Courses of treatment are worth 1, 3 or 12 UDAs, depending on complexity.

Private dentistry—that is, treatment provided outside the terms of the NHS but often by the same dentists—may be funded by direct payment or via one of a small number of dental insurance contracts.

One contextual factor plays a big role in the growing prominence of dental therapists in recent years: the dental workforce shortage. From the late 1990s, it became increasingly clear that some people were having difficulty finding a

dentist in the United Kingdom. National newspapers printed photographs of people queuing to register with one new NHS dental practice. These problems were attributed to a shortage of dentists, in itself attributable to more demanding requirements for the registration of dentists from Commonwealth countries, a decrease in dentists' working hours, reductions in time dentists spent on clinical work, feminization of the workforce and changed work patterns. In addition, two dental schools had closed in 1990, reducing the number of new entrants into the workforce. Naturally, the law of supply and demand operated and some dentists used this situation to increase their prices, which they could only do by leaving the NHS and seeing more patients privately. These changes may have resulted in a 9 percent shortfall in the dental workforce in 2003, which was predicted to rise to 16 percent—21 percent by 2011. Dental therapists were seen as one solution to this problem and so the number of training places for dental therapists was quadrupled.

HISTORY AND DEVELOPMENT

As early as 1909, local authorities in the United Kingdom had recognized that a group of workers could be trained to substitute or supplement dentists to provide dental treatment to children as part of the School Dental Service (**Gelbier, 2005; Gelbier, 2006; BADT, 2011**). After World War I, these workers were termed "dental dressers" and were predominantly women, who could work with dentists to clean, fill and extract children's teeth under the direct supervision of a dentist. Dentists objected to the use of dental dressers and their use in one county was abolished in 1921. In 1932, dressers were further restricted to only scaling and polishing teeth.

With the high level of untreated disease and workforce shortage after World War II, the government decided to experiment with supplementing the School Dental Service with a new group of workers: dental auxiliaries. Despite considerable opposition from dentists (**Nuffield Foundation, 1993**) a new school opened in New Cross, London, for these new auxiliaries in 1959. The auxiliaries would work to the prescription of a dentist in the School or Hospital dental services, filling teeth and extracting deciduous teeth. This experiment was deemed a success in 1965 and they were made an official part of the dental team. The British Association of Dental Therapists was formed in 1962 (**Gelbier, 1995**).

Dental therapists were initially poorly received by the profession, but over the following decades a number of government and nongovernment reviews recommended the expanded training and roles for dental therapy **(HM Government, 1979; Nuffield Foundation, 1993)** and gained attention even outside of dentistry **(Dewar, 1988)**. These recommendations were finally endorsed by the regulatory body for dentistry, the General Dental Council (GDC), in 1998 and enacted from 2002 onward (**GDC, 1998; GDC, 2004**). From 2002, dental therapists were permitted to work in all sectors of dentistry. By 2011, approximately 1,500 dental therapists were registered with the GDC.

Although the School at New Cross closed in 1983 (**Rowbotham et al., 2009**), as of December 2011, 21 organizations trained dental therapists (**GDC, 2011b**). Their current scope of practice was defined by the General Dental Council (**2009a**) to include all the duties permitted of a dental hygienist, and in addition they may:

- carry out direct restorations on permanent and primary teeth;
- carry out pulpotomies on primary teeth;
- extract primary teeth;
- place preformed crowns on primary teeth;
- plan the delivery of a patient's care.

Additional skills dental therapists may develop during their careers include:

- administering inhalational sedation;
- varying the detail of a prescription but not the direction of a prescription;
- prescribing radiographs;
- carrying out tooth whitening to the prescription of a dentist;
- removing sutures after the wound has been checked by a dentist.

Dental Therapists do not carry out a patient's initial diagnosis or take overall responsibility for planning a patient's treatment.

A number of other factors complicate this topic. What we now call dental therapists were previously called dental ancillaries or dental auxiliaries. However, all classes of dental worker other than dentists were also grouped together under the term "dental auxiliary" until the 1990s. The generic term for dental workers other than dentists has also changed. They were termed "Professionals Complementary to Dentistry" (PCDs) in the 1990s, and from 2005, "Dental Care Professionals" (DCPs). Current nomenclature is used in this document.

In addition, developments of the role of dental therapists cannot be seen in isolation. There have been similar developments for other classes of DCP during this time, with the introduction of clinical dental technologists and orthodontic therapists, etc. Taken together, these developments are sometimes called "the broader dental team," "the wider dental team," "team working" and "skills mix." The development of dental therapists is often implicit when these phrases are used. However, there are relatively few clinical dental technologists or orthodontic therapists, and so phrases such as "skills mix" can often be seen as particularly applicable to dental therapists.

The advantages of dental auxiliaries were seen to be that they offered "a means of increasing the amount of dental care without lowering the standard of care" and that delegating care to dental therapists liberated dentists' time for more complex treatment. Mindful of the need to evaluate the use of dental therapists, Sutcliffe (**1969**) used clinic records to assess the productivity of a dental surgeon

first working without, and then working with an auxiliary. Working together, the dentist and auxiliary saw 64 percent more patients, completed 50 percent more procedures and restored 79 percent more teeth. These indicators were suggested for the further evaluation of services involving auxiliaries.

In 1975, the Royal Commission on the NHS (**British Medical Journal, 1979)** made a series of recommendations across health-related matters, including dentistry. It stated, "Until the implications of a shift in policy towards prevention have been identified dental student entry numbers should not be altered, but flexibility in meeting demands should be achieved through the increased use of dental ancillary workers."

A series of monographs on the assessment of the quality of dental care reported on an experimental dental care project in London (**Allred, 1977**)**.** This experiment created quality criteria and assessed the effects of changes in the structure of dental services, including dental team composition, on those criteria. The objectives in relation to ancillaries were to:

- Determine the spheres of activity of the various types of personnel who may compose a team;
- Determine the composition of a team in relation to the requirements of a defined community it is to serve;
- Determine the effectiveness of such a team or teams in achieving and maintaining dental health with the selected communities.

The project involved three units, one each for research, training and community care. It had been noted that the training of dental ancillaries was conducted away from dentists; therefore, the team studied in this project comprised dental undergraduates, dentists, dental ancillaries and dental surgery assistants, the latter alternatively referred to as dental nurses in the United Kingdom. The monograph on team training concludes that dental students would spend more of their time on preventive activities and learn to delegate more work if they worked with ancillaries. They concluded that there would be considerable benefits from training dental teams together.

Ribbons (**1978**) was a teacher on the New Cross course and therefore able to give a firsthand account of its development. The "value to the community" and "work of great value" of the school had been identified and the treatment carried out by the auxiliaries was noted to be satisfactory in quality. Ten years after opening, the school's two-year course was graduating 50 auxiliaries each year, of whom 521 were still enrolled on the register to work in 1978. Most (93 percent) of these were thought to be working in the community services with the remainder working in hospitals.

At that time auxiliaries could:

- Extract deciduous teeth under infiltration anesthetic;
- Undertake Class I, II, III and V fillings in deciduous or permanent teeth;
- Scale and polish teeth;
- Apply fluoride solutions and gels;
- Apply fissure sealants;
- Give oral hygiene instruction.

All this work had to be carried out under the direction of a dentist.

Stephen (**1978**), a children's dentist in Scotland, felt sufficiently confident in the skills of a dental auxiliary to use one to apply fissure sealants in trial to test an improved technique.

The Nuffield Foundation (**1980**) has had a long-standing interest in dental health. The foundation conducted a comprehensive review of dental education, visiting 27 dental schools across Britain and Europe and receiving written and oral submissions. Their conclusions envisaged greater team dentistry with delegation of care in the future. They regarded diagnosis, prescription and quality control to be the exclusive domain of the dentist, but recognized that this would require training in leadership. The inquiry concluded there was a need to research the best balance of staff within the dental team, but specifically recommended the creation of schools for dental auxiliaries that were linked to dental schools. They anticipated greater flexibility in the movement of auxiliaries among different careers within dentistry. They felt this would not exclude their becoming a dentist should they meet the criteria. The inquiry did not call for more dentists, but felt there should be more auxiliaries.

The New Cross Dental Auxiliary scheme was investigated and reported widely by Holt and Murray (**Holt, Murray, 1980a; Holt, Murray, 1980c**). About half of qualified dental therapists were currently working, 35 percent full time and 13 percent part time, with a proportion of the (entirely female) workforce taking career breaks. Despite being open to both genders, no men had taking up dental therapist training. Lack of suitable posts was a major factor in not returning to work, being restricted to community and hospital placements. Most found the clinical aspects of their career more rewarding than dental health education, and GDC regulations limiting their role were a significant problem in terms of career progression. Dental auxiliaries working in the CDS in London spent 87 percent of their time providing treatment, with the remainder offering dental health education (**Holt, Murray, 1980b**). More than half their patients were under age 9, and the most common treatment was amalgam restorations. The study aimed to analyze cost factors, but this proved difficult and no real conclusion could be drawn on their cost-effectiveness.

The following year, Jones and colleagues (**1981**) reported on the service provided by a team comprising one dentist and four dental therapists, each working in mobile units in Kent. The quality of the dental therapists' care was described as comparable to that of dental surgeons and the dental therapists were capable of high productivity, but economic comparisons were difficult because dental therapists worked to a prescription rather than providing comprehensive care. It was difficult to generalize from the specific conditions of this locality, but the data suggested that the potential of dental therapists to meet demands in dental services had not been fully realized.

The position of dental therapy was now unusual. Government and other reports (**Royal Commission, 1979; Nuffield Foundation, 1980**) had concluded in favor of the use of teamwork involving ancillary workers, yet the New Cross School for Therapists was to close in 1993. Woolgrove and Harris (**1982**) worked at New Cross and surveyed the attitudes of dentists to delegation of care. These data should be seen in their historical context because it was to be some 20 years before dental therapists could work in anything other than hospitals or the community school dental service. Consequently, most dentists would never have had any experience of delegating care. Moreover, at that time dental therapists could provide a narrower range of services than they can now. Dentists who were younger or who had worked in the community service were more likely to be happy managing a dental team and delegating care. The tasks most likely to be delegated were dental education, scaling or fissure sealing teeth, and taking radiographs. One-third (37 percent) would be happy to delegate a filling to a dental therapist and one-quarter would delegate the extraction of a deciduous tooth. Slightly later, a review of the history and potential use of dental therapists described the debates over the closure of the New Cross school (**Woolgrove, Boyles, 1984**). The authors considered their value in relation to the falling disease rate, some very simplistic data on cost-effectiveness, and quality of care.

The GDC president's address of 1983 noted that the term "ancillary dental worker" would be replaced by "dental auxiliary" beginning in January 1984 (**Lawton, 1983**). Despite the Nuffield Foundation's recommendations of three years earlier, the GDC was not contemplating any changes regarding the supervision of any dental auxiliaries or in the sectors where they could work. The president felt the need to emphasize to the profession that any changes to the role of dental auxiliaries were dependent on resolutions in both houses of Parliament and reassured them that "no such changes would be introduced without prior consultation with the Council and with the profession." Ironically and in a different section of the address, he commended the achievements of dental therapists at the New Cross school, which was due to close.

As signs of the decrease in dental caries in the industrialized world became more apparent in the 1980s, Sheiham (**1984**) attributed these trends to increasing

availability of fluoride in toothpaste, as well as to changes in sugar consumption and the use of antibiotics. He concluded that not only would there be less caries, but that caries would progress more slowly and could be treated by dental therapists instead of dentists, leaving dentists to deal with more complex problems. These potential advantages have been a recurrent theme in the dental therapy debate (**Hancocks, 2011**).

Davies (**1986**) brought the dental auxiliary regulations to the attention of readers to clarify permitted duties of hygienists and dental therapists.

There were few changes regarding the position of dental therapy for some years.

In 1998, a postal survey gauged dentists' opinions of dental therapists. More than two-thirds (69.2 percent) of participants envisioned a role for dental therapists in the CDS, with just 47.5 percent saying they would like to see dental therapists in the GDS splitting their time equally between clinical care and oral health advice (**Hay, Batchelor, 1993**). Recently qualified dentists were more likely to be in favor of their introduction.

An opinion piece by a dental adviser to Hampshire Family Health Services anticipated the forthcoming Nuffield Foundation report (**Lynn, 1993**). His focus was on the creation of large "dental centers" as a more efficient business model rather than focusing particularly on dental therapists. However, he found the argument for greater use of hygienists and dental therapists within this model to be compelling. Such an approach should create paths for dental promotion for all team members.

The Nuffield Foundation (**1993**) conducted a second wider-ranging inquiry to investigate the role of personnel auxiliary in dentistry, the best possible combination of skills, and their education and training. Again, the foundation consulted widely. Galloway (**1992**) had requested evidence from individuals and organizations regarding the changing dental team, trends in organizational structure, the role of dental auxiliaries, and how that role might be developed. The Nuffield Foundation report was hugely influential and is still referred to some 20 years later. It noted that there was no national strategy for the education and training of auxiliaries and that the method of dentists' remuneration added to the problems of auxiliaries.

By this time there were only 371 dental therapists on the dental register, of whom 259 were working in the community service and 40 in hospitals. Most of the others were not working as dental therapists. Dental therapists found it difficult to find work using their therapy skills and were frustrated because of this. Despite the high levels of unmet treatment need in some parts of the country and the fact that dental therapists were seen to play a valuable and cost-

effective part in solving this problem, they could not work in the general dental service. Indeed, the report wrote, "it makes little sense for dentists, educated in a dental school for five years at considerable expense, to spend much of their time carrying out work that could be done effectively by someone trained for a shorter period to do a narrower range of relatively simple work at less cost." The report emphasized the need for a team-based approach and the introduction of "clinical auxiliaries," aka dental therapists, into general practices, especially in areas of high need. Aligned to this was a recommendation for elements of training outside of dental hospitals and universities.

The Nuffield report was greeted enthusiastically from a number of perspectives. Smith (**1993**) was so taken by it that he suggested that working up through the ranks from dental nurse to hygienist and then dental therapist might provide an alternate, but possibly superior, route to becoming a dentist. He saw the practical and human experience of this as advantageous in some ways over the intellectual sterility of learning purely at a university. This idea was taken up 10 years later as "the skills escalator." An editorial in Community Dental Health, the journal of the British Association for the Study of Community Dentistry (**Lawrence, 1993**), also welcomed the report, whose recommendations could improve equity of access to care, better value for money and a service that was more responsive to consumer need. Lawrence recognized the tactical steps required for implementation of the recommendations and hoped for an intelligent dialogue between the professional groups to get broad agreement for change. The president of the BDA (**Mason, 1994**) welcomed the report as a step toward a better-trained and regulated dental team. His address was made before the BDA had a chance to respond formally, so he could not express opinions on the more radical suggestions at that time.

A private dental insurance company sponsored a research think tank to consider futures for NHS Dentistry. Perri (**1996**) felt that dentists had "successfully subordinated" other kinds of dental health care workers to its control, suggesting that dental professional bodies had only recently accepted that there may be a case for increasing their role. The report regarded dental therapists as "poorly paid, confined to work with children, and face long training times; it is not surprising that they are few in number." The report recognized the important role for all these groups, especially in relation to the treatment of periodontal disease. It also felt that the pressure of auxiliaries taking on expanded roles might be a driver for change but saw the reaction of some dentists as a barrier to this. It concluded that dentists' monopoly against a greater role for "auxiliaries" was unsustainable and that dentists should be prepared for change in this regard, perhaps with small pilots of team approaches. This was seen to have implications for the education sector.

A recurring theme in the United Kingdom is the variety of views held among United Kingdom dentists, much of which appears in the letters pages of the British Dental Journal. One characteristic exchange was prompted by a leader

on the opening of a dental therapy training programmer in Cardiff in 1996 and the soon-to-be-opened programmers elsewhere in the United Kingdom. Grace (**1996**) welcomed the development, partly because of his experience working with a New Zealand dental nurse who could only work as a dental nurse (assistant) in the United Kingdom. He regarded this as a loss of her potential and felt advantages to employing dental therapists, in terms of increasing the workforce, having better interactions with patients and, indirectly, as managing a team, would allow the development and increased career satisfaction of dentists. Later that year, Swallow (**1996**), who had worked with dental therapists in Holland, commented that they were easy to train and worked with a high level of skill. However, he saw no evidence that they were suited to a highly developed society with a demand for high-quality care. He used some simple and not entirely accurate modeling to suggest that dentists would not have time to do anything other than treatment plan for dental therapists. He also felt that patients would resist being referred "downward" to a dental therapist, that there would be a high turnover of staff, and that the real reason to encourage the use of dental therapists was to reduce costs rather than increase quality.

Green, Galloway and Gorman (**1996**) responded that NHS data indicated that at least 80 percent of clinical activity could be undertaken by a dental therapist and cited examples where delegation worked effectively. They also felt that use of dental therapists was a more efficient use of resources and that dental therapists could have rewarding careers. In a lively reply, Swallow **(1996b**) challenged the quality of the evidence supporting the use of dental therapists and called for clinical trials of the effects of using a wider workforce. Green, Galloway and Gorman (**1996b**) then acknowledged the lack of good evidence and suggested that dental therapists be considered as expanding the team rather than substituting for dentists. Clewett (**1997**) also spoke in favor of dental therapists, paralleling their use to the delegation of care in medical teams, and wrote of the success of the New Zealand nurses.

Ireland (**1997**) commented on the 1993 Nuffield Foundation report and the forthcoming report of the GDC's Dental Auxiliaries Review Group. He noted that opinion was divided on dental therapists and called for further research into their cost effectiveness to justify expanding training opportunities.

Following on from the Nuffield report, Kwan and colleagues (**1996; 1998**) assessed the value of using dental auxiliaries to diagnose caries in dental surveys. A test validation study showed them to be as reliable as dentists and found that a day-and-a-half training was required for them to meet required standards, which is of potential benefit when conducting epidemiological studies.

A survey of the dental workforce across 18 European countries found that dental therapists, or their equivalent, were permitted only in the United Kingdom and Switzerland (**Anderson et al., 1998**).

The General Dental Council was naturally concerned with the dental team. It already had responsibility for registering dental hygienists and dental therapists. In response to the 1993 Nuffield report, the General Dental Council appointed a Dental Auxiliaries Review Group (DARG) (**GDC, 1998**), whose report was sent out for wide consultation in May 1998. DARG acknowledged that dental support staff are professionals in their own right, so the term "dental auxiliary" was replaced with Professional Complementary to Dentistry (PCD), which represented a significant positive change in attitude. DARG also concluded that dental therapists should be able to work in all sectors of dentistry. It felt that, after appropriate training, the duties of a hygienist or dental therapist should be extended to include the replacement of crowns with temporary cement, removal of excess cement, taking impressions and the administration of inferior dental block regional anesthesia.

The DARG report closely followed the findings of the 1993 Nuffield Review but gave them the weight of a regulatory body. Galloway and Gorham (**1998**) supported the DARG findings but felt that the focus on registering the whole dental team was a potential distraction from the wider benefits. Seward (**1999**), then president of the GDC, wrote strongly in favor of the adoption of the term Professional Complementary to Dentistry, which she thought would enhance mutual respect, trust and understanding of the team's respective roles. She asked dentists to embrace the science and art of teamwork and argued that education, training and imaginative employment of PCDs was the way to the future. The following year she encouraged further integration of the dental team to strengthen the relationships between PCDs and dentists (**Seward, 2010**).

Mike Grace, then editor of the British Dental Journal, was a consistent supporter of greater teamwork and for the use of dental therapists. He commented on responses to the DARG report and whether DCPs should have specified job roles or a flexible role defined by need (**Grace, 1999**). He also felt that the report failed to address the most pressing issue of team development, concluding that there was a need for resources for dental training and education in this area. The following year, he commented on the decision in 2000 by the Privy Council to reject changes in the Dental Auxiliaries Regulations to enable dental therapists to work in all sectors of dentistry (**Grace, 2000**), which he found inexplicable in light of gaps in the dental workforce. Dental therapists also had to find work in general practices as hygienists, due to the lack of vacancies for dental therapists in the community service.

The DARG changes (**GDC, 1998**) were finally enacted by government in 2002 (**Hartridge, 2010**) and from this time forth, dental therapists have been able to work in all sectors of dentistry. The additional skills were added to training programmers for new dental therapists. For some years afterward, dental therapists who were already registered could take short "extended duties" courses to acquire these skills.

Grace (**2004**) continued to comment on the resistance of dentists to delegate treatment to other members of the dental team, which may have hindered integration of dental therapists. He felt this had led some to believe that they were not cost-effective to employ.

The dental workforce of a large part of central England was surveyed in 1999 (**Pay and Workforce Research, 2000**)**.** Dental practices identified via NHS organizations were surveyed with a questionnaire. Four hundred twenty-six practices took part, but none of these employed a dental therapist, which was not yet permitted. In general, most dentists felt that hygienists and dental therapists who worked in practice should be able to replace crowns with temporary cement and take impressions, but fewer than half thought they should administer inferior dental block anesthesia. Fifty-five percent welcomed the prospect of dental therapists working in practice but only 37 percent envisaged employing one.

Anticipating the move to greater skill mix over the coming years, a team at King's College London conducted a series of prescient studies and drew attention to themes that would become increasingly important over the coming decade. For example, with greater feminization of the dental workforce and the preponderance of women in hygiene and therapy in particular, Newton and colleagues (**2001**) investigated the career patterns of these three professional groups. Using national samples, they discovered that more dental therapists (71 percent) than female dentists (61 percent) took career breaks, and that dental therapists were the professional group most likely to have left the dental team (24.7 percent). Workforce planning would need to take account of these career breaks and losses from the profession. They also studied vacancies for all professional groups in 992 dental practices to discover the proportion of GDPs who would consider employing a dental therapist (**Newton, Gibbons 2002**). It should be noted that this was a secondary analysis of data collected in 1992. Forty-six percent of GDPs would have employed a dental therapist had legislation permitted. Approximately half of those not wanting to recruit a dental therapist said their main reason was insufficient space.

The same team (**Gibbons, Corrigan, Newton, 2000**) surveyed dental therapists registered with the GDC to examine their working practices and job satisfaction. There was high job satisfaction (80 percent) in the role, which at the time was solely carried out by females. Most participants were employed in the community services, which afforded flexibility of a career break or part-time work for child care. Holt and Murray (**2001**) commenting on this work, drew attention to their own studies of 10 years earlier, and suggested that research of dental therapists who were no longer working as dental therapists—that is, not on the register—revealed greater levels of dissatisfaction. They felt dental therapists were undervalued and underutilized and that little had changed in the intervening

20 years. Finally, the King's team compared career satisfaction among dental therapists, hygienists and dentists (**Newton, Gibbons, 2001**).

Harris and Haycox (**2001**) discussed the scope for PCDs to extend access to dental services in the light of financial pressure. Reduced availability of care was caused by many factors, including the nature of dentists as independent contractors and more dentists moving to private rather than NHS practice. They proposed increasing productivity using an expanded-team approach. They noted that this important area of skill mix and dental team development lacked evidence and that there was a need for further research to inform policy-making.

At about this time, several government documents were very influential on the organization of NHS dentistry, which had important beneficial consequences for dental therapy. In 2000, the United Kingdom government undertook a substantial reform of the NHS (the NHS Plan) to make it patient-centered, faster and more accessible. The dental part of this plan was published as "Modernising NHS Dentistry," with increasing access to care as a core component (**Department of Health, 2000**). "Modernising NHS Dentistry" adopted the approach of using dental therapists to increase access to care and "free up dentists' time." In a section titled "Making the best use of professional skills," it proposed that dental therapists should be able to work in all areas of dentistry, that their range of permitted duties be expanded to include block anesthesia, re-cementation of crowns and taking impressions. It outlined the responsibilities of NHS organizations and the professional bodies in moving toward these aims, including making training more widely available. It reassured dentists, however, that they maintained overall accountability for their teams.

By this time, the dental workforce shortage was becoming evident. Scarrott (**2000**) argued that the shortage of dentists could lead to changes in the workforce that made more business sense, but the solutions would vary depending on local needs. Therefore, a local rather than central approach to decision-making should be considered. She expressed caution over whether PCDs were the right way to meet this need.

The United Kingdom Parliament Health Committee's (**2001**) report "Access to NHS Dentistry" mentioned the role of dental therapists in response to the workforce shortage. Representatives of several professional groups suggested increased roles for their members, including giving dental therapists the right to work in general practices and extending their duties. The report attributed some problems of access to the NHS fee structure, which raised the same problem for the employment of dental therapists in GDS practices as it did for dentists themselves. More broadly, the committee had serious concerns that "Modernising NHS Dentistry" could alter fundamentally what was a deteriorating situation

and recommended a review of the dental workforce. These concerns were proved valid a few years later.

Dental Update is a well-known journal that publishes review articles for the continuing development of dentists in the United Kingdom. It has published numerous updates on changes in the dental team over the last decade or so. Clarke (**2002**) reviewed PCD developments with reference to changes in the light of the Nuffield Foundation (**1993**) and DARG (**GDC, 1998**) reports. She outlined the roles of each of the professional groups and current changes in the NHS.

The themes from "Modernising NHS Dentistry" were developed in a report to the government by the chief dental officer (**Department of Health, 2003**). "Options for Change" was seen as a radical document by the standards of dentistry, proposing a series of substantial changes relating to the way NHS dentistry would be commissioned and funded, the use of clinical pathways, and increasing the size of dental practices to better use the skills of the entire dental team. One of the eight areas for major change was development of the dental team to improve patient care and enhance job satisfaction. "Options for Change" cited many examples where dental therapists had been used to improve patient care. Suggestions to take this further included piloting novel ways of training all team members away from traditional dental hospitals, in order to increase numbers in the workforce and enhance the relevance of training.

Sprod and Boyles (**2002**) surveyed the working patterns, training experiences, estimated size and future training needs of the workforce of DCPs in the general dental service in southwest England. There was strong support for expanding the role of a hygienist to that of a dental therapist. It was concluded that there was substantial unmet need for pre- and post-qualification training for complementary professionals, but this was found to be compounded by marked inequalities in access to training. A similar survey in the Midlands was conducted in the same year, but not reported until four years later (**Hornby et al., 2006**). At the time of data collection, legislation had only just been changed permitting dental therapists to work in the general dental services, and the data confirmed that none was employed at that time. Suggestions that greater demand for dental treatment could be met by increased use of hygienists and dental therapists were tempered with concerns about the cost-effectiveness of doing so.

The Galloway (**2003**) review was a funded systematic review of the work of professionals complementary to dentistry, which has never been subjected to peer review and has not been widely published. Nonetheless, it remains an important and widely cited document on the quality of care provided by PCDs. "Quality" is divided into dimensions of diagnosis and screening, technical competence, health promotion, acceptability and productivity. Unfortunately, for the purposes of this

monograph, the different professional groups are rarely considered separately, so it is difficult to draw conclusions regarding dental therapists.

There are two areas of quality where PCDs can be regarded as analogous to dental therapists: the diagnosis of dental caries (15 studies) and technical competence at undertaking complete restorations (four studies). In both dimensions, the quality of the research was poor and only tentative conclusions could be drawn. However, the quality of care appeared to be similar among groups. Galloway and colleagues concluded that there was little relevant research, of which much was old and of poor quality, and recommended that more research be carried out. What data there were consistently suggested that nondentists could diagnose a range of oral diseases and complete a wide range of dental procedures as well as dentists.

The president of the GDC reported on reforms to the council, many of which related directly or indirectly to DCPs, including dental therapists. The General Dental Council was changing fundamentally, becoming smaller, more strategic and able to embrace the principles of modern regulation of health care (**Wilson, 2002**). PCDs would now be answerable to the GDC if they practiced outside their competency. In 2002, statutory continuing professional development (CPD) was required of all dentists and would be introduced for dental care professionals (**Wilson, 2003**). Like dental therapists, all PCDs would now have to register with the GDC. These changes were reported to dentists in an educational supplement of the British Dental Journal (**Watkins, 2003**), along with a reminder about the extension of hygienist and dental therapist duties in 2002.

Following a long and rich tradition, dentists' knowledge and attitudes toward the employment of dental therapists in general practice was surveyed in 2003 (**Gallagher, Wright, 2003**). Thirty-eight percent of dentists would employ a dental therapist if permitted. The main barriers to employment were cost, lack of knowledge and acceptance by the profession. In commenting on this paper, Batchelor (**2003**) drew attention to the capital costs of employing a dental therapist when most dental practices only had two surgeries. He regarded dentists' knowledge of dental therapists as an issue of governance that could be tackled by more information from the regulatory bodies. He also felt that debates on the effectiveness of some dental treatments and proposed changes to dental education called for a coherent policy on personnel requirements.

The Department of Health's commissioned evaluation of PDS pilot schemes was published in 2003 (**Goodwin et al., 2003**). The Personal Dental Services pilots explored alternative ways of remunerating dentists after a series of consultations and policy documents between 1994 and 1997. Sixty-nine practices took part in the pilots, with the evaluations involving 20 of these. The PDS approach had enabled providers to tailor their treatment towards a preventative approach and to develop services to meet specific local needs. One of the main aims of the scheme

was to develop the role of dental auxiliaries, but the evaluation highlighted that most pilots failed to properly consider the role of PCDs. The intention to improve skill mix was missed. Hall and colleagues (**2003**) presented more detail on the attempts to integrate PCDs. About half of the dentists, but only 34.6 percent of PCDs, had noted a change in their roles. Dentists also reported improved job satisfaction, unlike PCDs. The pilots failed to fully realize the potential of skill mix in practice, which was mirrored in the recruitment process; only 4.3 percent of PCDs were offered a financial incentive, as opposed to 27.5 percent of dentists.

The GDC (**1997**) had published requirements for education and training of dental therapists, recognizing their value as members of the dental teams. This document was superseded by the GDC's "Developing the Dental Team" (**2004**)**,** a significant document for several reasons. Most important, though, this document allowed a skills escalator. Instead of having a list of permitted duties, "Developing the Dental Team" allowed all DCPs, including dental therapists, to carry out any procedure within their training and competence. Thus, a dental therapist who had been appropriately trained could undertake any dental procedure.

Empirical evidence for the dental workforce shortage emerged in 2004 with the publication of the "Report of the Primary Dental Workforce Review" (**Department of Health, 2004b**)**.** The shortage was attributable to more demanding requirements for the registration of dentists from Commonwealth countries, a decrease in dentists' working hours, reductions in the time dentists spend on clinical work, feminization of the workforce and changed work patterns for both genders. In addition, two dental schools had closed in 1990, reducing the number of new entrants into the workforce. These changes were said to have resulted in a 9 percent shortfall in the dental workforce in 2003 and would continue to rise to 16 percent—21 percent by 2011. The number of dental therapists was predicted to increase over time and the contribution of dental therapy to the total dental workforce could be estimated. NHS organizations were advised to consider the role of skill mix in workforce planning.

The government set out its new policy for dentistry as "NHS Dentistry: Delivering Change" (**Department of Health, 2004**)**.** This was the government response to the ideas in 2002's "NHS Dentistry: Options for Change." NHS Dentistry: Delivering Change set out a vision of greater access to NHS dentistry, improvements to oral health and reforming NHS dental services. The policy highlights the role of hygienists and dental therapists in allowing dentists to work differently and freeing up their time so that the skills of the whole dental team are used more appropriately. The government set out its plan to train more dental therapists, increasing the number nationally from 50 to 200 per year. Also relevant to dental therapy, this document made the first hints of its 2006 NHS Dental Contract, in which NHS Primary Care Trusts would commission dental services with an annual base contract, rather than on a fee-per-item service basis. "NHS Dentistry:

Delivering Change" gave the impression that the new contract would be based on the Personal Dental Services Pilots, although it indicated that further negotiations were underway with the profession and that another group was considering how patient charges would be calculated.

The National Audit Office scrutinizes public spending in the United Kingdom and reports on the economy, efficiency and effectiveness of public bodies such as the NHS. Its report "Reforming NHS Dentistry: Ensuring Effective Management of Risks" (**National Audit Office, 2004**) considered the return on the £1.8 billion NHS contribution to dental care in England. The review was based on a comparative evaluation of the remuneration systems for NHS dentistry, a patient survey, visits to dental clinics and an analysis of the NHS's database of dental contracts. The final report was wide-ranging and recognized the then-current dental workforce shortage, including both dentists and dental therapists. At that time, the Department of Health was planning to increase the number of dental therapists in training. The review concluded that NHS bodies responsible for commissioning dental care should be "taking into account the development of new roles and skills within the dental team," which was to acknowledge the impact of the growing role of dental therapists at that time.

Harris and Burnside (**2004**) looked at the role and cost-effectiveness of dental therapists, which both varied with the composition of the team in which they are employed. Typically, dental therapists would see patients with high need and a higher proportion of failed appointments. While the data suggested that income generated by dental therapists was insufficient to cover their employment costs, the study did not examine the value of their contribution in terms of providing care to groups of patients who may not otherwise have received care, nor did it compare the cost of a dentist providing the same care or the additional income arising from liberating dentists' time.

It may have been that the practices would not have been able to provide the care at all or at the same quality (**Holt, 2004**).

Mossey (**2004**) reviewed the "new" dental team approach and believed dental education needed to respond accordingly. Mossey saw this as involving a three-dimensional problem: increased breadth across the dental team; vertical integration within and between specialties; and expansion longitudinally with lifelong learning. He concluded that dental schools would continue to be at the forefront of this change but the dynamic meant that dental schools alone would not provide the total learning environment. Challenges envisaged, such as the dynamic among the dental team, could be met by placing some dental education outside dental hospitals and succoring the role of professions complementary to dentistry.

During the days of the deepest workforce shortage, the chief dental officer, at that time professor Raman Bedi, was involved in an exchange of letters regarding problems of access to dental care. Marshall (**2005**) challenged the government's promise about whether it would train more dental therapists and suggested that DCPs should have directly paid salaries. The chief dental officer affirmed the government's commitment to addressing the shortage, in part by increasing the number of training places for dental therapists from 50 to 200 students per year (**Bedi, 2005; 2006**). **Gibson** (**2004**) also wondered whether the dental workplace shortfall should be met with more dentists or dental auxiliaries.

Ross (**2004**) argued that there was an increasing need for a team approach in which DCPs could make a substantial contribution to address disease levels, especially in remote and rural areas. She paralleled this to the use of nurse specialists to provide routine medical care and felt that DCPs should not have to work from a written prescription and should be able to provide emergency care for patients in what, she felt, was often a nebulous referral system. Positive views regarding the role of dental therapists were again evident in 2008 (**British Dental Journal, 2008**) at a reunion of staff and students of the original United Kingdom therapy school at New Cross. An ex-director of the school spoke of its capacity to meet the oral treatment needs of children, whereas ex-students reported a continued lack of knowledge about dental therapists.

Dental Update carried another review (**McGlashan, 2004**) of the expanding roles of PCDs. In the absence of any data, the authors argued that PCDs could offer oral health services at a reduced cost and with shorter training, which could rapidly reduce health inequalities. The need to develop an appropriate skill mix and team approach was vital, with joint education considered a valuable way to achieve this.

A workshop was held to explore innovative approaches to the education and training of PCDs (**Newton et al., 2005**). There were three phases to this project. The first phase reviewed existing arrangements for education and training, the second appraised four options by PCD educators in a one-day conference, and the final produced an "ideal" program. The findings were very compatible with "Developing the Dental Team" **(GDC, 2004)** that training and education of PCDs should be based on a skills escalator incorporating flexibility in roles. Entry should facilitate recruitment of individuals with few formal qualifications.

This interest in the education of DCPs extended to a survey of the DCP workforce in northwest England to identify training needs (**Yeung et al., 2005**). Between them, the 467 responding practices employed two full-time and 15 part-time dental therapists. Parenthetically, some of these are almost certainly the same dental therapists employed in more than one place. Forty-five practices intended to recruit a dental therapist in the future.

Lambert-Humble (**2005**) suggested that the whole dental team would benefit from the forthcoming 2006 dental contract and specified opportunities for each group within a broader team approach. Dental therapists were said to have the greatest potential now that they were dually qualified as hygienists and could work in all sectors of dentistry. He felt they had the greatest scope and opportunity to solve workforce shortages in dentistry with shorter training programs than for dentists, and asked whether they should be permitted to diagnose and treatment plan. He also called for education to enable further progression of PCD roles as well as team building skills.

Dental Outreach programs were also developed as a result of Nuffield and "Options for Change" and at the suggestion of educationalists (**Mossey, 2004**) so that students could learn together in settings outside dental hospitals. An early qualitative exploration of such a program considered dental and therapy students' experience of such a program (**Smith et al., 2006).** The students were very positive about their experience and the potential role of outreach within dental education. Key themes described by the students included the benefits of team working and acquiring more holistic and pragmatic views of dental care. A sense of realism was linked to teamwork within a busy schedule. Students were able to see how their courses fit together through experiential learning reinforcing theoretical learning. They became more confident in self-criticizing their clinical skills. Preliminary nerves were replaced by increased confidence of hands-on application of skills.

One general practitioner echoed "Options for Change" (**DH, 2002**) by reiterating that health need and demand were outstripping the capacity of the established professions to provide full and responsive services (**Ward, 2006).** Consequently, complementary professionals had a role in dentistry. He cited experiences of working with highly motivated and qualified staff whose full potential was not being realized. Noting that since 2002 dental therapists could work in general dental practice, he concluded that they could play an increasingly important role.

Later that year the same author called for more support for dental therapists to help them sit more comfortably in NHS practice with its new contract (**Ward, 2006).** It was now difficult to measure a dental therapist's contribution, but he repeated the idea that employing one to undertake routine dentistry would allow dentists to provide more complex treatments, thus achieving a high UDA target. He also suggested that Primary Care Trusts could commission directly from dental therapists. Overall, he suggested that focusing on the dental team as a multiprofessional unit, the professional, managerial and health and safety issues involved in working together could be addressed.

The greater role for teamwork in the new millennium required additional guidance from the General Dental Council. "The Principles of Dental Team Working" (**GDC, 2006**) outlined the nature of the dental team and the role of good

leadership in developing a team that works cohesively to provide good patient care, particularly focusing on the need for good communication and recognition of individual responsibilities. Inclusion of hygienists and dental therapists in the GDC "Maintaining Standards Document" (**2007**) outlined the role and range of treatments permitted under dentist supervision. The British Dental Association also produced guidance to its members on the remit and training of dental therapists, which gave specific advice on working with a dental therapist and on employing one in NHS and private practice.

Several international comparisons appeared at about this time. Naidu and colleagues (**2006**) compared levels of career satisfaction among dental nurses in Trinidad and dental therapists in the United Kingdom and New Zealand, all thought to be comparable. Participants were asked to rate their overall career satisfaction. Thirty-two percent of U.K. dental therapists felt they were not a valued members of the dental team, compared with 59 percent and 39 percent in New Zealand and Trinidad, respectively. The authors concluded that dental therapists working in different health care systems reported different levels of career satisfaction and that there was a need for further research in the area to address the impact of low career satisfaction on the dental workforce, such as workforce retention, quality of patient care and interactions with patients.

Another international comparison examined the salaried services of Western Europe, Australia, Canada and New Zealand (**Downer et al., 2006**)**.** While salaried services can be costly in relation to activity, services could be made more cost-effective by employing DCPs. The authors recommended affording dental therapists and hygienists greater independence and wider responsibilities.

Another international comparison of attitudes toward dental therapy was informed by literature reviews and semistructured interviews (**Kravitz, Treasure, 2007**). Drivers for change included workforce shortages and increased disease levels. Belgium and Greece showed little or no support for auxiliaries. While other countries were more supportive of hygienists, there was still a more negative attitude toward dental therapists. Attitudes in all countries except Belgium were improving over time.

Back in the United Kingdom, Jackson and colleagues (**2007**) examined the composition of the DCP workforce in South Yorkshire and found shortages among all groups of DCPs, finding problems with both recruitment and retention of staff. At the time data were collected **(2004)**, dental therapists had been permitted to work in the general dental services for two years. Data were provided by 156 dental practices, of which only 22 (14 percent) employed a dental therapist. Many of these practices only employed a dental therapist part time, with only 10 full-time equivalent dental therapists employed among the practices. The dentists had mixed views about the role of skill mix to increase efficiency. Some were broadly positive,

whereas others questioned whether teamwork would increase productivity. One young dentist said, "The only way you're going to sort it out [efficiency] is to train more dentists to start with."

Dentists' knowledge and attitudes toward dental therapists were also investigated in the light of their being able to work in the general dental service (**Ross et al., 2007**). Only 2 percent of dentists in southeast Scotland employed a dental therapist. Dentists' knowledge of their clinical remit was limited, but most (64 percent) said they would consider employing one. Reasons for negative responses included lack of space and reservations about clinical skills, competence, and responsibilities and costs.

From 2008 on, all DCPs, including dental therapists, were required to undertake statutory continuing professional development (**GDC, 2011a**). CPD is any activity that contributes to professional development. DCPs must complete at least 150 hours of CPD over a five-year cycle, of which 50 hours must be verifiable. Verifiable CPD must have clear educational aims and objectives, clear outcomes, quality controls and documentary proof. The GDC suggests that some of this CPD should be in three core subjects: medical emergencies (10 hours per cycle); disinfection and decontamination (5 hours); and radiography and radiation protection (5 hours).

By 2008, there were concerns that the 2006 dental contract would not bear fruit in terms of increasing access to care. The government health committee's (**2008**) investigation of the contract revealed several problems, including a failure to solve access issues and a reduction in the number of complex procedures carried out. The lack of suitable pilots before implementation was criticized, and hence the changes had failed to bring improvements where needed. The government's response to the health committee report was to commission professor Jimmy Steele to review the funding of NHS dentistry in England (**Steele, 2009**).

The use, or lack thereof, of skill mix was seen as part of the problems of the 2006 contract (**Freeman, 2008**) and this unintended consequence became a frequent discussion point. A general dental practitioner regarded the employment of dental therapists as "unviable" (**White, 2010**). From the perspective of a dental therapist, Griffiths (**2010**) wrote about the difficulty of finding employment, as well as inadequate working environments and lack of integration into the dental team. Wanless (**2009**) attributed this directly to the new dental contract along with dentists' lack of understanding. He reassured Griffiths that the situation was improving and could be helped by stable supportive positions and vocational training for hygienists/dental therapists. Gupta (**2011**) welcomed moves to look at the use of skill mix in practice, particularly in meeting the business needs of dental practice in terms of profitability.

An important series of studies regarding dental therapists was conducted in South Wales by a team at the University of Cardiff. First, Evans and colleagues (**2007**) used patient records at 17 dental practices to estimate the proportion of treatment that could be undertaken by dental therapists. Within their current skill set, dental therapists could provide 35.3 percent of care as measured by number of visits or 43 percent of the clinical time. Dental therapists who could undertake examinations and treatment planning could substitute for more of the work.

Jones and colleagues (**2007**) surveyed the attitudes of dentists in Wales toward hygiene therapists. Half of the dentists employed a hygiene therapist, with lack of space being the major problem for those who did not. The dentists lacked knowledge of the cost-effectiveness of dental therapists, with 60 percent preferring to appoint an associate. The suggestion was made that this stems from a lack of understanding over the training and role of dental therapists.

The same team studied the working practices of dental therapists (**Jones et al., 2008**). Most were using only a fraction of their skills in practice. This varied with their work settings, with the majority of dental therapists working in the GDS being restricted to the role of hygienists and only 9 percent of their time being spent using their therapy skills—raising the question whether training should return to singly qualified hygienists or whether a system could be introduced that would encourage dentists to make use of the full range of dental therapist skills.

Mike Grace's successor as editor of the British Dental Journal has also been a frequent supporter of the wider dental team. Hancocks (**2007**) focused attention on the need for DCPs to be registered with the GDC, which he felt reflected greater respect for the dental team members and brought ethical and legal responsibilities. He challenged dentists to reward this new status with more than mere lip service. Later Hancocks (**2009**) proposed that all DCPs should be able to subscribe to the British Dental Journal or have membership of the British Dental Association (BDA). He wanted the BDA to be at the forefront of the process of integration of all members of the dental team.

A coalition of DCPs argued against joining the BDA and felt their own interests would be better served outside the organizations (**Swain et al., 2010**). DCPs who might join the BDA for professional development, indemnity insurance and professional support could join their own professional organizations, which would be better able to advise them on their specific needs. In response, a group of dentists (**Joffe, 2010**) bemoaned such an isolationist stance and felt DCPs would benefit from affiliation with the BDA, citing the inclusive nature of the British Orthodontic Society, where inclusion of DCPs had benefitted all parties. The BDA chief executive was surprised by the fervor of this debate but agreed that it raised important points (**Ward, 2010).** He added that the BDA was supportive of the DCP organizations and was happy for DCPs to have the freedom to join the BDA in addition to their own bodies.

Later still, Hancocks (**2011**) cited the reducing incidence of dental disease and treatment need in the population. With dental therapists able to perform 70 percent of the treatments a dentist can provide, many find employment opportunities sparse and end up deskilled, prompting a need to look at how the dental workforce needs to evolve to keep ahead of oral health trends.

The General Dental Council published a series of papers to explain to dentists their plans for the future. The first of the series (**Mathewson, Rudkin, 2008**) outlined the dilemmas faced to maintain standards. One standard related to whether DCPs could be allowed to see patients who haven't seen a dentist first. This in turn related to "scope of practice"—that is, who can do what within the clinical dental team. After "Developing the Dental Team," the remit of dental hygienists and dental therapists expanded so that they could work within the "limits of their competence." While this had allowed development and extension of roles, it lacked clarity and resulted in confusion that the council would address.

Hancocks (**2008**) discussed the difficulties that arose from not having a list of permitted duties, feeling that without clear roles and responsibilities, members of the dental team would not be used to their full potential. In 2009 the **GDC** (**2009**) returned to a list of permitted duties in its "Scope of Practice Document." With the greater emphasis on dental therapy, several programs training dental hygienists had been modified to train dental therapists. In some cases, graduates from these courses are called dually qualified hygienists/dental therapists, which is a misnomer, as in recent times a dental therapist has been able to carry out all of the duties of a hygienist. Successive GDC documents have been quite explicit about this (**GDC, 2004; 2007; 2009**)**.** However, Hillam (**2008**) raised concerns that the well-defined role of hygienist was being phased out in favor of the less well-defined role of dental therapists due to combined training in dental schools. The larger number of vacancies in practice for hygienists was thought to reflect the fact that the dental therapist role was open to interpretation and was expanding, leaving most dentists reticent to employ them within current practice structures.

Hillam also questioned whether moving from hygienist to dental therapist causes a shift from preventative to operative patient care, and suggested that this shift should be examined. Ross (**2008**) took issue with Hillam's suggestion that hygienist/dental therapists "will push to the legal limits or even further, with or without the blessing of a dentist who may be unclear of the regulations," believing that the oral health of the population was the concern of all dentists and dental care professionals. By working together, progress in addressing the unacceptable levels of disease would continue.

The idea of team training to integrate the dental team had been popular in dentistry since the landmark document "Options for Change" was published.

Although not studying dental therapists directly, Morison and colleagues (**2008**) studied the attitudes of dental and DCP students toward such interprofessional education (IPE), using the "Readiness for Inter-Professional Learning" (RIPLS) and the "Dental and Dental Care Professional Roles and Responsibilities" (Dental R&R) scales in dental ($n = 189$), hygiene ($n = 8$) and nursing students in Belfast. The students had positive attitudes to IPE because it improved their teamwork and communication skills. Some areas of practice, particularly personal care and advice to patients, were considered as shared roles. Barriers to the effective development of IPE were found in the attitude toward hygienists from both dentists and nurses, wherein the latter two groups felt that the hygienists did not have a substantive role to play in practice. Further research was suggested in order to clarify roles and responsibilities and to ensure that IPE programs develop positive attitudes to teamwork.

At this time, the Steele (**2009**) review of NHS dental services reported on improving access to and quality of services. It recommended a series of profound changes with the emphasis on achieving oral health rather than remunerating dentists to provide treatment, the inclusion of quality indicators as part of the NHS contract, and the use of care pathways to standardize treatment. As of 2011, these recommendations are being piloted across England, with a view to the introduction of a new dental contract in 2014-15. Steele highlighted the importance of effective training and development of the whole dental team. Dentists who contributed to the review gave mixed accounts of their experiences using, for example, dental therapists. Some saw it as a false economy whereas others saw it as a good business model.

Gallagher and Wilson (**2009**) also adopted a strategic perspective, focusing on the future dental workforce in the light of registration of all members of the dental team, the GDC's "Scope of Practice" (**2009a**) documents, evidence supporting greater use of skill mix, a review of quality care in the NHS (**Darzi, 2008**), local policy-making and an inflow of European dentists. There had been little consideration of funding mechanisms to encourage skill mix. Cumulatively these factors created a need to plan the future dental workforce that would be patient-centered and promote oral health. Dental education would need to adapt to changing skill mix and practices would need larger premises to house larger teams.

Although the general trend of government and professional policy had been to expand the use of dental therapists since the 1990s, very little attention had been paid to the views of lay people. Sun and colleagues (**2010**) compared patient satisfaction between patients seeing a dentist and those seeing a dental therapist. Patients treated by dental therapists were more satisfied than those seeing dentists. It is difficult to interpret these data, especially as only four practices were involved. In a closely related series of studies, Dyer and Robinson (**Dyer et al., 2010; Dyer, Robinson, 2008; Dyer, Robinson, 2009**) first explored these

views and then measured them. Their qualitative research identified three main themes, the first two of which ("Perceptions of the Nature of Dental Services" and "Anxiety about Dental Treatment") influenced views in the third ("Support for Skill-Mix"). Consumerist views and greater dental anxiety tended to be related to lower support for skill mix. The possibility of lower treatment costs was seen as beneficial. Public service views saw increased efficiency and access to services as potential benefits. Attitudes varied widely on the treatment of children. Two surveys, one local and one national, totalling 1,500 adults, had similar results. No members of the public could describe the duties of a dental therapist. On having these duties explained to them, most (60 percent) would accept simple restorative treatment from a dental therapist. Men, younger people, and those who thought they needed treatment were more likely to accept treatment. Fewer people would accept the same treatment for a child (55 percent) and, again, younger people found this more acceptable. Patients receiving treatment outside the terms of the NHS found it less acceptable for themselves or for children, and about half of participants felt that treatment by a dental therapist should be cheaper. The authors concluded that careful communication of the rationale and potential benefits of skill mix was needed.

Researchers and public health practitioners at the University of Leeds wrote an authoritative series including a literature review and data from a survey of dental therapists in 2009 (**Rowbotham et al., 2009; Godson et al., 2009; Williams et al., 2009; Csikar et al., 2009**). Their review described how the number of students entering training for dental therapy and their scope of work had increased (**Rowbotham et al., 2009**). The possibilities for dental practitioners to work with dental therapists were therefore greater, so they needed to be clear about dental therapists' potential capacity to provide added value to the dental team. This paper traced the history of dental therapy together with the development of dental therapists' training opportunities and emerging competencies. Their survey participants regarded themselves as part of the dental team but most felt underutilized. They believed the dentists could refer more patients to them and that working practices could be shared among dentists (**Csikar et al., 2009**). There was marked regional variation in the employment of dental therapists. By this time, the liberalization of places of work was evident, with half of participants now working in general practice rather than the community services (31 percent) (**Godson et al., 2009**). Not surprisingly, more recently qualified dental therapists were more likely to practice. However, the survey noted a number of dental therapists now working as hygienists, highlighting concern over potential deskilling. Remuneration arrangements for dental therapists were also studied (**Williams et al., 2009**). Almost two-thirds of their 470 participants (63 percent) worked in multiple locations and received more than one type of payment, with hourly rates or fixed monthly amounts being the most common. Nine percent received performance-related pay, based upon goal-setting, incentives and bonuses.

Stakeholders in dental education were invited by the Council of Heads and Deans of Dental Schools to discuss the future provision of dental education (**Wilson et al., 2008**). The rapid expansion in training for DCPs was predicted to lead to a wider degree of skill mix, in turn, requiring undergraduate training to include enhanced understanding and appreciation of the roles DCPs could play, together with more instruction on dental team leadership.

Dentists' lack of knowledge about the roles of dental therapists is a recurring theme since dental therapists were permitted to work in all branches of dentistry after 2002 (**Ross et al., 2007; Stockley, 2007; British Dental Journal, 2008; Nilchian et al., 2009; Csikar et al.; 2009; Bullock et al., 2010**). Several of these authors have commented on the scope to improve dentists' knowledge in this area. One student dental therapist wrote an article for the British Dental Association's magazine for DCPs (**Close, 2009**). The "catalyst for my writing this article is that despite being such a forward-thinking profession, so many dentists still do not realize what a dental therapist is and what our remit is." Earlier an editorial in the same magazine had complained about the myths held by dentists about the role of dental therapists (**Stockley, 2007**).

Nilchian and colleagues (**2009**) explored dentists, hygienists' and dental therapists' perceptions of factors that influenced the referral of children to dental hygienists and dental therapists for fissure sealants. In their qualitative data, no factors systematically influenced referral but idiosyncratic factors occasionally played a role. Structural factors included use of resources, payment and contracting systems, and practice characteristics. Individual patient-related factors were parents' and patients' attitudes and patient characteristics. Dentist-related factors included dentists' preferences, perceptions of DCPs, their perceived role of DCPs, and providing a service to patients. The paper concluded that dentists' knowledge of the roles of DCPs might be assessed to see if dentists need further education.

An opinion piece in the British Dental Journal had commented on the industrialization of the dental profession (**Cottingham, Toy, 2009**), which described an increasing factory-like, production-line approach to dentistry, citing the growing use of ancillary staff and the breakdown of treatment plans into manageable segments as examples. In a lively response, Renshaw and colleagues (**2009**) supported hygiene and dental therapists. They pointed to the times that a dentist has to defer to consult to a DCP colleague and that patients want to know who is treating them. They concluded that patients should be listened to more often.

Lloyd (**2009**) gained experience of teamwork and skill mix use on a fact-finding mission from Minnesota and found that dental therapists led to improved patient access to care. He felt that dental school-based training for dental therapists was paramount to ensure the respect of the profession and acceptance by dentists.

Integration into the dental team and use of their full skill set was important in making dental therapists cost effective.

After several high-profile cases, the Department of Health focused on the role of dental teams in identifying child abuse and introduced training for dentists for this purpose. As dental therapists have traditionally been associated with the treatment of children, they were also felt to have a role in identifying abuse (**Chadwick, 2009**). A survey of all registered dental therapists found that more than one-third recalled undergraduate training in the identification of abuse and almost two-thirds had received additional training since qualification. One-third of dental therapists had suspected child abuse, of whom most had acted in line with contemporary guidance. The same year, Harris and colleagues (**2009**) reported a postal survey of dentists and DCPs, including dental therapists, with an interest in children's dentistry to explore their experience of safeguarding children. The research was conducted before child protection was included in the GDC's standards guidance and mandatory health care trust training. In most cases, child protection training succeeded in raising awareness but didn't necessarily lead to professionals responding effectively to recognizing signs of abuse, with potentially one-third of suspected cases going unreported. There was a lack of confidence and considerable concern about consequences of reporting among health professionals, and a recognized need for improved training of dentists and DCPs.

U.K. dentists are required to undertake a one-year period of vocational training between graduation and taking up practice. Vocational training involves working in a carefully selected dental practice and having one day per week continued learning at an educational center. A need for similar schemes for dental therapists was identified and such schemes have been introduced, although some of this work seems to have been misconstrued (**Firmstone, 2008; Firmstone et al., 2008**). One such scheme was evaluated by Bullock and colleagues (**2010**). Nine dental therapists took part in group discussions, completed a questionnaire and had their educational portfolios assessed. Most of the trainees felt the scheme had helped their confidence and clinical skills and felt such schemes should be compulsory. Along with many authors, this group saw the growth of skill mix in dentistry as likely and concluded that schemes such as this would be a useful aid to dental therapists' development.

Job satisfaction was compared between hygienists and dental therapists in light of the underuse of dental therapists' skills (**Turner et al., 2010**). Multiple regression analysis identified several predictors of overall job satisfaction: satisfaction with colleagues; remuneration; variety of work; rating of hygiene work as rewarding; and not being self-employed. Satisfaction with the variety of work was the strongest predictor, itself strongly predicted by the extent the clinical remit was undertaken. The authors summarized this in a structural model, hypothesizing that greater use of the skills possessed by a staff member and better recognition of their remit,

qualifications and quality of work by their dentist colleagues were linked to job satisfaction. In an allied paper, the same authors investigated autonomous working among hygienists and dental therapists (**Turner et al., 2010**)**.** Participants were asked whether they undertook 15 clinical activities on their own initiative, how comfortable they would feel undertaking such clinical activities if referral from a dentist were not required, and how they perceived dentists' reactions. Hygienists and dental therapists had high levels of experience and confidence in their ability to work autonomously across a wide range of investigative, decision-making and treatment-planning activities. The exceptions to this pattern were appropriate to the clinical remits of these groups.

A small study compared the personality characteristics of students at one London medical and dental school (**Belsi et al., 2011**). Dental Hygiene and Therapy students were observed to be less extroverted/sociable than other students, but the design of this study prevents firm conclusions being drawn.

Along with the trend toward greater use of skill mix, there had also been a move in England to move more dental treatment out of hospitals into primary care. Williams and colleagues (**2010**) sought the evidence about whether the move to skill mix could be effective, reduce costs, and enhance access to or quality of care or whether it would improve patient reported outcomes. They conducted a systematic review using all of the major databases but found only 26 reports that met the inclusion criteria. There was limited evidence of improvements to cost- effectiveness or health outcomes, but some evidence of improved access and patient and professional satisfaction. Not surprisingly, the authors called for better primary data from service evaluations.

The previous year, Kolaczkowski and Charles (**2010**) had investigated the source of referrals to hygiene therapists in southwest England. The majority came from principles, and mainly for hygiene work. Dental therapists were found to be an underused resource because their remit was not clear to the dentists who could be making better use of their services.

Modeling has emerged as a method of anticipating and evaluating the value of skill mix in recent years (**Gallagher et al., 2010; Brocklehurst, Tickle, 2011a**). Operational research modeling was used to consider the capacity to meet the oral health needs of older people in 2028, in relation to demand, workforce supply and different scenarios of skill mix (**Gallagher et al., 2010**). A maximum skill mix model involved more staff (clinical staff equaled 10,337, of whom 2,623 were dentists, 4,180 hygienist/dental therapists and 3,534 clinical dental technicians) if care was provided at the relevant level of competence. Widening skill mix was therefore predicted to play a major role in building dental care capacity.

Researchers at the University of Manchester have made substantial contributions to the debates about the use of dental therapists as substitutes for dentists in recent years. Their consideration of the policy context for the use of skill mix used a well-developed economic model that brought together both productivity and need for service (**Brocklehurst, Tickle, 2011b**). Like Perri 6 (**1996**), they recognized the anomaly that both dentists and DCPs were regulated by the same body, so restricting the professional autonomy of all classes of DCP, including dental therapists, although DCPs had been represented on the Council of the GDC since its restructuring in 2003 (**Wilson, 2003**). They suggested that the substitution of dentists by dental therapists would not produce gains in efficiency unless dentists refrained from providing the same services. Moreover, substitution in this way carried financial risks if dentists were to employ dental therapists into dental practices run as small independent subcontractors. The long-term appropriateness of dental therapy was also considered worthy of consideration, especially with a cohort of older people whose dental treatment needs were likely to be increasingly complex. This interesting paper suggests a number of areas for future research. Brocklehurst and Tickle (**2011a**) also applied concerns about the exquisite sensitivity of the finance of dental practices to the use of skill mix under the current NHS dental contract. Anecdotally, the NHS dental contract introduced in 2006 was seen to discourage the employment of dental therapists, an unintended consequence of the contract. These anecdotes were confirmed by applying some principles of economic modeling to the employment of a dental therapist in small dental practices. A significant barrier to the cost-efficiency of using dental therapists in practice was the use of the dentist to diagnose and treatment-plan.

Despite all the changes and recent information from the GDC and BDA, Dental Update published another update of the changes in clinical practice, and the fundamental role DCPs now play (**Hartridge, 2010**). Sixty percent of the dental workforce now comprised DCPs. There was still reluctance among dentists to accept the expanding role of dental therapists, as well as a lack of understanding over what precisely the role should entail, something that may be reduced by increasing team development training of students of all dental disciplines.

Models of practice organization were studied in six dental practices that employed dental therapists (**Sun, Harris, 2011**). Qualitative interviews with the practice staff revealed insights into how work was delegated in the practice, how dental therapists were reimbursed, and satisfaction with the different models of employment. Each dental practice adopted its own model of organization. Even in the larger practices, not all dentists referred work to the dental therapist because of reimbursement issues. In two practices the system was satisfactory to all parties. The study concluded that while the remuneration system contained some potential disincentives to dental therapist (DT) delegation, some practices innovated to overcome these issues. The dentists regarded DTs as a financial asset to the practice mainly because of their capacity to generate private income.

Bullock and Firmstone (**2011**) also warned against simplistic consideration of the benefits of skill mix. They acknowledged the threats to dentists' professional identity and autonomy and drew attention to the ceiling on career progression for dental therapists. They considered the policy context for dental therapy at three levels: macro (national factors such as government, the NHS, professional organizations); meso (the dental practice); and micro (interactions with patients and other members of the dental team). They also considered the role of education and training toward skill mix change before discussing the conditions required to implement skill-mix more widely in U.K. primary care dentistry.

A restorative dentist conducted two small studies of the training of dental therapists. Lynch and Wilson (**2010**) found that posterior composite restoration teaching was a well-established part of dental therapist training. Although there was some variation between different centers, overall experience was sufficient to meet the GDC guidance. Lynch and colleagues (**2011**) evaluated education of hygienists/dental therapists, and cited the concurrent dental student/dental therapy student teaching in dental schools as important in overcoming recognized difficulties in effective team-working and skill utilization in practice. Community-based clinical teaching of hygienist/dental therapists was found to be very valuable. A much more comprehensive evaluation was reported the same year by Smith and colleagues (**2010**) based on a primary care placement program that had been running for seven years from the University of Sheffield. During the placements, dental students planned treatment and then referred patients to dental therapy students for treatment. The dental students were also expected to provide appropriate developmental experiences for the therapy students. They were given project work that required them to identify the duties of a dental therapist and to review the experience and competence of the dental therapy students working with them. This aspect of the program allowed dental students to reflect on their role as team leader. The dental therapy students provide feedback on this to the dental students.

Nilchian and colleagues' (**2011**) case note review of children treated in primary dental care yielded preliminary data on the effectiveness of fissure sealants placed by dentist, hygienists and dental therapists. Caries experience among the children was high, with a mean baseline DMFT of 4.5 (SD=3.9). With caries transformation as the outcome, the mean survival time for sealants placed by dentists and DCPs was the same at 6.4 years. It was concluded that dentist and DCPs were similarly effective in providing sealants for caries prevention and that these data could be used to plan trials to provide more conclusive comparisons.

In preparation for the future NHS dental contract, and anticipating a move toward greater delegation of care, Robinson and colleagues (**2011**) were commissioned to model the future dental workforce supply in England. Major dental and DCP groups (including 800 dental therapists) were surveyed to ascertain their current

working patterns. Dental therapists often worked peripatetically and most only worked part-time. Only 44 percent of their clinical time was spent working as a dental therapist rather than carrying out the duties of a hygienist. Two scenario models were built that were live and sensitive to changes in assumptions: stocks and flows and participation rates. Participation rates were deemed more useful for modeling the dental therapy workforce because most dental therapists were women. Both models predicted an increase in the number of dental therapist WTEs over the next two decades. Working in several locations and the underuse of skills did not aid the retention of dental therapists in the workforce. The current employment arrangements and working practices of dental therapists were also suggested to not be a suitable basis for projections for this group of workers. The current NHS dental contract did not encourage the use of dental therapists in NHS practice. The assumptions in the model for dental therapists were also thought to require revision, as there were anecdotal reports of decreased commissioning of dental therapy training.

Section 7

CANADA

Canada is one of the largest countries in the world, with a total area of 3.8 million square miles. For its size, Canada has a small population: Although it is the second-largest country in the world, its population is approximately 34.3 million, or about one-tenth that of the United States. There are 10 provinces (British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, Newfoundland, Nova Scotia, New Brunswick and Prince Edward Island) and three territories (Northwest Territories, Yukon and Nunavut). Despite the vastness of the nation, 90 percent of the Canadian population lives within 100 miles of the U.S. border. The majority of the population resides in urban areas.

Understanding how dental therapists came to play a role in providing oral health services to Canadian children first requires an explanation of how health care is administered and funded in Canada. The federal government provides funding through cash and tax transfers to the provinces and territories to help pay for health care services, but the actual delivery of services is a provincial/territorial responsibility. Each province or territory is responsible for specific planning, public health and the financing of the health care system. However, the federal government is responsible for delivering health care services to specific groups, such as First Nations and Inuit citizens and veterans.

The Canada Health Act is Canada's federal legislation for publicly funded health care insurance. The act sets out the primary objective of Canadian health care policy, which is "to protect, promote and restore the physical and mental well-being of residents of Canada and to facilitate reasonable access to health services without financial or other barriers." The aim of the Canada Health Act is to ensure that all eligible residents of Canada have reasonable access to insured health services on a prepaid basis, without direct charges at the point of service for such services. Dental care is not included in the Canada Health Act. As in the United States, the majority of Canadians receive dental care in private dental practices and either have some form of private or public dental insurance or pay the entire cost themselves.

Canada has a history of two separate and distinct dental therapy programs. The province of Saskatchewan operated a dental therapy program in the 1970s and '80s in order to provide oral health care to all of the province's schoolchildren. The federal government also initiated a dental therapy program in 1972 to provide access to dental care for Canada's aboriginal peoples.

HEALTHCARE FOR CANADIAN ABORIGINALS

The aboriginal peoples of Canada, as defined by the Constitution Act of 1982, comprise the Indian, Inuit and Métis peoples. They represent about 4 percent of the Canadian population. Approximately 0.3 percent of the total Canadian population resides in the Yukon, Northwest Territories or Nunavut, a vast realm encompassing more than one-third of Canada's total land mass and bordered by the Arctic Ocean, Alaska and the Atlantic Ocean. These territories also have the highest proportion of aboriginal populations in the country: Nunavut (85 percent), Northwest Territories (50 percent) and the Yukon (25 percent).

As stated previously, the federal government is responsible for delivering health care services to First Nations and Inuit citizens. Treaty Number 6 was signed in 1876 by the Cree of central Alberta and Saskatchewan and the Canadian government. It contains the "medicine chest" clause that is the basis of First Nations claims that health care is a right. The wording in the treaty is that "a medicine chest shall be kept at the house of each Indian agent for the use and benefit of the Indians at the direction of such agent." This constitutes the only written treaty that defines the responsibilities of the federal government in regard to native health care services. Subsequent legislation and federal regulation includes the Indian Health Policy of 1979 and the Canada Health Act of 1984.

THE FEDERAL DENTAL DELIVERY SYSTEM IN THE 1960S

Bedford (**1993**) described the state of dental delivery services in the 1960s and '70s in Canada's northern territories: "There were virtually no formal dental delivery services in place in remote locations. It was not uncommon for nurses, and sometimes priests, to extract teeth." He further illustrated the depth of the problem by saying, "There was little or no equipment available to provide restorative care in remote communities, and government salaries were too low to attract good personnel. As well, dentists were far too busy in their private practices to have any interest in providing more than emergency care to Indian patients, particularly since the approval and payment systems operated by Medical Services Branch [the federal health department] were very slow and cumbersome."

Schnell (**1992**) also outlined issues with the delivery of dental services to Canada's north in the late 1960s and early '70s:

"Prosperity in southern Canada had created an isolationist attitude among most medical and dental practitioners as far as considering traveling to northern Canada to provide services. Only the very adventurous dental or medical practitioners were willing to accept the challenge to "go north" and face not only

cultural and geographical challenges but the hardship, challenge, and culture shock in attempting to provide dental services in remote northern communities."

Canada's northern aboriginal population was found to be bearing a disproportionate burden of dental disease. Schnell (**1992**) observed that "Major urban areas such as Toronto, Montreal, Edmonton and Vancouver as well as smaller centers such as Inuvik and Frobisher Bay, and Sioux Lookout began receiving increasing waves of northern natives in dire need of basic dental care." Schnell further noted that "dental needs were observed to be phenomenal particularly among northern native children…."

The Hospital for Sick Children in Toronto, Ontario, is one of the foremost institutions in the world dedicated to the care of children. Dr. Keith W. Davey, a pediatric dentist, was the hospital's Head of Children's Dentistry at this time. He noted the poor oral health of children being referred to the hospital for treatment. As Schnell reported, Davey "found himself appalled at the dental status of these native children and began his quest to address and find a solution to this endemic problem. His aim was to find a compact and universal program to solve this sorely lacking aspect of health care in Canada for native Inuit and Indians."

FOUNDING OF THE NATIONAL SCHOOL OF DENTAL THERAPY

In 1970 and '71, Davey and Dr. Sy Black, the federal government's senior dental consultant, discussed using the New Zealand dental therapist model as a possible means of providing dental care to aboriginal children: "Dr. Davey and Dr. Sy Black carried out an in-depth analysis and assessment of the nature and workings of the New Zealand dental nurse program providing dental care for school children" (**Schnell, 1992**).

As a result of these deliberations, Davey proposed that the federal government develop a New Zealand-style dental therapist program for the delivery of primary dental care, including restorations, extractions and preventive services, to aboriginal residents of northern Canada. This ultimately led to the federal government contracting with the University of Toronto to establish the National School of Dental Therapy (NSDT) in Fort Smith, NWT, in 1972:

"A joint proposal agreement between Medical Services Branch [federal government] and the University of Toronto was struck on a probationary basis and as a pilot project for 2 years to test Dr. Davey's idea of a modified New Zealand dental nurse program to be instituted for the delivery of primary dental care to natives, Indian and Inuit, in northern Canada with particular emphasis on school children. Under this proposal agreement, the federal government, through Medical Services Branch, was to provide total program funding and the University of Toronto was to provide the administrative arm of the program. As a result, in

1972, the National School of Dental Therapy (NSDT) was founded at Fort Smith, Northwest Territories, as a 2 year trial program with Dr. Davey as director. This program was to train native northern Canadians to provide auxiliary dental care services to small remote northern Canadian communities (preferably their own home communities) in the NWT and the Yukon" (**Schnell, 1992**).

The federal government bore the costs of tuition, books and supplies for dental therapy students. The government's interest in providing this financial support was explained by Schnell:

"The rationale used by Medical Services Branch [federal government] is that a graduate working at an acceptable productivity level for 2½ years, (on salary) will have paid for their training costs in deference to Medical Services Branch paying for dental services provided by a dentist on a fee for service basis."

THE NATIONAL SCHOOL OF DENTAL THERAPY: PHILOSOPHY AND CURRICULUM DEVELOPMENT

In 1974, Davey, the first director of the NSDT, published a paper in which he documented the objectives of the federal dental therapy program and how the school achieved them (**Davey, 1974**). He described the "two essential components" of the program: to first "develop a school and train students in a 2 year training program," and second, "to organize the service aspect to ensure control of the quality and delivery of dental care by certified graduates in the field."

Davey outlined the "three prime objectives" of the new federal dental therapy program:

1. *To train residents of Canada's north to administer a major portion of high quality primary dental care to be carried out under the prescription of a dentist;*
2. *To make dental care available to everyone, particularly inhabitants of small settlements, by establishing dental clinics manned by a resident dental therapist;*
3. *To establish a program of dental health education and preventive dentistry in each community.*

He stated that these objectives were reached by centering the program on three principles:

1. *Standardization of equipment and procedures throughout the service;*
2. *Quality control of the work that the dental therapists and dentists produce in the field;*
3. *Portability of clinics.*

Standardization was essential because "standardization permits graduates to transfer from one location to another without requiring retraining in equipment or procedures. This flexibility is desirable because it helps maintain high morale and also ties the program together across the country."

Quality control of work performed by dental therapists was the "responsibility of dentists, coordinated from the school of Dental Therapy, who are willing to accept and work with the therapists." The dental therapist was expected to reside and work full time for a minimum of one year in an assigned community. A dentist from the NSDT visited the community for a few days each month to "monitor the work to be completed by the therapist, examine patients charted by the therapist and prescribe appropriate treatment plans for future work to be carried out in his absence."

Portability of the equipment was necessary, given the challenges of transporting dental equipment to set up clinics in remote communities accessible only by air. Additionally, equipment had to be easily portable in case it had to be returned to the NSDT for major repairs. The prerequisite to entering the program was successful completion of a Grade 12 level of education. The school was designed for a total enrollment of 30 students over age 2 and was staffed by five full-time dentists and five support staff. Davey stated that the school "strongly supports the principle that dental therapists must be identified as auxiliaries within the dental profession and therefore teaching at this school is carried out primarily by certified dentists." Davey observed that "the study of academic subjects has proved to be more difficult for the students than the development of manual skills." He attributed challenging environmental circumstances as the reason the school experienced a high attrition rate in its first few classes, with eight graduates from the first class and a projected 12 to 14 in the second class of 20 students.

Davey emphasized that in the curriculum structure: "The students are not given much latitude with respect to the various methods of treatment and all equipment and procedures are standardized. This standardization will be maintained in the field operation." Development of manual skills was initiated early on in training: "Students also begin operative procedures on mannequins within two weeks of enrolling in the program." Procedures that dental therapists were trained to perform included:

1. *Conduct school dental health programs;*
2. *Radiograph and chart patients;*
3. *Administer local anesthetic using the infiltration technique and the mandibular nerve block;*
4. *Place amalgam and composite restorations in deciduous and permanent teeth;*
5. *Perform vital pulpotomies and place preformed stainless steel crowns on deciduous teeth;*

6. *Perform uncomplicated extractions of deciduous and permanent teeth;*
7. *Take and pour impressions for study models and some prosthetic appliances that will be designed by the supervising field dental officer;*
8. *Clean teeth and apply topical fluorides;*
9. *Handle emergency dental procedures until professional advice or assistance becomes available.*

Also integral to the dental therapy curriculum, according to Davey, was helping develop individuals to be successful as community oral health educators: "One major responsibility for the graduates will be to fulfill their role as dental health educators. In addition to their background course in preventive dentistry, a program in public speaking and classroom teaching techniques has been organized in cooperation with the elementary and high schools of Fort Smith."

Part of the second year of training was spending a minimum of one month working in an isolated community. These clinic experiences were "operated by one instructor and four students" and "proved invaluable" in preparing dental therapy students for their future working conditions.

Davey was critical of past attempts to deliver dental service to northern aboriginal Canadians by private practitioners "blitzing" an area for "short intensive treatment periods." He felt this method of treating patients was "poor delivery of health service and lacks the continuity that preventive dentistry requires," as opposed to the dental therapist program, which was "designed to encourage graduates to take up residence in a community and identify with the people of the settlement in order to render maximum service."

Davey continued to chronicle the outcomes of the federal dental therapy program in a series of articles he published throughout the 1980s. By 1980, he reported that there were 44 dental therapists working in northern aboriginal communities, of whom 14 were native. He reiterated the importance of acknowledging that "the dental therapist is not trained as a 'fill in' person in a crisis situation, but is to function as a member of a team," and that "professional control, nurtured in an attitude of respect between the dental therapists and their supervising dentists, was essential to ensure that a quality service was delivered effectively and economically to the specified communities."

In 1982, Canada was approached by the Mozambique government, which expressed an interest in the Canadian dental therapist program. Subsequently, a group of African students completed the two-year dental therapist program. Davey noted the similarity in problems in facing both the Canadian and Mozambican governments in providing health care to rural areas, as "none of these communities can support a private dental practitioner nor would any go to such remote locations." He felt the success of the dental therapist program

in Canada was the result of the "philosophy that is important to provide care in isolated surroundings that is consistent in both quality and availability, as against the visiting dentist concept." Hence, the "mutual appeal for both the Mozambicans and Canadians in the development of specially trained dental auxiliaries to administer community dental health programs and provide primary dental care" (**Bedford, 1987**).

Fifteen years after the NSDT was founded, Davey (**1988**) reported that "113 dental therapists have graduated and 67 percent are still working, of which about half are native or northern people." Therefore, the dental therapy program demonstrated that it was possible to train high school graduates to deliver quality oral health services after two years of training. However, Davey noted that "Students with a full Grade 12 level of education have about a 70 percent pass rate and almost all complete the program in 2 years. Students with only Grade 10 have a 25 percent success rate." He felt that the standardized clinical techniques and portable equipment were critical components of the program's success: "The equipment has proved to be durable, portable and for the most part, repairable on site."

Immediately upon establishing the dental program in the community, "dental therapists are expected to spend 20 percent to 25 percent of their time in preventive dentistry activities, regardless of the demand and requirements for dental treatment." A review of the dental therapy programs in eight northern communities in which a dental therapist had worked for at least three consecutive years showed that "virtually all, not just half, of the dental patients reached a maintenance level of care." Hence, the statistics "revealed that the average time that could be devoted to preventive dentistry could be doubled in the 3 year period." In these communities, dental therapists would now "spend about half of their time carrying out preventive and educational programs"(**Davey, 1988**). Based on these findings, Davey concluded that "for Arctic communities, the two year training of highly skilled para-dental workers, the designing of appropriate dental equipment, the ability to reduce treatment demands, are all possible, realistic and successful goals."

RELOCATION OF THE NATIONAL SCHOOL OF DENTAL THERAPY

C.G. Petrikowski (**1988**) described the relocation of the National School of Dental Therapy from its original location in Fort Smith, Northwest Territories, to Prince Albert, Saskatchewan, in 1983. The issue of "relocating the School of Dental Therapy arose because of a lack of patients for teaching purposes. Previously, people from Fort Smith and surrounding areas came to the school for dental treatment. Eventually, the demand for basic dental treatment diminished so that the students were not getting adequate clinical experience. Because of preventive efforts, the dental health of the population had progressed to the point that very

few stainless steel crowns were needed and often only very simple amalgam restorations were performed by students.… Staff and students were forced to pack their equipment and go into the field to find suitable teaching patients."

The subject of recruitment of suitable candidates also played a role in the decision to relocate the school since "it was also felt that the number of qualified candidates applying to the program from NWT and Yukon regions was limited and that future candidates from other parts of Canada might be reluctant to move to Fort Smith for training, and the number of graduates from the program would diminish."

Controversy surrounded the proposed move and "relocation of the school met with strong opposition from various sources. The town of Fort Smith was very unhappy at the prospect of losing the school and the prestige it brought to the area. The provincial dental associations were opposed to placing the school in their provinces because they still did not support the dental therapy concept."

The subsequent delay in deciding upon a new location for the NSDT had a deleterious effect upon the program. "During these delays, the school in Fort Smith was faced with such an acute shortage of patients that staff and students had to travel to areas as far away as Labrador in search of patients. As a result, the instructors were forced to be away from their families for four to five months at a time. Instructors began to resign and the school was then faced with a shortage of teaching staff." As a result of these issues, "The school finally closed its doors on September 1, 1981, obliging the government to choose a new site. By January 1983, a permanent facility was found to accommodate the new School of Dental Therapy." The decision was made to place the school in Prince Albert, Saskatchewan. The author speculated that "The reason Prince Albert was chosen may be attributed to the fact that Saskatchewan already had a program similar to that of dental therapy. "

Petrikowski summarized organized dentistry's opposition to relocating the dental therapist program from the Canadian north to one of the provinces:

> *In January, 1980, the Board of Directors of the Alberta Dental Association (ADA) asked the Attorney General to investigate the activities of dental therapists practicing in the provinces and sent RCMP officers to question the therapists in the field. The ADA wanted to be certain that the therapists were operating only on Crown Land or reserves…. This Investigation lasted only three or four months and no charges of any kind were placed.*
>
> *In January 1980, the Canadian Dental Association (CDA), the Medical Services Branch [federal government], the provincial dental association and Native representatives held a meeting in Ottawa to discuss dental therapists. The CDA was opposed to dental therapists and felt that by operating in the provinces, the*

therapists were practicing illegally because they were not licensed in the province. The CDA also felt that all irreversible therapeutic dental acts or services must be rendered only by a licensed dentist.

The provincial dental associations also felt that their respective provinces had enough dental manpower to service all their inhabitants, including native Indians and Inuit living on reserves and that therefore, dental therapists were not needed.

Medical Services Branch [federal government] emphasized however that these people needed more care than a dentist could offer in a two or three week period a few times a year. The Medical Services Branch agreed to relocate the therapists to more remote regions but maintained that the school would not be closed.

In the months following the meeting, the provincial dental associations endeavored to prove that there was no need for dental therapists due to a surplus of dentists but to date this has not been demonstrated. The Alberta Dental Association has invited dentists to treat natives on Federal reserves; only about sixty dentists responded. When these dentists were informed of the actual working conditions, the list of those interested decreased considerably. Unfortunately, a very small number of private practicing dentists want to work on reserves.

QUALITY EVALUATION AND ASSESSMENT OF THE DENTAL THERAPIST PROGRAM

On Jan. 8, 1989, the Canadian federal government contracted Dr. Ralph Crawford and Dr. Bradley Holmes (**1989**) to assess and evaluate dental treatment provided by dental therapists to the Inuit people living on Baffin Island. Both dentists had served the profession in the capacity of president of the Canadian Dental Association: Dr. P.R. Crawford in 1984-85 and Dr. B.W. Holmes in 1985-86. The dental treatment evaluated had been provided by four delivery systems: private practitioner contract, McGill University contract with dental residents, dental locum and dental therapist.

The methodology of the evaluation was as follows:

Patients to be examined who had received treatment within the past 18 months. These patients were to be examined in the nursing stations or school facilities. All communities visited had permanent clinics with dental chairs and lights. The dental examination was performed with a mirror and explorer. The condition of all teeth was recorded and all missing teeth were noted on the forms. The restorations were evaluated as R [superior], S [satisfactory], or T [failed].

Detailed evaluation criteria for ratings included appraisal of surface and color, anatomic form and marginal integrity. The examiners visited five remote settlements, examined 323 patients and evaluated a total of 1,860 restorations, including amalgams, resins and stainless steel crowns. Of the dental restorations placed by dental therapists, 31.7 percent were excellent, 65.7 percent were satisfactory and 2.5 percent were failures. Of the dental restorations placed by dentists, 8.1 percent were excellent, 80.5 percent were satisfactory, and 11.4 percent were failures.

Crawford and Holmes then went on to provide an evaluation of the advantages and disadvantages of the four delivery systems. The following are direct quotations:

Private practitioner contract

Advantages:

1. *Self-administrating and managing*
2. *Guaranteed delivery and frequency of treatment*
3. *Appear highly productive. Considerable visibility and dental "activity" with many patients being treated, raising the question, "is more and more better?"*

Disadvantages:

1. *Very expensive. It is a profit motivated service which tends to utilize high yield/low time procedures. Examples would be completing many minor restorative procedures such as occlusals, buccal pits, etc. and neglecting more major larger restorative needs: "two step" denture procedures involving impressions and a "bite" at one appointment, with insertion (often by another dentist) weeks or months later.*
2. *Children seem to be neglected (related to the above?). Numerous pre-schoolers and younger children could benefit from more attention to restorative such as stainless steel crowns.*
3. *No evidence whatsoever to the needs for oral hygiene. There appears to be no scaling or prophylaxis and prostheses were being placed in mouths that were precarious from a periodontal position.*

McGill University Residency Program

Advantages:

1. *Inexpensive??? We don't know as we have not seen the total bill!*
2. *Dentists are licensed and North American trained and hold NDEB certificate.*
3. *The program is externally administrated so that it reduces the paperwork for the territorial government.*
4. *Four or six weeks are a good length of time to spend in a community.*

Disadvantages:

1. *Residents are inexperienced for many of the types of service they are required to perform … the residents see only 4 or 5 patients a day.*
2. *Although an interpreter is provided, there is no dental assistant.*
3. *In the northern environment there is always a communication difficulty … many of the people, including the children, do not speak English.*
4. *Residents are accustomed to supervision … there is just no one to turn to or talk with regarding less than ideal situations.*
5. *There is some indication that some of the residents may be in Broughton Island against their will. It is not something they want to do … it is almost a sentence.*

Dental locum

Advantages:

1. *Paid on a per diem basis and not pressured by profit motive.*
2. *Often return to the same community and therefore become known and trusted.*
3. *Often, because of the per diem arrangement, the locum by nature tends to be more adventurous and patient oriented. Quality is maintained.*

Disadvantages:

1. *"Scarce." Individuals must be recruited and should be known to be concerned, adventurous people who maintain a high level practice elsewhere. Must be committed to put in at least two to four weeks per year and be motivated for the more humanitarian reasons than the profit incentive.*
2. *Travel and maintenance costs.*
3. *Varying productivity. The possibility exists, depending upon the individual, of varying productivity. Some may work very hard and others not quite so conscientiously.*
4. *Varying treatment modes … there will be variation in treatment modes which may not necessarily be in the best interests of the patients.*

Dental Therapists

Advantages:

1. *Consistent quality: wherever therapist's treatment was observed, the quality of the work was good to excellent. There was hardly a case where a failed restoration was observed.*
2. *Therapist is resident in a community, becomes known to the community and often is married and raises a family in the area.*
3. *Essentially is trained to treat children of all ages which is where the success of the overall treatment strategy must begin.*
4. *Therapists are not motivated by a profit margin and therefore do not mind treating children, nor taking the time to do the work well.*

5. *A moderate producer: pattern seems to indicate that therapists will treat about six patients a day: a patient an hour. Considering they work without an assistant, have to book their own patients and do all the turn-arounds, a patient an hour does not seem unreasonable.*
6. *Costs are fixed: known ahead of time what it will cost to maintain in field for a year, or any specific period of time … controllable and not profit motivated.*

Disadvantages:

1. *Scope of practice is limited. Their two year course is a rigid technique course that is designed to keep the therapist out of difficulty. However, considering the premise that it is the children and young adults who require the priority, the therapist is trained to do 90 percent of the dental requirement.*
2. *Therapists do not make dentures. It would be handy if they even did denture adjustments and minor repairs.*
3. *Therapists are not treating the pre-school children…. If initiated early enough it would prevent so many of them having to be sent out for general anesthesia.*
4. *Therapists work without assistants. They would/could be much more efficient with chair side help.*
5. *Therapists are asked to work without "secure" space…. This could lead to difficulties with management cases, medical compromises and abuse accusations. When a therapist is located in a school or the nursing station at least other people are around to support and assist.*
6. *Too much "down time". The therapist works essentially within the school year and is unproductive during most of June, all of July and August, and during Christmas and spring breaks.*

Comments from local community members interviewed during the assessment process included opinions such as: "The need to retain and expand the dental therapist program, not curtail it in favor of contract dentists." Crawford and Holmes noted that "in all observations and conversations with residents and officials on Baffin Island it is recognized that the dental therapists play a very important role in maintaining dental health in the communities." Crawford and Holmes stated that "it is not recommended that dental therapists be replaced by contract dentists. A program of integration of the two systems is suggested, rather than the elimination of therapists." The report's final recommendations regarding dental therapists were "that their role be expanded … as much as one therapist in every community … and they become much more active in the provision of oral hygiene instruction and restoration procedures for pre-school children."

In a 1991 publication, Davey stated that his views on the achievements of the federal dental therapy concept were confirmed by the independent audit conducted by Crawford and Holmes (**Davey, 1991**). He felt that critics of the federal dental therapy program should take note that "auditing results seem to show that the curriculum balance is effective in a two year program and that dental therapists are able to successfully work as trained."

A further in-depth study of dental services provided by federal dental therapists was undertaken by Gordon Trueblood (**1992; 1993**). The purposes of the study were:

1. *To observe how the quality of care provided by dental therapists compares with the level and quality of care provided by dental practitioners in achieving the same service objectives.*
2. *To identify what effect the dental therapy program is having on the dental health status of communities.*

Trueblood explained that for the first part of his investigation "the data for this study was obtained from an earlier study by Drs. Ralph Crawford and Bradley W. Holmes." Trueblood felt that a limitation of Crawford and Holmes' study "was the failure to make maximum use of the data collected." He completed a further analysis of the Crawford and Holmes data to compare the quality of care provided by dental therapists versus dentists. "The application of additional statistical techniques serves to more accurately communicate the nature of the findings and how seriously to regard the apparent differences found between dental therapists and dentists" (**Trueblood, 1992, 1993**).

In order to assess the effectiveness of dental therapist interventions on community dental health status, Trueblood used two indexes: "the ratio of restorations to extractions and the ratio of restorations to preventive work. The two ratios are highly sensitive to the resolve of dental therapists to render comprehensive care and have been shown to correlate excellently with the quality of services provided to patients and communities."

COMPARISON OF QUALITY OF RESTORATIONS BY DENTAL THERAPISTS VERSUS DENTISTS

After in-depth statistical analysis of the Crawford and Holmes data on the number of superior, satisfactory and failed single and multisurface amalgam and resin restorations placed by dental therapists and dentists, Trueblood found that "from a statistical point of view, on the basis of six clinical restorative procedures encompassing 1,799 dental restorations, the quality of restorations placed by dental therapists was equal to but more often better than that of those placed by dentists."

Trueblood proposed three possible variables that could be associated with the superior quality of care provided by dental therapists:

1. *Dental therapists in training spend almost four times as much time on the subject of restorative dentistry than undergraduate dental students.*
2. *An important component of the quality control system built into the dental therapy program is periodic evaluation by dentists of the quality of selected*

procedures performed by the dental therapists. Accordingly, unlike dentists, dental therapists carry out dental procedures aware that the end results are subject to future assessment by a dentist.

3. *Dental therapists are salaried and will suffer no loss in revenue by taking their time; whereas dentists are "piece work" operators whose economic gain is linked directly to output levels.*

Trueblood stated that his results "provide assurance to the consumer, to the dental profession, and to dental therapists themselves that the dental therapy program is not a 'second rate' delivery system. It also serves to rule out possible criticism that training and supervision are lax or overly lenient."

Trueblood pointed out that "an important question arising from the very favorable findings in the quality of restorations placed by dental therapists in the study group relates directly to the external validity of the findings: To what extent can these findings be generalized to other dental therapists trained…?" In order to address this potential study limitation, he noted that "dental therapists are trained to function as technicians, not professionals…. To counteract the lack of direct supervision, the dental therapy program has been carefully and elaborately standardized in virtually every detail…. The high degree of standardization in the training of dental therapists and the operation of the program plus its high degree of enforcement, provide a reliable line of evidence of the similarity of all dental therapists in critical respects." Based upon this line of reasoning, he concluded that "it may be assumed that the quality of care found in this study is, in general, descriptive of the quality of care provided by the target population of dental therapists."

EFFECT OF DENTAL THERAPISTS' INTERVENTIONS ON COMMUNITY DENTAL HEALTH

The second part of Trueblood's study was an evaluation of the impact of dental therapy programs on communities served because "improvement in the community's dental health status should be the decisive factor in determining if the resources consumed by the dental therapy program are commensurate with the results obtained." This was evaluated using two indexes: the ratio of restorations to extractions and the ratio of restorative to preventive work (**Trueblood, 1992, 1993**).

Trueblood explained that the ratio of restorations to extractions (R/E**)** is "highly sensitive to the commitment of dental therapists to render comprehensive care. The results have also been shown to correlate excellently with the quality of services provided to patients…. A low R/E is suggestive of poorer overall dental health … while a higher ratio indicates better dental health among the population served."

The ratio of restorations to extractions (R/E) in five Canadian provinces and territories served by dental therapy programs was examined. Over a 10-year period from 1978 to 1988, "the data clearly shows a steadily increasing ratio which reveals dental therapists are having increasingly better effects on dental health in the communities they serve…. The steadily increasing trend is the first important line of evidence of the overall effectiveness of the dental therapists in improving dental health in the communities in which they work."

The ratio of restorative to preventive work (R/P) is "derived by dividing the total restoration RVUs by the total preventive dentistry RVUs." Trueblood explained that "This ratio is an important measure from the view point of public health dentistry and economics. The ratio is affected by the natural shift from restorations to more preventive work…. This ratio should decrease over time to show the desired shift from restorative services to preventive work. A low ratio indicates more preventive work than restorative work, suggesting overall improvements in the dental health of communities served by dental therapists."

The ratio of restorative to preventive work (R/P) was calculated by the aforementioned geographical regions for all dental therapists from 1978 to 1987. During this period, "the data reveals a steadily declining ratio indicative of consistently improving levels of dental health in the communities served by dental therapists." The decline in the R/P ratio is an indicator that "the need for clinical dentistry may be decreasing in communities served by dental therapists. Therefore, the dental therapy program may be justified on the grounds of savings in future treatment expenditures alone."

Trueblood concluded his study on the quality evaluation of dental services provided by dental therapists with the statement, "The foregoing analyses provide convincing evidence that dental therapists provide high quality services resulting in positive outcomes for both the patient and the community. These findings reveal that dental therapists are a good pool of health manpower who can treat patients with high quality of care at low cost."

In a different study, Trueblood (**1994**) asked the question, "From the point of view of Health and Welfare Canada, do the benefits of the current program justify the costs?" He conducted his costs and benefits economic analysis "using an ex post facto intra-cohort trend study of 32 dental therapists who were trained and employed between 1982 and 1987. The costs and benefits attributed to the cohort were measured annually from date of entry into training, through graduation and employment to June 30, 1990, or date of termination, whichever came first. The cost and benefit data for the entire cohort were aggregated on an annual basis and, using an inflation factor for each year, adjusted to 1990 dollars and tabulated for comparison." Trueblood concluded that "the economic analysis arrived at a positive net present value for the cohort." In other words, "the

government benefits monetarily when dental therapists perform services that would otherwise be performed by a dentist and billed to Health and Welfare Canada.… Over the life of the program, the sum of the avoided costs will exceed the operational costs of the program and the program will be considered cost-beneficial to the federal government."

McDermott, Mayhall and Leake (**1991**) plotted the total number of extractions, restorations, and preventive procedures by federal dental therapists between 1974 and 1986. They concluded that while evidence exists that an emphasis was being placed on attaching the high rate of caries in the native population through an active preventive program, insufficient data existed to determine the effectiveness of the program. They concluded, "The dental therapist program has achieved some very positive results. The program has demonstrated that native people can be trained to perform a variety of dental procedures, including simple extractions, and restorative procedures, and that these graduated can enter the community and provide a high level of dental health care to their community. The use of dental therapists in the N.W.T. [Northwest Territories] is proving to be an effective alternative to the problems of mal-distribution of dental health providers."

NATIVE SELF-DETERMINATION

Native self-determination refers to the aspirations of First Nations and Inuit people to return to self-governance in accordance with their historical and cultural traditions. This involves aboriginal communities taking control of health care administration, including dental programs aimed at improving native oral health. In the 1990s, the impact of this cultural factor upon the national dental therapy program begins to enter the literature.

By 1992, a review of the federal dental therapy program by G.M. Schnell, dean of the NSDT during this time, documented that the "federal government has expanded the service area to include all crown lands [reserves] south of 60° latitude. As a result, federal dental therapists are now located on crown lands [reserves] in all areas of Canada with the exception of Ontario and Quebec.… At present in Canada there are 70 dental therapists in the workforce, 27 of which are in the NWT, 10 in the Yukon, and 33 in the provinces. Of the work situations of approximately 100 clinics in total, 65 are permanent community based clinics and 35 are being operated as satellite clinics" (**Schnell, 1992**).

The benefits of the federal dental therapy program were summarized: "A continuity of community dental treatment has been achieved in many remote communities which was and is not possible or feasible in situations whereby itinerant dentists provide treatment to communities." Schnell was critical of the dental profession's failure in meeting the oral health needs of all Canadians:

"Unfortunately, at present the provision of dental care to isolated communities by the dental profession itself remains much as it was in 1972. A great number of dentists oppose (either actively or passively) the dental therapy program but are themselves not willing to take an active part in provision of dental services to native communities."

Schell noted that the burgeoning First Nations and Inuit movement toward self-determination would very likely have an impact upon the federal dental therapist program: "the future may bring unanticipated changes to the operational and delivery system of dental care. Along with greater demands for dental care, native communities are demanding authority to hire and manage dental therapists and dental therapy services."

In 1993, Davey, although retired from his role as the original director of the NSDT, also provided some perspective on the effect of native self-determination on the future of the dental therapy profession: "The federal government is committed to transferring control of Northern health services to Indian and Inuit organizations … several transfers have already taken place, although only a few have included dental services." Only one example of long-term management of the dental therapy program by a native organization had been documented to date, "in 1976, when the Manitoba based Swampy Cree Tribal Council took over control of their band's dental program. The program has had some difficult periods since then, but it has survived. Current plans call for the program to be expanded by using dental therapists to service six communities under the council's jurisdiction" (**Bedford, 1993**).

As earlier noted, the NSDT was moved from Fort Smith, NWT, to Prince Albert, Saskatchewan, in 1982. The influence of the strengthening native self-determination movement on the national dental therapy program is evident. In 1995, management of the NSDT was awarded to the Saskatchewan Indian Federated College (**SIFC**), a recognized aboriginal educational institution:

"The National School of Dental Therapy was managed by the University of Toronto from 1972 until 1995 when it was decided to restrict contract bidding to nationally recognized aboriginal educational institutions. This was intended to create much greater involvement of representatives of First Nations and Inuit people in a program designed to serve their needs and to improve the appropriateness of the NSDT environment to try to counteract any dropout which might be due to culture-shock or alienation. This change resulted in the Saskatchewan Indian Federated College (SIFC) being awarded the contract to operate NSDT for the period July 1, 1995 to June 30, 2000" (**Tynan, 2001**).

This change in administration, after a long and successful history with the University of Toronto, was not without effect:

"This change in management, coupled with some abrupt changes to NSDT policies and personnel seemed to foster an impression, in the minds of some, that the NSDT program was deteriorating under its new management. In response to these concerns, SIFC moved swiftly to replace the NSDT Dean, to restore and define policies, invite a report from an external consultant, and generally to review the currency of the program, both from dental and educational perspectives" (**Tynan, 2001**).

Upon completion of the initial 1995-2000 five-year contract to run the National School of Dental Therapy, the Saskatchewan Indian Federated College was awarded the contract to operate the school for another five years. Included in the new contract was a requirement for a specific review and annual report of the NSDT program. The annual report outlined accomplishments of the program, including curriculum review and revision, policy reviews, community consultation, relationship with University of Saskatchewan, College of Dentistry, accreditation, staffing, students' accomplishments and recruitment of aboriginal students. It also contained a description of the ongoing challenges of managing the program, including staffing, students and finding an appropriate patient base. Some of the major points of the report are given below (**National School of Dental Therapy, 2001**):

Community Consultation

A need was perceived for a survey on the future needs of communities for dental therapists…. A consulting firm in Saskatoon, Anderson Fast and Associates, was engaged by the College of Dentistry, University of Saskatchewan, to design and carry out such a survey. The survey questions were jointly designed by faculty members of NSDT and the College of Dentistry under the guidance of the consulting firm. One hundred First Nations and Inuit communities were chosen at random to participate in the telephone survey, and the surveys were specifically targeted at Health Directors in these communities. The staff at NSDT is confident that the information gained substantiates what was already suspected and known (but heretofore undocumented) as to community needs and wants for dental therapists across Canada.

Recruitment

Over the last 5 years since SIFC secured the contract for the operation of the NSDT, a concerted effort has been made in attempting to recruit, retain and graduate an increased number of First Nations and Inuit students as dental therapists…. While the graduation of First Nations and Inuit students is highly dependent on qualified applicants and enrollment, ongoing efforts are being made to attract and graduate more First Nations and Inuit students on a regular annual basis.

Curriculum Outline

The curriculum is structured over a two year period leading to a Diploma of Dental Therapy. Almost all of the academic subjects are completed during the first year of the course. The second year is devoted primarily to patient care and clinic administration. Courses in the first year are grouped in four major areas:

1. *Diagnostic Dentistry*
2. *Operative Dentistry*
3. *Community and Preventive Dentistry*
4. *Program Support activities*

Accreditation

The Curriculum Advisory Committee placed a heavy emphasis on having the review done with future accreditation of the NSDT program in mind. A joint letter from Dr. Eber Hampton, SIFC, and Dr. Charles Baker, College of Dentistry, was forwarded to the Commission on Dental Accreditation in Canada, requesting that the Commission consider setting up guidelines for the eventual accreditation of the NSDT training program. In anticipation of such an eventual accreditation, Dr. J Tynan was successful in contracting the services of Dr. Marcia Boyd to assist…. Dr. Boyd is the recently retired Dean of the Faculty of Dentistry, University of British Columbia.

Community Outreach

Community outreach remained a pillar of the dental therapist program. Treatment rendered by dental therapy students took place primarily in rural field clinics (48 percent), followed by school clinics (26 percent) and finally in the NSDT clinic facilities (26 percent). "Field clinics for Year 2 students remain an integral part of preparing students for graduation. Because the focus of the program is to train students to go into remote, northern First Nations and Inuit communities, it is a very valuable experience having students live and work in such communities in a supervised group clinical setting…. While a good number of preventive and diagnostic services were provided, the main thrust of the clinics was again on operative services which include endodontic (pulpotomy), surgical (extractions) and restorative services. These operative services provided on student field clinics account for 48 percent of all operative services done by Year 2 students during the operating year.

Despite the emphasis placed on field experience in order to attract graduates to remote and northern communities, "NSDT increasingly faces the disheartening fact that many recent graduates have opted to work in private dental practices in Saskatchewan, where dental therapists have been recognized in provincial legislation."

Another issue noted in running the program was that if a staff dentist vacated a position, it was difficult to find a replacement because "It is unfortunate that very few qualified and licensed dentists who could fill this position are interested in public health dentistry or in fact in the dental therapy training program."

When the SIFC was awarded a second five-year contract to operate the NSDT from 2000 to 2005, one of the requirements of the new contract was "that a review of the NSDT curriculum be carried out during the first year of the contract. This is intended both to ensure that the didactic, pre-clinical and clinical aspects of the NSDT program meet appropriate academic and professional standards, and to develop documentation which will assist in seeking program accreditation through the competency based approach now being used by the Commission on Dental Accreditation of Canada"(**Tynan, 2001**).

The review of the curriculum was carried out by SIFC's affiliated partner, the University of Saskatchewan's College of Dentistry. The reviewers were dental specialists from the dental faculty, a restorative dentist from the Faculty of Dentistry, Dalhousie University and an expert in infection control from the U.S. Air Force. The curriculum content being evaluated included: Medical Evaluation, Dental Evaluation, Dental Radiology, Case Presentation, Head and Neck Anatomy, Infection Control, Local Anesthesia, Oral Surgery, Periodontics, Restorative Dentistry, Community Dentistry I, Community Dentistry II, Administration, Equipment Maintenance and Repair, and Dexterity Projects:

"The procedure followed [for the review] was generally based on using the format in the Curriculum Management section of the April, 2000 version of the DDS/DMD educational requirements obtained from the Commission on Dental Accreditation of Canada. Reference was also made to the Accreditation Documentation at the University of Saskatchewan's College of Dentistry, the American Association of Dental Schools curriculum guidelines, the 1995 Standards of Practice for Dental Hygiene, and a British Columbia Diploma Dental Hygiene Learning Outcomes document" (**Tynan, 2001**).

Overall, the review of the curriculum was very positive: "general content is very relevant and rich with practicality." Comments upon the program were generally favorable:

> *"Dental therapists see more patients, perform more radiographic procedures, and are evaluated more often on their applied skills in patient care than any of the other students (e.g., dental assisting, dental hygiene and dental students)."*

> *"Productivity data from NSDT shows that dental therapy students far exceed the numbers of procedures performed by dental students in all relevant categories, both pre-clinically and clinically. This also applies to pediatric restorative and*

> *pulp therapy procedures. Further, the expectations required of NSDT students are much more explicitly defined, both in terms of the level of performance and numbers of procedures which must be achieved prior to students being permitted to provide patient care."*

> *"None of the curriculum information obtained regarding programs for dentistry students showed anything comparable to the extent of the preparation of NSDT dental therapy students for classroom teaching and community health promotion in terms of theory and practical application."*

Interestingly, one reviewer actually recommended considering expanding scope of practice to include nitrous oxide because "this technique makes the management of children and other apprehensive patients so much more successful, so much more pleasant, and so much more humane that I feel its absence every time I visit the NSDT clinic or spend some time in field clinics. In fairness, the same could be said about most undergraduate dental clinics and many dental practices."

The general conclusion of the curriculum review: "In comparing dental therapy students to dental students regarding the specific restorative procedures that dental therapists are trained to perform, the conclusion is that the dental therapy students are evaluated according to equivalent qualitative standards while surpassing the quantitative standards of the dental students…. The recommendations do not address many of the minor modifications which are seen as normal, operational adjustments which are continually being made in any dynamic program" (**Tynan, 2001**).

Dr. J. Tynan, the faculty member from the College of Dentistry, University of Saskatchewan, was the main author of the final review of the curriculum report of the NSDT. He provided a number of thoughtful observations on the program and its objectives, including concerns about the long-term impact and sustainability of the program (**Tynan, 2001**):

> *Seeing them begin patient care, doing fillings, removing teeth, after less than 12 months of training after high school graduation is a dramatic contrast to the dental students having their first clinical experience after as much as four years of preparation at the university level…. Is the commitment to so much pre-dental education justifiable? Is the link to "outcome competency" proven, self-evident or demonstrable? There are no easy answers to these types of questions, but the tacit challenge posed by a dental therapy program is that it seems to suggest that the answer is "no."*

> *I have real concern, humanly and professionally, about dental therapists beginning practice in remote locations with no readily available experienced help when they encounter treatment complications or unusual clinical situations.… Again, if a*

dentist was readily available to manage these common complications, the situation would be more comfortable, but it is the non-availability of dentists which is one of the basic reasons why dental therapists are being trained in the first place.

Dentist support is a safeguard against the possibility of errors in patient evaluation or treatment planning and brings the broader based and more in-depth background of the dentists in the system.

There needs to be more clarity as to whether the role of dental therapists is as an interim or stopgap measure until such time that somehow the broader range of services provided by dentists is available to all First Nations and Inuit people or whether there is a vision of a longer term solution with career ladders closing the gap between the range of services presently offered by dental therapists and that provided by dentists.

The NSDT program is challenging and demanding. This in itself may be significantly related to the high dropout rate in first year.

Tynan thought that factors to consider in realistically assessing potential impact of dental therapists on aboriginal oral health included the following:

1. *The rapidly growing First Nations and Inuit population. This means that even if per capita indices of oral health are not worsening, the overall unmet need is still rapidly increasing. The transfer program seems partly intended to limit funding which, if this is so, will further compromise the adequacy of resources for a growing target population.*

2. *The impact of socioeconomic factors on First Nations and Inuit people. The dependency, the poverty, the violence, the crime , the alcoholism, the disproportionate disease burden, the despair, the suicides, for example, are root causes of the type of dysfunction which also expresses itself as poor oral health. Expecting a small number of dental therapists to somehow achieve dramatic oral health improvements without positive changes in these root causes is unrealistic. Education is often seen as the answer. Evidence supporting the effectiveness of oral health educational programs is at best weak and to place much reliance on them in the face of the aforementioned structural influences is very optimistic.*

3. *Compounding this limited capacity to provide care is the continuation of training only dental therapists and training them to work alone. This not only severely compromises potential productivity but is almost certainly a factor in causing dental therapists discouragement with their working conditions and hence contributing to higher rates of attrition among practicing dental therapists.*

4. *The uncertainty caused by transfer and the general lack of recognition and licensing for dental therapists are also deterrents…. Not surprising that there is a disproportionate number of applicants for dental therapy training from Saskatchewan and Manitoba. Given the geographic location of the school and given that Saskatchewan is the only province which licenses dental therapists and Manitoba has long been expected to do likewise.*

Tynan concluded that "Based on my experience with dental therapists since 1974, and of NSDT since 1995, particularly in terms of supervising in student clinics and field clinics over that period, I believe that the NSDT provides a very good and well organized program of training" (**Tynan, 2001**).

Subsequent annual reports from the Saskatchewan Indian Federated College National School of Dental Therapy included updates on the curriculum revision, staff hiring, recruitment and setting up field clinics. The response to the formal letter sent to Canadian Commission on Dental Accreditation to begin accreditation for the dental therapy program was that the request was being "tabled" to some future unidentified date due to "anticipated changes in the structure" of the Commission on Dental Accreditation (**National School of Dental Therapy, 2001-02; National School of Dental Therapy, 2002-03**).

THE FUTURE OF THE FEDERAL DENTAL THERAPIST

The National Aboriginal Health Association released a 2003 paper that reviewed the profession of dental therapy in Canada. The number of dental therapists practicing in Canada remained small, with 54 dental therapists employed by Health Canada, 24 by the provincial government of the Northwest Territories, five by the provincial government of Saskatchewan and five at the NSDT.

The authors speculated that "given the high growth rate of the Aboriginal population and the fact that there is just one training school, it is difficult to imagine that there will not be a shortage of dental therapists in the coming years." Further, the growth of the profession was likely to be restricted in Canada due to a number of issues, including the "lack of labour mobility may hamper efforts to recruit people to the dental therapy profession" as the "sole employer of these professionals is government and through various Aboriginal health agencies."

Nonetheless, the paper observed that the dental therapy program has "broad support throughout Indigenous Canada" and that in 1999, the Assembly of First Nations Confederacy of Chiefs supported the program: "Be it resolved that the AFN Confederacy of Chiefs support the retention of the NSDT in Saskatchewan and that it remain under the administration of the Saskatchewan Indian Federated College" (**National Aboriginal Health Association, 2003**).

In a 2007 article titled "Improving Community Health Through Continuity of Treatment: A Case Study of Dental Services in the Mushkegowuk Territory and the Natural Progression Toward Community Based Dental Therapy," Tsuji and Katapatuk reviewed the inequities in dental health between native and non-native Canadians: "Aboriginal people still have the poorest overall health status of any group in Canada" (**Tsuji, Katapatuk, 2007**).

Using the ratio of restorations to extractions (R/E) and the ratio of restorative to preventive work (R/P) performance indexes in a native community that had a continuous 10-year period (1990-99) of dental services provided by the same dental provider, they found that "continuity of dental health care has resulted in significant improvement of native health" compared with native communities with a history of sporadic care by different providers. They used their results to promote "initiation of a community based dental therapy program" in First Nations communities and said that "assigning dental therapists to these communities would give dental services in the region a community-based presence and be the first step in alleviating the inequality in community health. Continuity of treatment would be maintained…." Tsuji and Katapatuk concluded the study by stating, "It should be emphasized that a community based program with First Nations personnel should always be the final goal.… Remote First Nations communities should not be solely dependent upon external 'experts'; self-sufficiency is an important part in the self-determination process."

In recent years, the introduction of the dental therapist auxiliary into the U.S. dental delivery system has been the topic of heated debate between American legislators, foundations and organized dentistry. In a paper titled "On the pediatric oral health therapist: lessons from Canada," Quinonez (**2008**) suggested that the challenges experienced by Canada in using this model would be of relevance to the United States, "as it is the only country in the Western hemisphere to have such a provider, and because both nations hold specific challenges within indigenous populations." Also, in both countries, "the private profession has tended to discourage significant public involvement in service delivery."

Quinonez made three main suggestions "for consideration by American stakeholders in order to safeguard the long-term success of the pediatric oral therapist":

1. *As a model of care, policy stakeholders should promote the pediatric oral health therapist in a nonpartisan way, meaning that efforts should be ensured to gain support from all members of the political spectrum.*

2. *As an institution, the pediatric oral health therapist should be organized in such a way as to be cognizant of indigenous efforts at self-determination, but should not be put at risk by the complexities of such efforts (as they relate to*

> *state/indigenous relations). In effect, the pediatric oral health therapist should principally be conceived as a primary health care provider, who secondarily, is part of state/indigenous relations and their service delivery milieu.… This will safeguard the pediatric oral health therapist as a service delivery concept outside of indigenous care, and strengthen the idea of this form of provision in other public service environments.*

3. *The training of pediatric oral health therapists should be prepared to meet the societal need for them…. This provider is valuable in different service settings.… US private markets may come to incorporate therapists, so conceiving of such potential is, at the very least, prudent in terms of dental human resources training and planning.*

He concluded by stating that "it is clear that pediatric oral health therapist provides a long term, sustainable option to responsibly meeting the needs of America's socially marginalized groups."

CLOSURE OF THE NATIONAL SCHOOL OF DENTAL THERAPY

In 2011, the Conservative federal government announced it was eliminating the yearly funding necessary to keep the National School of Dental Therapy open. The issue was brought up in federal parliamentary debate (**Canada Debates of the Senate, 2009**):

> ***Hon. Robert W. Peterson:*** *Honourable senators, the condition of Aboriginal health services and higher education in Canada continues to lag far behind the national average. One can imagine my surprise when I became aware of the government's plan to cut funding to the First Nations University of Canada's National School of Dental Therapy in northern Saskatchewan at the end of the current academic year. Honourable senators, this program provides much needed training for Aboriginal Canadians in Saskatchewan and other provinces and territories and ensures that dental health professionals are present in some of our country's most remote regions…. My question is for the Leader of the Government in the Senate. At the very moment that the government should be investing in technical programs to develop skills and better health services for First Nations people, why is the government doing just the opposite?*

The Conservative federal government's justification for eliminating funding to the National School of Dental Therapy was presented in Parliament (**Canada House of Commons, 2009**):

> *Since the funding of educational institutions is a provincial responsibility, rather than acting as the sole funder of the National School of Dental Therapy, Health*

> *Canada will be limiting its support to providing $600,000 in financial assistance directly to aboriginal students pursuing careers in dental studies. To ensure that the national school will be able to continue operations, we will work with the school's administration to help find alternative sources of funding. Net savings are approximately $1.4 million.*

Reaction to the announcement from Western Arctic Member of Parliament Dennis Bevington (**2011**) was typical of the response of those with an interest in improving aboriginal health: "Considering the high levels of dental problems faced by Aboriginal people it is unconscionable that in order to save a few dollars the Health Minister has killed the only school in Canada which produced Aboriginal dental therapists…. It just seems to me to be another case of the Conservatives being 'penny wise and pound foolish.' I just can't understand this Conservative Health Minister; she would rather pay the costs of poor oral health than spend a small amount of money on training dental therapists."

No alternative source of funding the school was found and the National School of Dental Therapy closed its doors in 2011.

THE SASKATCHEWAN DENTAL THERAPIST

In 1972, the province of Saskatchewan launched a dental therapist training program to provide oral health care for the children of Saskatchewan. The first class graduated in 1974 and began working in school-based dental clinics.

Following is the political and social backdrop of the problem that led to the development of provincial dental therapists:

> *Saskatchewan is a Canadian province comprising an area of 251,700 square miles and supports a predominantly agricultural economy whose major product is grain…. The great distances and low population have always imposed a burden on the Saskatchewan people, particularly with regard to public services such as education and health…. An analysis of dental manpower in Saskatchewan provided three important findings:*
>
> 1. *The available dental manpower was concentrated in the two major cities. Data from 1973 indicated that 54.8 percent of Saskatchewan dentists were practicing in either Regina or Saskatoon which between them contained only 29 percent of the Saskatchewan population.*
>
> 2. *Beyond, there was a clear cut lack of dentists. In 1970, Saskatchewan had a total of 206 licensed dentists for a dentist to population ratio of 1:4,573.*

3. *In 1970, there appeared to be little hope that the number of dentists could be significantly augmented in the future. Between 1957 and 1970, Saskatchewan had a net gain of only 4 licensed dentists. (Ambrose, 1976)*

The level of dental care provided to Saskatchewan schoolchildren at the time was considered inadequate:

"Dental surveys conducted in 1968 showed that the dental health of the children in Saskatchewan was very poor. At age seven, children had an average of 5.4 primary teeth decayed, extracted, or filled. Of this number, more than three teeth per child were decayed while less than one was filled. Eleven year old children had an average of 2.3 decayed permanent teeth; 75 percent of these children needed fillings, and 26 percent needed extractions" (**Lewis, 1977**).

In order to address the issue of dental care for the province's children, the New Democratic Party (NDP) government decided to initiate a dental therapist project, known as the "Oxbow Dental Care Pilot Project." The success of this program led to the province opening a school for dental therapists in 1972:

*The poor health of children in the province, together with the serious shortage of dentists, caused the dental division of the Department of Health to seek alternative methods for delivering dental care to children. The division began with a pilot project in a rural area [Oxbow], which the federal government agreed to finance. In September, 1970, a sixty-foot mobile home was converted into a four chair dental clinic to service, in rotation, four major elementary schools. A dentist was hired to supervise the project, and two dental auxiliaries from the New Cross School in London were hired to provide the dental care. At the end of two years, the project had demonstrated, first, that parents in rural Saskatchewan would enroll their children in a dental program where the basic services were provided by operating dental auxiliaries and, second, that the quality of care provided by the auxiliaries was considered satisfactory after regular examinations by a team of Saskatchewan private dental practitioners. On the basis of this successful project, the government of Saskatchewan in 1972 announced that a children's dental plan for the people of Saskatchewan would commence in two years (***Lewis, 1977***).*

THE SASKATCHEWAN GOVERNMENT'S DENTAL PLAN FOR CHILDREN

In November 1972, the provincial government prepared "A Proposal for a Dental Program for Children in Saskatchewan," which outlined the plans to provide dental care for all school-age children in the province (**Saskatchewan Department of Public Health, 1972**):

The dental health of children in Saskatchewan is poor. There is an insufficient number of practicing dentists in Saskatchewan to provide all the dentist services needed. Moreover, dentists are distributed throughout the province in such a way that a large number of people do not have adequate access to dental services.... It is clear that a bold and imaginative plan must be designed to attack the health problem and that the public, the dental profession and the government must act cooperatively and deliberately to meet the dental health challenge in this decade.

The evidence of the extent of the dental health problem is startling. For example, a 1971 dental survey of six Saskatchewan school units revealed that:

a. At age 7, 76 percent of children required restorations, and 39 percent required extractions. On the average, each child had 5.5 def (decayed, lost, filled) teeth. However, 3.2 still required restoration.
b. At age 11, 75 percent of children surveyed required restorations and 26 percent required extractions. On the average, each child had 4 EMF permanent teeth, and 2.3 still required restoration.
c. By age 11, 40 percent have some degree of gum disease; approximately the same percentage display evidence of poor oral hygiene; and 20 percent require orthodontic work on their front teeth.

However, on average, a Saskatchewan child receives only a fraction of the time needed for dental services…. It is estimated that it would require at least a 50 percent increase in the number of practicing dentists to provide the treatment services required annually for children ages 3 to 12 in Saskatchewan.

Therefore, in order to address the problem of unmet dental need in Saskatchewan schoolchildren, the provincial government unveiled a province wide school-based dental program.

The proposed program covers a wide range of dental services to children aged 3-12. Services emphasize prevention (such as cleaning and scaling, topical application of fluorides, dental health education, and prevention of irregularities of tooth development); and are supplemented by basic restorative procedures (such as fillings, treatment of gum disease), and extractions....

The least complicated services would be provided by dental auxiliaries [in a province-wide school-based dental program] under the functional supervision of dentists. The more complex services would be provided by dentists through a referral system on a fee-for-service, salaried, or contract basis.

Delivery System
The clinics would be as close as possible to schools. In fact, where possible, they would actually be in the schools.

Objectives

1. *To improve the dental health of people in the Province of Saskatchewan by providing a program for the prevention and treatment of dental disease among children from the ages of 3-12 inclusive.*
2. *To maximize the benefits from the program by:*
   a. *Encouraging high utilization of services by making them as accessible as reasonably possible.*
   b. *Making best use of the various types of dental manpower, consistent with their recognized level of competence.*
   c. *Promoting an increased level of public awareness of the need for dental health preventive measures, both at the individual level and the community level, including the promotion of fluoridated public water supplies.*

Program Components

1. *The program includes the following services, rendered by dental auxiliaries, dentists or both:*
   a. *Preventive (oral hygiene instruction—chair side and classroom, prophylaxis, topical application of fluorides, other appropriate preventive procedures, preventive orthodontics such as space maintenance, habit correcting, cross bite treatment, dental arch expansion).*
   b. *Diagnostic (exam, diagnosis, treatment planning, x-rays, other diagnostic aids).*
   c. *Restorative (plastic restorations, stainless steel crowns, treatment of anterior fractures).*
   d. *Surgical (removal of deciduous and permanent teeth).*
   e. *Periodontic procedures (scaling: supra gingival and sub gingival, gingivectomy).*
   f. *Endodontic procedures (pulp capping, pulpotomy, pulpectomy, root canal procedures).*
   g. *Emergency services (relief of pain, relief of acute infection, initial care for traumatic injuries).*
2. *The proposed program would include recall on a semi-annual basis.*
3. *Dental health education is considered to be a most important aspect of this program proposal.*

Beneficiaries

All children resident in the province between the ages of 3 and 12 would be considered beneficiaries when the program is fully implemented, with the exception of Indian children living on reserves….The population which might be expected to be using the program during any year is estimated to be about 140,000 children.

How Would the Program Work?

1. *Parents would be invited to register eligible children and a medical history of the child would be obtained from the parent.*
2. *All children would be examined by dentists as they first enter the program.*
3. *Normally, the auxiliary team would conduct a pre-screening of all school age children prior to the scheduling of the preventive and restorative visits.*
4. *Preschoolers would be notified of initial appointment date and time.*
5. *Following the scheduling of local school children, preschoolers and schoolchildren from surrounding locations, clinic appointments would begin.*
6. *Preventive and restorative measures would be completed where possible and referrals would be made to dentists as required.*
7. *Simultaneously, clinic, classroom and community dental health education would be carried out by the auxiliary team.*

All services beyond the competence of the dental therapists would be referred out to a dentist:

1. *private dentists of the patient's own choice remunerated on a fee for service basis;*
2. *salaried dentists;*
3. *to dentists on contract who now provide dental services for public institutions.*

In the provincial government's proposal, it is noted that the possibility of providing the required dental services to children on a fee-for-service basis was considered and ruled out because:

1. *Cost approaching $11.5 million.*
2. *Lack of dentists.*
3. *Mal-distribution of dental manpower geographically would limit accessibility to basic preventive measures as well as to treatment services.*

The provincial government's proposal did consider the impact of the dental program on private dental practices in the province and considered that it would be generally favorable:

> *Obviously, with a dental program fully implemented there would be an impact on private practice. It is suggested that this impact would be primarily a change in the nature of services rendered i.e. complex services derived through the referral system rather than simpler ones…. It is believed also that dental health education would bring about a greater awareness and consequently a greater demand for dental services in the general population (***Saskatchewan Department of Public Health, 1972***).*

RESPONSE OF THE DENTAL PROFESSION TO THE SASKATCHEWAN DENTAL PLAN FOR CHILDREN

The College of Dental Surgeons of Saskatchewan (CDSS) released its own "Dental Care Plan for the Children of Saskatchewan" in 1973 in response to the proposed provincial plan. The provincial dental association was highly critical of the provincial government's planned delivery system and the introduction of unsupervised dental therapists to provide dental treatment for children.

The CDSS position was that "to concentrate solely on methods of delivery and methods of financing treatment services would be to run the 'danger of pandering to the understandable urge to buy a quick solution for a difficult problem.' " It was disapproving of what it described as the government's plan to "rush pell-mell into a massive program of dubious quality which is difficult, if not impossible, to upgrade" (**Saskatchewan College of Dental Surgeons, 1973**).

Throughout this document, censorious words described the dental association's view of the Saskatchewan government's intent to "institute a universal program of dubious value. We believe the most damaging policy would be to focus attention and funds solely on the mass delivery of care while at the same time neglecting in-depth comprehensive services that currently comprise our concept of dental care for children." Further communicated was that "Too often, we find that too much emphasis has been placed on numbers and statistics and delivery systems involving hordes of statistics." Other criticisms of the plan included such statements as, "Any plan which merely results in millions of filled, patched-up teeth is, in our opinion, of questionable value, and when viewed in light of present day knowledge is ludicrous, to say the least."

The CDSS was also skeptical of the government's plan to institute school-based dental clinics: "Ideally, clinics would be established at each and every school in the province; however, we feel that this is beyond the realm of possibility." The CDSS favored the conventional approach of the parent bringing children in to see the dentist: "There are definite benefits to be achieved by requiring the parent to actually come with his child to a clinic as close as possible to where they live." The CDSS was also strongly opposed to the concept of dental therapists providing treatment to children without the direct supervision of a dentist as indicated by the following statements:

> *We are adamant in the belief that a dentist must be present at all times to directly supervise any auxiliary performing treatment services such as cavity preparation, insertion of fillings, extractions etc.*
>
> *While the treatment is being given, a registered dentist must be within call, in person and not by telephone, so that he may be able to deal with any difficulties as they arise.*

Social attitudes toward the role of women are also apparent in the CDSS's expressed concerns about dental therapists:

> *The College believes strongly that the dental nurses should be required to be female.*
>
> *If the girl is to be unsupervised, she will be expected to be a personnel manager in charge of two certified assistants; we think it is obvious that problems will result…. Productivity will be much greater than if unsupervised, hence the public's tax dollar will be better spent. With a supervisor on the premises and delegating work to the nurse, it is quite likely she will do more work in a given time than if she can work at her own speed.… the College feels that it will be quite difficult for a young nurse to manage two or more assistants and at the same time do her own duties.*

In fact, the CDSS was not supportive of the introduction of dental therapists to provide restorative care for children. Rather it "favor[ed] the development of preventive auxiliaries, as opposed to treatment auxiliaries." There was expressed concern about the new auxiliary: "The College is somewhat skeptical that it is possible to develop a nurse [therapist] to perform the functions of a nurse, and a hygienist in two academic years" (**Saskatchewan College of Dental Surgeons, 1973**). The CDSS had a very different opinion on the effect of the school dental program on private dental practices in the province as opposed to the provincial government's generally positive predictions. The CDSS forecast a very dire future for rural Saskatchewan dentists:

> *Children below the age of 12 comprise about 35-40 percent of the average rural dental practice. In many young practices, this figure is significantly higher. It is obvious that removal of this segment from a dental practice without compensation will have a detrimental effect both in the quantity and quality of the practice.*
>
> *A very real possibility exists that significant numbers of these dentists will relocate their practices if a plan unacceptable to them is implemented. This would leave large segments of the adult population with no dentist to provide needed services.*

Overall, the feeling of the CDSS is conveyed with the statement, "The College is unhappy with the way in which planning on the dental care program has been carried out up until now. We would like to have been consulted" (**Saskatchewan College of Dental Surgeons, 1973**).

In 1970, a survey was sent to all practicing and licensed Saskatchewan dentists to assess their attitudes toward a prepaid dental care program for children in the province. A second follow-up survey was sent in 1972 after the provincial government's announcement regarding the opening of the two-year dental therapist program to assess dentists' attitudes toward the program. Sixty-eight percent of the province's 211 dentists responded to the first questionnaire and

66 percent of the province's 209 dentists responded to the second questionnaire (**Thomson, 1973**).

Data from the 1970 survey indicated that 89 percent of dentists acknowledged an extreme shortage of dentists practicing in rural Saskatchewan. Seventy percent of the dentists felt that the source of services for a prepaid dental plan should be in private dental offices and 26 percent of dentists thought that school clinics would be a more effective source. Eighty-eight percent of respondents thought the public would support the introduction of a prepaid dental plan. The majority of respondents, 82 percent, indicated a preference for fee-for-service as method of payment for dental services.

In both surveys, questions were asked about attitudes toward British-type auxiliaries (dental therapists). Opposition to dental therapists fell from 58 percent in 1970 to 40 percent in 1972. The percentage favoring dental nurses rose from 29 percent in 1970 to 40 percent in 1972. Overall, 56 percent of dentists thought the public would support dental therapists and 37 percent of dentists thought the public would be indifferent toward dental therapists. Forty-five percent of respondents indicated they would hire a dental therapist to work in their practices to ease workload and free the dentist's time for more complex treatment.

Based on these results, the authors' opinion was that "the new dental nurse program, instituted by the government, is viewed by some as a threat to the dentists' independence as reflected by (a) preference for a children's dental care program initiated by the profession, (b) substantial preference for fee for service private practice rather than salaried employment in a dental care program and (c) that dental care services should be largely rendered in the private office" (**Thomson, 1973**).

IMPLEMENTATION OF THE SASKATCHEWAN DENTAL PLAN FOR CHILDREN

P.F. Barker completed an extensive study titled "The formulation and implementation of the Saskatchewan Dental Plan" (**Barker, 1985**). He observed that "the formulation of the Saskatchewan Dental Plan was partly a result of bargaining involving the premier of Saskatchewan, the minister of public health, public officials, and leaders of the dental profession. Other factors, such as political parties, policy ideas, and dental needs, contributed as well."

Given that "the senior health professions, as interest groups, have had a profound impact on health policy in western democracies," Barker noted that "it is surprising to see that the dental profession of Saskatchewan had almost no effect on the scope of the Saskatchewan Dental Plan, and only a small effect on the shape and design."

The view of the dental profession was that "the introduction of dental nurses represents an attempt by government to regulate the provision of dental care. Until now, the matter of who provides what type of dental care has been the responsibility of the profession." In response to the provincial government's proposal to introduce dental therapists into the workforce, "The profession preferred that the government invest more time and money in the preventive auxiliary."

Part of the dental profession's failure to have much impact upon the Saskatchewan Dental Plan may have been the findings of the provincial government's committee "to examine health services in Saskatchewan and to recommend some new directions."

> *The committee's comments on dental care were discouraging. It noted that a large percentage of the population received no dental care and that very few people received complete dental care. In short, dental conditions were "appalling." And the blame was left largely with the profession: "It is not exaggeration to say that dentistry in its present organization has failed to serve the population, whatever the causes may be."*

In addition to a lack of government support, the dental profession had little public support:

> *Finally, the resources of the profession were unimposing. Even if the dentists wanted to do something about the government's intention, some dentists (and most government players) reasoned that their lack of power foreclosed any serious opposition. Any program would probably have little or no direct role for dentists, so a work slow-down or even a strike was out of the question.… Further, the profession enjoyed little public support; most citizens had something against the dental profession, be it the latter's inability to provide care in some areas, its campaign in favour of fluoridation, its attempts to prosecute denturists, or the simple fact that dentists meant pain.*

The dental profession had virtually no influence upon the formulation and implementation of the Saskatchewan Dental Plan because "the traditional way of providing dental care had failed."

Barker found that the Saskatchewan provincial government "redefined the problem: it was not the lack of dentists that mattered, but rather the lack of care for children. In other words, the goal was to provide care to children and all feasible means should be used to satisfy this end. With this, the Division of Dental Health [provincial government] broke the link between dental manpower and dentists. Auxiliaries counted, too."

The province of Saskatchewan implemented the Saskatchewan Dental Plan, whereby children received dental care from dental therapists in school-based clinics during the 1974-75 school year. The majority of parents chose to enroll their children in the Saskatchewan Dental Plan when it was put into operation. In the summer of 1975, a survey was carried out by the Saskatchewan Department of Health to identify reasons why approximately 20 percent of eligible children did not enroll in the program. Telephone interviews were conducted with 523 parents of nonenrolled children. The most commonly cited reasons for failure to enroll in the Saskatchewan Dental Plan were lack of information about the program, parents had misplaced the enrollment forms or the child was already being seen by the family dentist. About 6 percent of nonenrolled children were being seen by the family dentist. These families tended to have middle to high incomes and financial barriers to dental care were not a serious problem (**Swanson, 1975**).

Swanson suggested that the brochure sent with the enrollment forms include more specifics about the program and that a second mailing/reminder of enrollment forms would help parents of nonenrolled children, since "The results of this study suggest that no serious problems regarding enrollment now exist."

Swanson further investigated the survey data in a thesis titled "The Effect of an Alternative Delivery System on Social Class Variations in Utilization of Dental Care Services: Saskatchewan" (**Swanson, 1976**). She stated that under the predominant system of delivery, which was that private dentists were paid on a fee-for-service basis, "a relatively small proportion of the population is receiving dental care, and that much of this care is received by those in higher socioeconomic groups." She wanted to examine, in the case of the Saskatchewan Dental Plan, "whether a change in the nature of the dental delivery system would result in a change in the well documented relationship between social class and dental care utilization. In other words, would the lower classes continue to be non-utilizers of care even though an alternative delivery system had been introduced."

Swanson concluded:

> *The results of this study tend to support the contention that changes in the nature of the dental care delivery system can alter utilization patterns such that inequalities in the receipt of care are eliminated. Within one year of implementation of an alternative delivery system in Saskatchewan, it appears that virtually all of the first group of eligible children will be receiving care through either the provincial dental plan or private dental practice.*

THE SASKATCHEWAN DENTAL THERAPY PROGRAM

In 1975, G.W. Keenan, Chairman of the Dental Division of the Wascana Institute, which was the home of the Saskatchewan dental therapist program, authored an article that gave an overview of the program (**Keenan 1975**):

> *Although great emphasis is placed on prevention, the nurses are fully trained in clinical restorative dentistry and are able to provide most of the preventive and treatment services required. The total scheduled time involved is approximately 2300 hours in the two years of the program…. Students prepare and restore approximately 100 dentoform and natural teeth, utilizing three dentoforms which represent the deciduous, mixed and permanent dentition. They are also provided with pre-clinical experience in such areas as stainless steel crown technique, formocresol pulpotomy technique, application of simple space maintainers and pin amalgam techniques. All restorative techniques are performed utilizing rubber dam. Students are trained in administration of local anaesthetics including the inferior alveolar nerve block. Other areas include radiography exposure techniques, processing and interpretation of radiographs and diagnosis and treatment planning specifically related to dental caries.… The clinical year provides experience in the order of approximately 250-300 restorative procedures. At the end of this period, a student is capable of carrying out some measure of quadrant dentistry within an hourly appointment utilizing four-handed dentistry techniques…. Within the basic dental science are included approximately 360 hours of instruction in general and oral anatomy, histology and bacteriology, and 120 hours in general and oral pathology.*

Keenan emphasized that "prevention is primary" in the philosophy of the Saskatchewan dental therapist training program: "We believe that for an individual to make a meaningful contribution in the prevention of dental disease, she must believe that preventive dentistry is her primary duty.… One of the aims of the program is to train auxiliaries who will increase the sense of dental awareness in the general population of the province." This philosophy influenced how dental therapists scheduled appointments and interacted with families: "Parent contact is extremely important. It is difficult to expect a child's attitude to change when no effort is made to change that of his peer group or parent. At our clinic, we endeavor through letters to parents to interest them in being present during preventive sessions with their children. Before any restorative treatment takes place, at least two or three appointments are devoted to preventive instruction."

EVALUATION OF THE SASKATCHEWAN DENTAL THERAPIST

After the Saskatchewan dental program had entered its second year of operation, "it was the director's wish to assess whether … the most common restorative

treatment services were being carried out at an acceptable standard of quality. A team of three expert clinicians from outside of Saskatchewan was selected to come to the province in order to evaluate the quality of treatment provided under the program." Program evaluation was "taken to mean the direct examination and evaluation of treatment sometime after it has been completed" (**Ambrose, Hord, Simpson, 1976**).

The examination team was selected by the director of the Saskatchewan Dental Plan, who "engaged the services of three highly qualified dentists to conduct the clinical examination phase of the evaluation project. The examiners were Dr. E.R. Ambrose, dean and former chairman of operative dentistry at McGill University; Dr. A.B. Hord, chairman of restorative dentistry at the University of Toronto; and Dr. W.J. Simpson, chairman of children's dentistry at the University of Alberta. The three examiners' combined dental practice and teaching experience exceeded 60 years."

Examinations took place in 16 school dental clinics with standard lights, mirror, explorer, dental floss and a dental chair. The three examiners were calibrated. They were blinded as to whether a dentist in private practice or a dental therapist had placed the restoration in a child's mouth. The treatment evaluated consisted of amalgam restorations on primary and permanent teeth, stainless steel crowns on primary teeth and diagnostic radiographs. There were evaluation criteria regarding the anatomy, proximal contour, contacts, surface consistency, occlusion and margins of amalgams, the margin extension and adaption as well as tissue health around stainless steel crowns and diagnostic quality of radiographs. Restorations were evaluated as superior, acceptable or unsatisfactory.

A total of 2,107 amalgams were assessed by the three examiners. The quality of amalgams placed by dental therapists in deciduous teeth was: 52 percent superior, 45 percent acceptable, 4 percent unsatisfactory. The quality of amalgams placed in deciduous teeth by dentists was: 16 percent superior, 61 percent satisfactory, 23 percent unsatisfactory. The same pattern was apparent when amalgams placed in permanent teeth were evaluated. The quality of multisurface amalgams placed in permanent teeth by dental therapists was: 47 percent superior, 53 percent satisfactory, 0 percent unsatisfactory. The quality of multisurface amalgams placed in permanent teeth by dentists was: 22 percent superior, 60 percent satisfactory, 19 percent unsatisfactory.

A total of 61 children with 97 stainless steel crowns were evaluated for margin extension, adaption, occlusion and tissue health. There were no significant differences between the quality of stainless steel crowns placed by dental therapists versus stainless steel crowns placed by dentists. On the four criteria applied, the two different providers appeared to function at the same standard of quality.

Two hundred eighty-nine sets of bitewing radiographs were assessed, and 81 percent were evaluated as being of acceptable diagnostic quality. One hundred eighty-one periapical radiographs were evaluated and 95 percent were deemed of acceptable diagnostic quality. No comparison with radiographs taken by private practitioners was possible, so the authors referenced a paper by Friedman (**1975**) that found 35 percent of radiographs in dental offices were diagnostically unacceptable, which when used as a comparison would indicate the performance achieved by dental therapists was satisfactory.

In the discussion and conclusion section of their paper, Ambrose, Hord and Simpson had generally positive comments to make: "At the two year point in the operation of the Saskatchewan Dental Plan, the quality of children's dental services assessed by an independent evaluating team must be considered very acceptable…. Aside from the high standard of the treatment services, there is little doubt that the personnel of the Saskatchewan Dental Plan place a good deal of emphasis on the preventive aspects of dental care.… There is no question that the children's dental program functioning in Saskatchewan is providing much needed dental care to large numbers of children who otherwise would not be receiving it."

The authors also noted that in previous studies conducted in Prince Edward Island, Ontario, Oxbow, Alabama, Kentucky, Philadelphia, Minnesota and the U.S. Indian Health Service, "operating dental auxiliaries have performed their prescribed restorative procedures at a level equivalent or somewhat superior to dentists. The present findings, therefore, represent no departure from the accumulated evidence." In an attempt to explain "the favorable performance by the dental nurses", the evaluation team conjectured that there were "at least three interdependent factors at work." The dental therapist program "is perceived as an experimental, or metaphorically more apt, a pioneering project. As such, there likely exists the well-known Hawthorne effect which surely must be responsible for an undetermined part of the superiority demonstrated by the dental nurses' amalgam work." A second reason for the excellence of the work by dental therapists was that "the training program is well designed. Noteworthy was the fact that dental nurses appear to gain quantitatively greater experience in placing amalgam restoration than do most students graduating from Canadian dental schools." Finally, it was surmised that "A third factor for the present success of the program is probably related to the high degree of organization, standardization and emphasis on continuing education."

Ambrose, Hord and Simpson (**1976**) concluded that the "combined quality and coverage of care achieved by the Saskatchewan Dental Plan after nearly two years of operation is impressive." The authors also speculated that direct supervision of dental therapists was subservient to organization in explaining the success of the children's dental program. Regarding criticism of the limited degree of supervision of dental therapists, the authors stated, "On the basis of the data

presented here, it would be difficult to insist that more direct supervision of dental nurses take place without making the same suggestion in the case of dentists.… On the whole, it would appear that the essential ingredient in a successful dental nurse program is not supervision as much as it is good organization. A structured and well organized children's dental program would only incorporate that level of supervision which is required to ensure high quality care."

Dr. M.H. Lewis provided a three-year overview of the Saskatchewan children's dental program in 1977. At that point, he noted that 58,659 children (82 percent of eligible children) were enrolled in the program. Clinics had been established "in 215 schools by the end of the first year of the program, a further 60 clinics were established during the second year, and we expect an additional 60 during 1977." Dental therapists were "now treating, on average, 510 children per nurse. Planning calls for each dental nurse to treat about 580 children next year." It was also stated that the cost of treatment using the dental therapist program was cheaper than if a private practice fee-for-service program was utilized (**Lewis, 1977**).

Lewis reviewed the reasons for incorporating a school-based program: "It was decided early on that the dental services would be provided in the elementary schools.… It was also recognized that the key to getting high enrollment in a dental program is to place the dental clinic as close to the children as possible, eliminating the need for parents to bring the children to the clinic and also eliminating the need for making firm appointments."

The provincial government's decision not to build separate dental clinics was discussed: "Many professional dental organizations originally suggested that the dental plan should operate through large dental clinics located around the province, with a staff of ten to twenty dental nurses and with children bussed in from surrounding schools; this, it was suggested, would prove more efficient and would allow over the shoulder supervision by a dentist. On investigation it was found that to feed a clinic of this size, the average busing distance in most of the province would be 56 km and as much as 120 km for some areas. Therefore, the concept was rejected. As an experiment, however, one ten-chair dental clinic has been built…. Children are bussed into this clinic."

Lewis concluded that the decision to incorporate school-based dental clinics was the right one: "After two years' experience, we believe that one chair dental clinics established in as many schools as possible represent a better delivery system for us." He cited several practical reasons why school-based dental clinics were a more practical delivery system than busing children to a stand-alone dental clinic:

1. *The multiple chair clinic causes difficulties in scheduling…*
2. *Also disrupts schools…*
3. *It becomes harder to involve parents in their children's dental care.*

4. *It is more upsetting for small children to have a bus journey followed by a visit to this large, slightly overwhelming dental clinic.*
5. *We have found dental nurses to be quite capable of working without the constant presence of a dentist. In fact, they respond very well to the challenge.*

Lewis described the difficulties of providing care to children in extremely rural areas: "To serve the very remote areas of the province where schools are very small—sometimes with only half a dozen pupils—we have equipped two motor homes as dental clinics…. While the concept of these motor homes is wonderful, we have found them to have serious limitations in Saskatchewan" because:

1. *The weather is too cold for them to be used during the severe winter months. Even though they are winterized, there are real problems, because of freezing, in taking on water and getting rid of wastes.*
2. *Most of these remote areas are served by narrow gravel roads, and it is a real challenge to drive an eight and one half meter wide mobile home into some of these schools when the roads are icy and snow clogged.*
3. *In addition, we have found that most SK school playgrounds are anything but level, and the unit must first be leveled with jacks.*
4. *All in all, these [mobile] units have not been very satisfactory.… For five months of the year they are totally unsuitable. We have found that it is better, during the winter months, for a dental nurse team with a station wagon and a portable dental chair to handle these small schools.*

Lewis considered the reaction of the private dental community to the dental program to be "interesting." He said:

> *Initially, dentists were fearful.... What is this program going to do to my practice? Three years have passed now, and the College of Dental Surgeons of Saskatchewan supports the dental program…. And I think the reasons are quite obvious. Private dentists are busier than ever before. Their income in the two and a half years the program has been operating has increased by $10,000 net (from an average of $30,519 in 1973). The pattern of practice has also changed. Generally, dentists are not treating many children any more. But they are providing more, and more sophisticated, dental care to adults … a great deal more of the sort of dentistry that results in greater income.*

Lewis felt that "this program must be considered a success. It is most suitable for the particular situation in Saskatchewan and, I believe, for many areas where there is a scattered rural population and a shortage of dentists. But it obviously cannot be transplanted wholesale to other areas where the same conditions do not prevail."

PERFORMANCE OF THE SASKATCHEWAN DENTAL PLAN FOR CHILDREN: 1970S AND '80S

Another review of the Saskatchewan Health Dental Plan was undertaken in 1981 by D.W. Lewis. It was based on an analysis of computer data produced annually by the plan and included: "Nine different sets of computer output covering the first five program years, 1974-75 to 1978-79, were obtained and utilized in this analysis…. These data cover various facets of the Saskatchewan Health Dental Plan—enrollment, dental health, services, visits, referrals, operator service profiles, and service and oral health data by school division" (**Lewis, 1981**).

The report documented:

> *An important outcome of the SHDP is the extent to which the parents of enrolled children are satisfied with it. The findings from a sample survey of 600 parents/guardians in 1978-79 indicated that, despite some minor concerns, there was overwhelming support for the plan, its organization and the dental nurse services. Parents were very much satisfied…. 89.2 percent felt that dental nurses provide satisfactory services; respondents served in rural areas recorded the highest level of satisfaction with dental nurses in the province (94 percent) and respondents whose children receive services at the Wascana Institute of Applied Arts and Science registered the lowest level (86 percent).*

Further, it was observed that "The overall enrollment in the Plan by eligible children has been high, averaging 83 percent after the initial startup year. Importantly, the proportion of those enrolled each year who have received complete care is also high; averaging 76 percent to 90 percent…. The rate of completed care is one measure of successful outcome of the process of care rendered under the Saskatchewan Health Dental Plan…." Highlights of the report were:

1. *Examinations represent 8 percent to 14 percent of all services and their average use is increasing regularly each year.*
2. *There has been a dramatic drop in the average number of x-ray films per enrollee provided each year, from 2.41 films per child in 1974-75 to 0.57 films per child in 1979-80.*
3. *About one quarter of all services rendered each year are preventive in nature, with nearly every patient receiving prophylaxis, topical fluoride application and personal oral hygiene instruction, and about one-quarter receiving individual dietary counseling.*
4. *The average number of fillings per enrollee has dropped by about one half over the six years.*
5. *The average number of pulp treatments and extractions per enrollee has declined each year and it is especially important to note that about one third of the extractions were for orthodontic purposes.*

The number of children per dental therapist by program year increased from 262 children per dental therapist in 1974-75 to 638 children per dental therapist in 1979-80.

Lewis stated that "the performance to date" of the Saskatchewan Dental Program using dental therapists "gives early indications of the likely achievement of this long term goal [of] … improving dental health in Saskatchewan by making preventive and operative dental services readily accessible so as to encourage high utilization by eligible children."

A report was submitted to the minister of health and lieutenant governor of Saskatchewan in 1985 that presented statistical outcomes of the Saskatchewan Health Dental Plan for children to the provincial government. It was noted that as of August 1985, there were 565 dental clinics located in schools throughout Saskatchewan (**Saskatchewan Health, 1985**).

An account of the preventive component of the program was provided because one of the objectives of the SHDP for children was to "offer the most effective and practical measures available to reduce the incidence of dental disease." To that end, "An individual approach to prevention is used within the dental clinic… Children and adolescents receive individual oral hygiene and nutritional instruction, as well as topical applications of fluoride. The dental teams attempt to identify and concentrate their efforts on those children and adolescents with a high risk for dental disease." However, a concerted effort was also made to introduce weekly fluoride rinse programs and fissure sealant placement as part of the province-wide preventive program. As of June 1985, more than 10,500 students had participated in the weekly fluoride mouth rinse program. It was considered "a safe and economical way to prevent tooth decay and requires little classroom time…. This procedure is voluntary and without cost to parents."

The placement of fissure sealants was introduced in the 1981-82 school year. During the 1984-85 school year, approximately 140,000 fissure sealants were placed. It was observed that "As a result of this extensive use of fissure sealants, the number of fillings on biting surfaces being placed has dropped significantly." As a consequence of dental therapists placing sealants, the number of one-surface amalgams placed on the first permanent molars of 6-to-8-year-olds declined from 40 per 100 children in 1981-82 to 26 per 100 children in 1984-85. For adolescents, the decrease in the number of one-surface amalgams placed on the first permanent molars was 45 per 100 adolescents in 1981-82 to 30 per 100 adolescents in 1984-85. The report further documented that over a 10-year period (1974-75 to 1984-85), the decayed, missing, filled teeth index for 6-year-old children declined from 6.5 to 3.4 after the implementation of the school-based dental therapist program. Further, the d/df ratios declined, with the major category being "filled" as opposed to "decayed" teeth for 6-year-old children in 1984-85.

It was also noted that "referrals for children and adolescents to private practitioners are of two types…. [First] the examining dentist feels the management of the patient is beyond the capability of the dental therapist. Into the category of patient management fall individuals with such problems as mental or physical handicaps and medical or emotional problems." The second category of referrals was for "specific dental problems beyond the capability of the dental therapist. Into this category fall such services as treatment of minor orthodontic problems and extensive surgical procedures." Private practitioners also provided emergency services, defined as the relief of pain, treatment of infections or control of hemorrhage.

TERMINATION OF THE SASKATCHEWAN DENTAL PLAN FOR CHILDREN

Highlights from a 1988 statistical report on the Children's Dental Plan documented the substantial increases in diagnostic, preventive and restorative services being provided to children from the time of the dental therapist school program implementation in 1974. A positive trend was noted wherein the number of children with a DMFT of 0 increased from 1974 to 1982. There was improvement in the number of decayed, missing and filled permanent teeth for individual age groups. For example, the number of decayed, missing and filled permanent teeth per 9-year-old child declined from 3.1 in 1976-77 to 1.07 to 1987-88. The number of decayed teeth in 6-year-old children declined from 5.0 in 1974-75 to 1.1 in 1987-88 (**Saskatchewan Health, 1988**).

In 1984, a new Conservative government came to power in Saskatchewan. Despite the indisputable success of the Saskatchewan Dental Program in improving the oral health of the province's schoolchildren, the new government announced in 1987 that the school-based dental program would be dismantled and transferred to the private sector. The 1988 statistical report, cited above, provided information on the new "capitation model to encompass all children born between 1974 and 1982; i.e. ages 5-13 inclusive." In this delivery system of dental care to children, "The Department of Health contracted to make a capitation payment to the College of Dental Surgeons of Saskatchewan for each adolescent making one or more visits to a participating dentist. The College remunerated each dentist according to a fee schedule designed for the Plan. A prescribed range of services was provided at no charge to the parents."

A publication by J.W. Niedermayer, a past president of the Canadian Dental Association, further described the demise of the school-based dental program for children in Saskatchewan. In addition to transferring the entire program for children from schools to the private sector, "the government also cut back on the program, by restricting its availability to children from 5-13 years of age."

Niedermayer speculated, "As Saskatchewan's economy headed for a drastic downturn in the late 1980's and early 1990's, all social programs became subjects to government scrutiny." As a consequence of the government's decision to terminate the program, there was "closure of all the school-based clinics that had been established throughout the province under the NDP, and put some 400 dental therapists out of work." Further, as a result of termination of the school-based dental therapist program for children, "the training program for dental therapists was also closed" (**Niedermayer, 1973**).

Niedermayer reported that the cessation of the children's dental program met with "opposition in the legislative assembly, the employees of the plan and parents became outraged at the transfer of the school-based plan to the private sector." In fact, the dental therapists, as members of the Saskatchewan Government Employees Union, "brought a lawsuit against the College of Dental Surgeons of Saskatchewan, alleging wrong-doings in obtaining the dental plan for the private sector." The lawsuit was eventually lost in the Saskatchewan Court of Appeal. When the NDP returned to power in 1993, it ended all funding of the children's dental plan.

An article interestingly titled "SHDP: An Experiment in Success that Failed" reviewed the Saskatchewan Health Dental Plan with "particular emphasis on 'evidence' shaping public policy" (**Rezansoff, 1997**). The school-based dental therapist program was "examined in terms of how it met three criteria: 1. Public acceptance; 2. Cost effectiveness; and 3. Quality of service."

Rezansoff cited previously quoted research that demonstrated high enrollment of children in the program by their parents and concluded: "High enrollment is a major strength of school-based plans, as parents must arrange for private dental care if they choose not to use the service. Clearly, there appears to be little evidence of a lack of public acceptability." Regarding cost effectiveness, she noted, "The cost of treating a child under this plan fell by over 271 percent—from $341.89 in 1974 to $91.98 in 1986. This indicates that the rate of growth of costs associated with this program was probably not the source of its demise." Concerning quality of care, there was "strong evidence that quality of care provided by dental therapists was more than adequate—it was superior. The high level of quality of care delivered by dental therapists must remain one of the hallmark achievements of the Saskatchewan Dental Plan."

Rezansoff concluded:

> *The evidence indicates that the program received high public acceptance, it delivered superior quality of care, and it featured a cost-effective mode of delivery. Its two distinguishing features were its method of delivery and financial access to care, i.e., a publicly funded school-based program with care provided for by dental*

> *auxiliaries instead of private delivery on a fee for service basis. Province-wide financial access was successful in satisfying the pool of previously unmet need and may, paradoxically, have given rise to the demise of the Plan.*

In a 2010 study titled "The Saskatchewan Children's Dental Plan: Is it time for Renewal?", G. Ewart examined the program's ability to "improve the health outcomes of all citizens, and also reduce overall health care expenditures" (**Ewart, 2010**). His research was partly motivated by the belief that "The implementation and cancellation of this innovative program has failed to receive the attention and consideration that it deserves." Ewart wrote, "It seems the majority of Saskatchewan citizens were very happy with this program, while a minority and the Progressive Conservative government was not. The minority decided what was best for the majority."

He described the role of the Saskatchewan Children's Dental Plan (SDP) and wrote that it "was implemented as part of the social safety net and served to make Saskatchewan stand out because the provincial government was not bound by ideals of lowering taxes and paying into capital projects in support of big business at the expense of the community. The SDP was seen as a necessary program for Saskatchewan children because of the large rural population and the lack of dentists. It was designed to rectify the inequities that existed in Saskatchewan, especially amongst children. All children, regardless of parental income, and irrespective of geographical location, had the right and the opportunity to obtain proper dental care."

Ewart further stated, "If we are to believe in an egalitarian society, programs have to be kept in place to help the disadvantaged at the expense of those in higher income brackets." However, he observed:

> *Private practice dentists operate in a self-regulated market, on fee-for-service, as their own employer. Dentists are regulated by the College of Dental Surgeons of Saskatchewan, a group of dentists, and set their own prices, which gives them great control over their profession. They also have control over how dental care is distributed and administered. The dental profession determines whether they will focus on prevention or treatment, and what forms of prevention or treatment to utilize when dealing with patients. Also, dentists who own private practices are running a business and, as such, have to make money.… Dentists set up practices where it is economically beneficial, which means rural and low income areas are largely neglected…. However, the dental profession saw profits being minimized with the establishment of the Saskatchewan Dental Plan. It was a proverbial turf war where dentists were not content with therapists, assistants and other dentists working on salary; taking away an entire group of patients meant decreased profits for the profession.*

Ewart took issue with the Progressive Conservative (PC) government's stance that "the reason for dismantling the Saskatchewan Dental Plan was because the cost of the program was too great." He pointed out that:

> *… because the cost savings were proven to be well below the amount predicted, it can be suggested that the main issue came down to a shift in ideology. Therapists, employed by the government on salary, were not what the PC government believed in; their ideology was heavily based on notions of individuality. The PC government used the excuse that dealing with alcohol and drug abuse was more important than a child's teeth. This shows just one ideological shift that took place during the rise of the neo-liberal state. Governments around the world were shifting to a neo-liberal regime of accumulation by cutting social programs.… The election of the PC government saw the final transfer of state support for the Saskatchewan Dental Program to a deregulated, privatized entrepreneurialism, which put dental care on the open market and created the competitive nature advocated by a flexible regime of accumulation. Dentists in private practice had the ear of the government and both parties had the same objectives, to let the market dictate the cost of buying services.*

The demise of the Saskatchewan Dental Plan in 1987 proved to have deleterious effects on the oral health of the province's children. Ewart cited a 1999 document based on the Statistics Canada National Population Health Survey data that led to the headline in one of Canada's national newspapers, "Saskatchewan Children Have Third World Teeth." The data from the study, which involved 36,000 children, showed that "more than 53 percent of Saskatchewan children entering Grade 1 have a history of dental disease." The same study also demonstrated that "the majority of Saskatchewan health districts did not meet the objectives of the World Health Organization to have a '50 percent cavity-free goal.' "

Ewart concluded that "it would be in the best interest of this province, and the people that reside within this province, to have the government assume a true leadership role and take the initiative to establish a dental program for children" because the "state needs to be involved to implement what the marketplace cannot."

CURRENT STATUS OF DENTAL THERAPISTS IN CANADA

Dental therapists continue to practice in Canada. In Saskatchewan, the profession is regulated and all dental therapists are required to be registered and licensed with the Saskatchewan Dental Therapists Association. Saskatchewan's 215 licensed dental therapists work in a variety of settings, including private practice, teaching institutions, tribal councils and some regional school-based dental programs. In Manitoba, dental therapists who completed their training at Saskatchewan's Wascana Institute dental therapy program may work in private

practice under direct supervision of a dentist as long as they are registered with the Manitoba Dental Association. In all other Canadian provinces, dental therapists are directly employed by the federal government to provide dental care for aboriginal people living on First Nations reserves. The provinces of Quebec and Ontario currently do not employ dental therapists. Dental therapists working for the territorial governments of the Yukon, Northwest Territories and Nunavut must be registered and licensed by the local regulatory authority.

The future of dental therapists in Canada is unclear at this point. Alternate funding for the National School of Dental Therapy has not been secured to date. However, support for the role of dental therapists in caring for Canada's children remains strong among policy-makers. In a 2011 report by the Canadian Center for Policy Alternatives (**2011**) titled "Putting Our Money Where Our Mouth is: The Future of Dental Care in Canada," the authors ask: "How much would it cost to revitalize the Saskatchewan approach to providing preventive and basic curative care to set a solid foundation of oral health for all children across Canada today?"

The report concludes: "According to Statistics Canada, there were 3,740,000 children aged 5-14 in Canada in 2010. If 85 percent of them were enrolled in such a program today, based on the inflation adjusted per capita cost ($176.25), the price tag would be $560 million, Canada wide.

"This represents 4.1 percent of the Canadian Institute for Health Information's estimated current annual expenditures on dental services (forecast to be $13.6 billion for total private and public spending in 2010), and 0.3 percent of all annual expenditures on health care for 2010. An ounce of prevention is worth a pound of cure, indeed."

Section 8

THE NETHERLANDS

The Netherlands is a small country of 16,039 square miles in northwestern Europe. It is a constitutional monarchy with a parliamentary democracy. With 16.8 million inhabitants, it is one of the most densely populated countries of the world. The population has grown rapidly when compared with other European countries, from 5 million in 1950 to 16 million in 2000. The country encountered significant immigration from countries all over the world, especially Indonesia, Suriname, the Dutch Antilles, Morocco and Turkey, as well as other European countries.

Life expectancy at birth is 78 for men and 82 for women. There is a tendency for the elderly in the Netherlands to become "old" at a later stage, stay healthy for a longer period of time and keep active longer than people in other countries. Seniors generally keep optimal oral functions until the end of their lives. The number of elderly above 60 years participating in the labor force has doubled over the last century. This tendency may increase through reallocation of labor and adjustment to the individual lifestyle of "the elderly."

The official language is Dutch, but a large percentage of the population is able to understand and speak several foreign languages. For many people, English, French or German is the second language. First- and second-generation immigrants usually use the language of their home country.

THE HEALTH CARE SYSTEM

The health care system is based on public health insurance, with an additional private insurance system. Until 2006, those who were employed and earned below a certain amount were compulsorily insured in the public health insurance system.

In this system, insured persons were entitled to a restricted basic package of provisions set by law. In addition, they could take out additional private insurance for other care provisions. Those employees who earned more than this legally decided amount and those who were self-employed had to obtain private insurance. In 2006, the system was changed, and every citizen is now legally required to purchase basic health insurance, again with a restricted package and additional private insurances.

Within the basic public insurance, oral care is provided for children and adolescents up to the age of 18 years. The provisions contain all necessary preventive and

curative care, with the exemption of orthodontics and fixed prosthodontics. The latter are mostly covered through additional private insurances by the parents. For adults, only specialist care by an oral surgeon is covered. However, preventive and curative oral care for "special-need patients" is covered. Care that is not covered in the public system is paid by the patients out of pocket or partly through an additional private insurance policy. Approximately three-quarters of the adult population has additional private insurance policies for oral care.

No public school dental service exists. In a few regions, private organizations provide dental care for youngsters who are entitled to the basic package. They do so by employing dentists and dental hygienists who practice in "normal" offices and also in mobile clinics.

Almost all dentists and one-third of dental hygienists are in private practice.

WORKFORCE

In 2010, the oral care workforce consisted of 8,881 dentists, 2,425 dental hygienists, 234 oral surgeons and 275 orthodontists. Denturists, who provide removable prosthodontics care, are also recognized; 340, all male, are in practice (**Netherland's Capacity Body, 2010**).

Compared with other European countries, the ratio of oral care practitioners to the population is low, one dentist for 2,064 people, versus the average for Europe of one dentist for 1,516 individuals (**Widström, Eaton, Luciak-Donsberger, 2010**). There is commitment to changing the relative numbers of dentists and of dental hygienists in favor of increasing the number of dental hygienists. This is in accordance with the national health policy of reallocation of tasks among the various levels of care providers. Future policy is directed to more care being provided by dental hygienists rather than by dentists, based on the assumption that most routine oral care can be provided by the nonacademic dental hygienist. (The "new dental hygienist" in the Netherlands is comparable to the dental therapist/oral health therapists described for other countries.) The academically educated dentist can then provide care as an "oral physician" and concentrate on more complex care cases.

ORAL HEALTH

Since 1987, studies have been conducted periodically examining the oral health of young patients insured under the Dutch national public health insurance system. Additionally, the attitudes and behaviors of children and adolescents have been examined.

In 2009, Schuller (**2010**) found 77 percent of 9-year-olds from low socioeconomic backgrounds (SES) were caries-free, as were 85 percent of those from higher SES. At age 15, the figures were 42 percent and 53 percent, respectively; and at 21, 15 percent and 23 percent. Average DMFS scores were 0.6 (low SES) and 0.3 (high SES) for 9-year-olds; 2.6 and 1.7 for 15-year-olds; and 8.5 and 5.5 for 21-year-olds.

Compared with 2003, there were no changes in the percentages of children with caries-free permanent dentition in the 9-year-old or 21-year-old categories, either in the low or high SES categories. Nor was there any change in the DMFS numbers in the subjects with caries.

In the Netherlands, a dental visit is recommended twice annually. Of the 9-year-olds, 90 percent (low SES) and 92 percent (high SES) complied with this recommendation; these percentages were 83 percent and 89 percent for the 15-year-olds, and 70 percent and 73 percent for the 21-year-olds. The parents of the 9-year-olds, as well as the 21-year-olds themselves, were generally satisfied or very satisfied with the dental care provided. There were no demonstrable differences here associated with SES.

The oral health of the adults is also monitored periodically. Every five years, an epidemiological study is carried out in the town of Hertogenbosch. It should be stressed that the findings of these surveys are not representative for the Dutch population. Nevertheless, thanks to the periodic nature and the overall comparability of these findings, the survey gives a good insight into the developments of the oral health of the adult population of the country.

Most recent findings (**Schuller, 2009**) demonstrate that significant differences exist between "low " and "highly" educated categories regarding the number of functioning teeth, untreated caries and restorations, with lower-functioning teeth, more untreated caries and fewer restorations in the lower-educated category. This tendency in regard to the lower-educated category is also found for periodontal symptoms (more symptoms) and orthodontic treatment (less treatment). By comparing the findings of this survey in 2007 with the findings in 2002, it was concluded that the caries experience of all categories of the adult population (age cohorts, SES categories, gender and ethnicity) had slightly improved: less untreated caries, fewer fillings and extractions. No significant differences were found in relation to the insurance situation of these adults. On average, 70 percent of the adults appreciate their oral health situation as "good" or "very good." However, persons in the low-educated category and non-western immigrants consider their oral health less good and practice oral hygiene measures less than persons in the high-educated category.

RELEVANT DEVELOPMENTS IN SOCIETY

A number of factors, including rising expectations for the quality of life in modern society, the related need for medical care and an increase in the volume of knowledge available, have produced pressures for more knowledgeable and skillful health professionals, including dental hygienists (**Heuvel et al., 2005**). Dental awareness in the general population has grown. Patients have become more assertive and, with increased possibilities to obtain information (for example, the Internet), demand different kinds of treatments. They are also more oriented to preventive health care, including preventive oral health care. The aging population is increasingly retaining teeth and needs more, and often more complex, care than the previous elderly generation, who were often edentulous.

Apart from these demographic and cultural changes, there is a noticeable tendency toward more cooperative dental care: the team concept. Within the team, after suitable training, the dental hygienist is able to provide basic dental care for the large proportion of patients who require oral health screening, regular examinations, preventive care, treatment planning and, to some extent, curative care, including simple fillings. A minority of patients will require more complex care, either dentally or medically. Along with care for other specific groups of patients—for example, those in need of collective prevention—this complex care can be provided by dentists and, in some cases, dental specialists who have undergone further training over and above that of dental hygienists.

Such changes to the tasks and responsibilities of dental hygienists demand a professional who is able to anticipate and handle varied, complicated and unexpected situations. Apart from acquiring technical skills there is a growing need for communicative and team skills (**Schaub, 2007**).

To fulfill their new roles, dental hygienists must be capable of coping with problems and analyze, think and act methodically, in a reflective way. In the Netherlands, in order to develop all these skills, the period of education for dental hygienists has been increased by a year, from three to four years. Among other additional topics, the curriculum now includes simple restorative dentistry. It also leads to the awarding of a university bachelor's degree. These changes have necessitated the inclusion of education in more nontechnical skills and supra-professional expertise in the new program.

As a consequence of this new and extensive training program, dental hygienists in the Netherlands now have an independent status. They may work in locations separate from dentists, if desired. It is no longer required that a dentist refer a patient to a dental hygienist.

FURTHER BACKGROUND TO THE CHANGES—HUMAN RESOURCES

These changes have taken place at a time when there was an obvious shortage of dental clinicians, both dentists and hygienists, in the Netherlands. A solution had to be found. The epidemiological and demographic changes outlined earlier convinced the national health planners that it would not be sufficient just to increase the numbers of oral health care providers, but that radical changes to the structure of the system for providing oral care were necessary. A new and improved system based on suitability, effectiveness, accessibility and quality improvement was therefore designed. In the new system, patients are cared for by health professionals trained to provide the specific care and treatment that is needed, not according to a hierarchical structure, as was the case. This concept has led to a redefinition of the tasks that dentists, dental hygienists and assistants perform and should result in an optimal and more efficient functioning of the care system based on the knowledge and skills levels of the professionals involved. Job satisfaction will be an important side effect.

In the new system tasks are redefined as follows:

- The main task of the dentist is focused on general diagnosis and the coordination of a patient's care and treatment by him or her and his or her team; treatment performed by dentists is focused on patients with complex problems;
- tasks of the dental hygienist are focused on prevention (primary, secondary and tertiary), screening and monitoring and basic dental care;
- tasks of the assistant are focused on primary prevention, organizing the practice and assisting the dentist and the dental hygienist.

THE DEVELOPMENT OF THE PROFESSION OF THE DENTAL HYGIENIST

In the Netherlands, dental hygienists have contributed to oral health care for almost 40 years. In the 1960s, caries prevalence was very high. The number of available dentists did not meet the demand for care. Therefore, a two-track policy was developed. On one hand, new dental schools were founded in order to meet the demand for curative care and the total intake of dental students grew to 465 per year. On the other hand, the awareness of the need for a more preventive approach in oral care had become apparent. Experiences in the United States, the United Kingdom and other English-speaking countries with so-called "dental auxiliaries" inspired a select group of young Dutch women to be educated abroad as dental hygienists. After their return to the Netherlands, these pioneers shared their knowledge and skills as teachers in a newly founded school for dental hygienists in Utrecht. The intake of the school was five students in the first year. This soon evolved to 12 students per year in a two-year curriculum. Although

their education included the traditional aspects relating to the prevention and nonsurgical treatment of periodontal diseases, in the 1960s it focused on primary caries prevention through oral health education. This was the hygienists' focus after graduation. Subsequently, additional schools were opened in Amsterdam and Nijmegen. Total national intake was increased to 80 students a year.

At the end of the 1960s, the "discovery" that plaque lead to gingivitis and possibly periodontitis was followed by increasing attention on periodontal problems in the dental education and oral care provision. It widened the field for the dental hygienists because it was realized they could very well contribute to primary, secondary and tertiary prevention of periodontal diseases, rather than just perform scaling and polishing. However, there was still an overwhelming demand for restorative care following caries. The continuing shortage of dentists in the Netherlands demanded new solutions to the problem of availability of oral health care. As a result, some pilot projects using a New Zealand-type of curative (restorative) auxiliary were initiated in the beginning of the 1970s. A small number of dental hygienists received additional training to enable them to "drill and fill" as team members within a structured collaboration with dentists and assistants. In this structure, the members of the team collaborate while taking full responsibility for their own professional actions within the team. Moreover, evaluations of these projects showed clearly that the restorative dentistry practiced by the auxiliaries did not undermine their preventive approach to oral care.

In the 1970s, caries incidence started to decrease significantly, a development that has continued over the following decades. As a consequence, and in spite of the positive evaluations of the pilot projects involving curative auxiliaries such as New Zealand-style dental therapists, this approach was not adopted at that time in the Netherlands. In addition, the annual intake of dental schools was reduced from 465 to 120 students a year. Two dental schools were closed, and the two dental schools in Amsterdam were merged. This later change meant that the two related dental hygienist schools in Amsterdam also merged. However, there was no reduction in the size of the annual intake of dental hygiene students. Very soon after these measures were taken, it became clear that in the long term they would result in an uneven age distribution of dentists in the future, with large numbers retiring in the first decade of 2000, some 40 years after they qualified, with too few dentists to replace them. In addition, the demand for care has increased because of the increasing demand for periodontal treatment, the possibilities of implant treatment for the relatively large edentate population and growing interest in cosmetic dentistry. Furthermore, the expected demographic changes in the future will lead to even further increase in demand for oral care by the aging society. A significant increase in the number of oral health clinicians was therefore indicated. As a result, it was decided to reopen one of the recently closed dental schools in conjunction with a new dental hygienist school. The dental school and the dental hygienist school were tasked with developing an

integrated and flexible curriculum in order to create conditions for structured collaboration, on an equal basis, between future dentists and dental hygienists.

POLITICAL DECISIONS

Government policy

Based on the advice of an expert group consisting of representatives of the organizations and teaching institutes for oral care professionals, health insurance companies and consumer organizations, the government decided to introduce the following measures in 2000 (**Netherlands Ministry of Health, Welfare and Sports, 2000; Netherlands Institute for Research on Public Expenditure, 2006)**:

- increase the intake of dental hygienists to 300 per year and reduce the intake of dentists by 20 percent;
- promote the team concept of structured collaboration between dentists and dental hygienists;
- revise the educational programs for oral care personnel in order to ensure cohesion of future care provision, focusing on task reallocation;
- commence a four-year course in "oral care therapy" leading to a bachelor's degree.

These developments have resulted in fundamental changes in the roles of oral care professionals that need to be regulated by law.

Legislation

Legal regulation of the profession of the new-style dental hygienist was based on an accurate description of the competencies achieved during an accredited program of education. A crucial part of this program is the preventive orientation of the dental hygienist and the concept of prevention at primary, secondary and tertiary levels.

Compared with the education of the old-style dental hygienist, the main differences are the supra-professional competencies and the broadened professional competencies regarding tertiary caries prevention (preparation and filling of primary caries lesions). In addition, the referral of a patient by a dentist to a dental hygienist is no longer obligatory.

The fact that a referral is no longer necessary means that an overall medical/dental diagnosis may sometimes not be available to the dental hygienist. As a consequence, the dental hygienist needs to execute the screening not only

of teeth and gums but also of the overall health and oral health of the patient. This includes taking a medical history and understanding the significance of a wide range of medical conditions. However, patient treatment should always be performed within the distinct area of competencies in which the new-style dental hygienist has been trained and only with regard to the oral health of the patient. If necessary, the dental hygienist should refer the patient to the dentist or a physician. This also applies to situations that go beyond the competencies of the dental hygienist (**Nederlandse Vereniging van Mondhygiënisten, 2011**).

CURRICULUM FOR THE FOUR-YEAR PROGRAM

Bachelor of Health

From the academic year 2002-03, dental hygienist education in the Netherlands has been extended to four academic years and now culminates in the award of a bachelor's degree.

The new curriculum is based on the following topics: care-taking; functioning within an organization; professionalism of the individual and the profession itself; multidisciplinary integration; evidence-based practice; knowledge transfer; creativity; and awareness to work reflectively and methodically in complex situations. It also includes social and communicative skills, basic (administrative) management techniques and an awareness of social responsibility.

The program includes more extensive internships and the possibility of differentiation. This allows the development of additional specific skills for specific jobs linked to future employment opportunities. For example, someone who wanted to work with physically handicapped patients once they qualified might go on a work placement to work with such patients during training. Another extension of the training program is tertiary prevention of primary cavities by cavity preparation and restoration with plastic materials. After completing the four-year program, students have the possibility to continue education in a master's degree curriculum.

Curriculum Content

The developments in society and the profession have led to a different educational approach and resulted in competency-orientated education, which can be summarized as follows: working with patients/clients; working in and for an organization; improving professionalism.

Each field of competence is graded. Throughout the course, students are assessed on all topics on a scale from 1 to 5. During the course, the program is directed toward increasing self- management, increasing integrated working, increasing the complexity, increasing competence and increasing the quantity of clinical work.

In the first year, the student is considered to be a "choosing student"; in the second year a "trainee dental hygienist"; in the third year, a "junior dental hygienist"; and in the fourth year a "junior professional." Throughout the curriculum, distinctive themes are recognizable. They are: relating all training to practice; the acquisition of knowledge; the integration of knowledge into evidence-based practice; reflection on one's professional attitude; and coaching. The first year is primarily oriented to the development of learning skills and academic study. Students learn to function in the environment of a higher education system and become acquainted with the profession. The second year is devoted to creating a trainee dental hygienist; an appreciation of different categories of patients and the acquisition of technical skills are the main objectives. In the third year, there is far more emphasis on practical experience. Dentally and medically more complicated patients, as well as groups of patients in need of special care or education, are included in the training. The trainee dental hygienist becomes a junior dental hygienist and starts to develop scientific skills, including the ability to analyze the scientific literature in an objective and critical manner.

The last year of the program leads to the junior professional. Students are trained together with future dentists (students) working in teams. They choose a special graduation profile, involving internships and differentiation, and carry out a small research project. The conclusion of the course involves writing a publishable article or paper, and the verbal presentation of the research project.

EXPERIENCES TO DATE

The new curriculum has existed for the past 10 years. Teachers, lecturers and students have become increasingly satisfied with the new system. Initially, change created chaos, but the advantages are becoming evident. The acquisition of basic clinical skills is as far as possible integrated into the theoretical education and the training has become more focused on the actual practice of the dental hygienist. The role of the teacher has changed. The teacher has become a coach or facilitator rather that an instructor. Through training and practice, teachers have become accustomed to their new role.

EFFECTIVENESS AND QUALITY OF CARE

A few studies have been carried out to assess the effectiveness or the quality of the dental care service provided by the new-type dental hygienists in the Netherlands.

In a comparison of the daily practice of old-style hygienists, it was found that new-type hygienists worked more often in dental offices instead of being self-employed, and generally worked more hours per week than old-type hygienists. They performed tasks dealing with caries diagnosis and treatment more often, and tasks dealing with prevention and periodontology less often. These differences were statistically significant. However, in the dental offices, the differences between old-type dental hygienists and new-type dental hygienists were far less pronounced. In those practices, the "old" performed dental sealants, small corrections of dentures or restoration, and caries diagnosis during dental checkups no less frequently than the "new" hygienists. In conclusion, although prevention remains the core domain or role of all Dutch dental hygienists surveyed, the scope of practice substantially differed. This, however, depended not only on education, but also on type of practice. The new curriculum legitimated an already developed practice of task delegation (**Jerkovic et al., 2005**).

A comparison of the labor satisfaction of the old- and new-type hygienists was also executed. The 320 respondents who were self-employed or working in general dental practices could be divided into three clusters based on their scope of practice: full (50); limited substitution (107); mostly traditional tasks (124). Prevention and periodontology services remain the core tasks in dental hygienists' jobs. Extraction of permanent teeth is least substituted (3 percent). Respondents with a full scope of practice experienced the most skills variety, but lesser autonomy, feedback, task identity and significance than those focusing on traditional tasks. No direct relation was observed between extended scope of practice and intrinsic job satisfaction. The extrinsic job satisfaction was explained by employment form and practice size. In conclusion, it was stated that task redistribution between dentists and dental hygienists heightens skills variety in the latters' jobs, but does not increase the job's overall complexity. Decreases in other job characteristics tend to level out the skills variety's positive contribution. Consequently, dental hygienists' job satisfaction is expected to depend more on the work setting and structuring than on their scope of practice (**Jerkovic et al., 2010a, 2010b).**

An overall scientific impression of the role and position of the new-style hygienist versus the old in the Netherlands will become available on short notice (**Jerkovic, 2012).**

EMPOWERMENT

As a result of the changes in the professional responsibilities of the dental hygienists in the care system, the role and position of this oral care professional can be valued as of equal merit to the dentists with regard to the scope of care delivery. Nevertheless, in most cases a more traditional relationship between dentists and dental hygienists is still experienced. It is the attitude of dentists to maintain complete responsibility for the patient, including the care given by a hygienist. On the other hand, dental hygienists still feel like an auxiliary of dentists. In an attempt to change these attitudes, a project of "empowerment" of the dental hygienists was developed. In close collaboration between the Dutch Association of Dental Hygienists and the dental hygienist schools, a program to increase the professional self-confidence of the dental hygienist was designed. Apart from specific attention in the curriculum of the schools, activities are underway to further change the legally set responsibilities of the hygienist, as well as the development of a professional code of conduct.

Section 9

HONG KONG

Hong Kong, formerly a colony of the British Commonwealth, has been a Special Administrative Region of the People's Republic of China since 1997, with its own constitution-like charter (the Basic Law). It has a high degree of autonomy. With a land mass of only 426 square miles and a population of 7 million, it is one of the most densely populated areas in the world. Most of its population (95 percent) is ethnic Chinese. Age distribution: 0 to 14 years, 12 percent; 15 to 64, 75 percent; 65-plus, 14 percent. Most of the population is not religious, with only 43 percent practicing any form of religion, mostly Buddhism and Taoism. The predominant language is Cantonese; a third of the population also speaks English. English is the language of commerce. Most children begin preschool education at age 3. Full-time education is required from age 6 to 15. Then, three years of senior secondary education or vocational training is voluntary and completed by 90 percent of children. The literacy rate is 94 percent and life expectancy is 82 years.

HISTORY

The prevalence of dental caries among schoolchildren in Hong Kong used to be very high. In 1960, nearly all (97 percent) of 6-to-8-year-old schoolchildren in Hong Kong had experienced dental caries and their mean dmft score was 9.2 (**Evans, Lo, Lind, 1987**). The permanent teeth in older schoolchildren were also seriously affected by dental caries: Only 7 percent of 9-to-11-year-old children had a zero DMFT score and the mean score was 4.4. To prevent dental caries in the population, the Hong Kong government introduced a territory-wide water fluoridation scheme in 1961 and the average target fluoride concentration was set at 0.8 ppm (**Evans, Lo, Lind, 1987**).

Despite having the beneficial effects of water fluoridation, the dental health of schoolchildren in Hong Kong in the 1970s was still not satisfactory and nearly all of their decayed teeth were untreated (**Law, 1981**). A main reason is that there was no organized dental care service for schoolchildren in Hong Kong at that time. To solve the unmet dental treatment need of the primary school (grades 1 to 6) children, the Hong Kong government issued a policy paper in 1974 in which establishment of a School Dental Care Service (SDCS) was proposed (**Hong Kong Government, 1974; Chau, 1984; Davies, Corbet, Chiu, 1997**).

In the 1970s, there was a shortage of dentists in Hong Kong. The estimated number of practicing dentists in 1973 was 440 and the total population was

4 million, thus producing a dentist-to-population ratio of about 1:9000 (**Hong Kong Government, 1974**). There was no dental school to train dentists. On average, fewer than 10 dentists, all trained abroad, were added to the register of dentists in a year. The main duty of the government-employed dentists at that time was to provide a comprehensive dental care service for government civil servants and their families. They also provided limited dental treatment for the inpatients of government hospitals and emergency dental treatment for the public. Most of the dental care services for the public, including schoolchildren, were carried out by private dentists (**Chau, 1984**). Apparently, it was not possible to recruit or train sufficient dentists to run a School Dental Care Service (SDCS) for all the primary schoolchildren in Hong Kong at that time.

Aware that in some countries, such as New Zealand and Malaysia, school dental care was provided satisfactorily by trained dental therapists (then known as dental nurses), the government of Hong Kong decided to adopt such a dental service model, establishing a dental therapist training school in 1978 (**Wong, 1981**). A three-year training program was conducted by government dentists and the initial intake of dental therapist students was 33 a year (**Chan, Chu, Lau et al., 1984**). The SDCS was started in 1979 and the first batch of dental therapists graduated in 1981. Over the years, the SDCS has expanded to cover all primary schoolchildren in Hong Kong, but there have not been major changes in the mode of operation and the training of dental therapists.

TRAINING OF DENTAL THERAPISTS

The dental therapist training program is a three-year certificate curriculum (**Wong, 1981**). It is offered in the Tang Shiu Kin Dental Therapists Training School run by the Department of Health of the Hong Kong government. The students are employed by the government as full-time trainees. The teachers are government dentists and senior dental therapists.

1. The first year of the program is divided into two half-year courses. The first half-year consists of lectures on first aid, anatomy, dental anatomy, histology, dental histology and physiology. Practical work includes applied art, wax carving, use and care of dental instruments and equipment. The second half of the year includes applied dental subjects, such as operative dentistry, manipulation of restorative materials, administration of local anesthesia, and extraction. Other subjects such as oral pathology, pharmacology and therapeutics, orthodontics, radiography and dental health education teaching methods are also taught.
2. In the second year, the dental therapist students start to provide dental treatment to primary schoolchildren under dentists' supervision. Subjects such as preventive dentistry, dental public health, operative dentistry and dental

radiography are also taught. At the end of the second year, the dental therapist students are required to sit for an examination before they can be promoted to the third year of the course.

3. The third year mainly involves clinical training in the SDCS. The students also carry out oral health education activities in schools and other institutions.

SCOPE OF WORK

After completion of the training course, the dental therapist graduates are employed to work in the government dental services, mainly in the SDCS. Some dental therapists work in the government Oral Health Education Unit, which organizes oral health educational and promotional activities, and disseminates oral health information to the public in Hong Kong (**HKDH, 2011a**). They are prohibited by law to practice dentistry in the private sector in Hong Kong.

In the SDCS, the dental therapists work in large district-based school dental clinics under the direct supervision of government dentists. The dental care services the dental therapists can provide include the following items (**Wong, 1981**):

1. dental examination;
2. taking dental radiographs;
3. oral health education and instructions on oral hygiene;
4. scaling and polishing of teeth;
5. topical application of medicine or materials for the prevention of oral diseases, for example, fluoride gel varnish and fissure sealant;
6. treatment of decayed teeth, including placing restorations on primary and permanent teeth;
7. simple extraction of primary and permanent teeth under local anesthesia.

WORKFORCE SITUATION

With an output of about 30 dental therapist a year since the early 1980s (**Chan, Chu, Lau et al., 1985**), the number of dental therapists in Hong Kong increased steadily in the 1980s and 1990s. Results of health manpower surveys show that there were 296 dental therapists in Hong Kong in 2000, which was an 18 percent increase in number compared with 1996. The number of dental therapists has been maintained at around 300 in the last decade (**HKDH, 2011b**).

In 2009, there were 296 dental therapists working in the Hong Kong government dental service. Among them, 88 percent (261) were female. In that year, the number of SDCS participants (primary schoolchildren) was 350,000 (**Hong Kong Government, 2011**). Thus, the ratio of dental therapists to SDCS participants was about 1 to 1,200.

THE SCHOOL DENTAL CARE SERVICE

The School Dental Service (SDCS) in Hong Kong is a public dental service heavily subsidized and run by the government. It started to provide dental care to primary schoolchildren in late 1979. Currently, the service is provided to children attending grades 1 to 6 in primary schools in Hong Kong. In 2010, the participation rate was 95 percent.

The aim of the SDCS is to promote good oral hygiene and to prevent common dental diseases among primary schoolchildren (**HKDH, 2011a**). The clinical service is provided in nine large school dental clinics in various districts throughout Hong Kong. The clinics are located in government buildings outside the primary schools. A typical school service has a senior dental officer as the head and is assisted by two dental officers, with about 30 dental therapists and a small number of dental surgery assistants working in an open clinic. All primary schoolchildren are eligible to join the SDCS. They can enroll through their school by paying a nominal annual fee of $20 HK in 2011 (approximately $2.50 U.S.). There is no additional charge for the dental service, which includes oral health education, dental examination, preventive treatment and basic restorative treatment. Tooth extraction and more complex dental treatment may be provided if necessary. In general, orthodontic treatment is not provided.

The dental service is arranged in a way that aims to minimize disruption to the normal activities of the primary schools. All enrolled children receive an annual dental examination by a dentist under the SDCS. The children studying in grades 1 to 4 are brought to an assigned school dental clinic during normal school hours by specially arranged bus services. After receiving the necessary dental care service, the children are transported back to their school by bus. Appointments are given to the children attending grades 5 and 6, and their parents have to bring them to an assigned school dental clinic to receive dental service outside normal school days/hours.

Most of the dental service in the SDCS is provided by dental therapists. They work without a chairside assistant. They refer the more complicated dental procedures and difficult patients to dentists present in the school dental clinic.

EFFECTIVENESS AND QUALITY OF CARE

There is no published study on direct assessment of the effectiveness or the quality of the dental care service provided by dental therapists in Hong Kong. Despite this, there are two studies comparing the SDCS participants with nonparticipants, one conducted in 1984 and the other in 1990.

The first study by Chan and colleagues (**1984**) involved a questionnaire survey of the parents of SDCS participants in six primary schools and a clinical examination of 9-to-11-year-old children in these schools. Six hundred questionnaires were sent out and 590 (98 percent) completed questionnaires were collected. It was found that most parents were satisfied with the quality of the dental service provided to their child. Three-quarters (76 percent) of the parents thought that the dental therapists treated their child well. Most parents reported that the dental therapists had given adequate oral health instructions to their child and had taken necessary measures to minimize pain during treatment—78 percent and 64 percent, respectively. In the clinical examination of 209 SDCS participants and 36 nonparticipants, it was found that the two groups of children had similar levels of oral hygiene (mean Silness and Loe Plaque Index scores: 0.9 versus 0.8). Compared with nonparticipants, participants had less active decay in their permanent dentition (mean DT scores: 0.2 versus 0.7) and more fillings (mean FT scores: 1.3 versus 0.4). Caution needs to be taken when interpreting the results of this study because the study sample was not randomly selected, and the number of nonparticipants was small.

The second study used a two-stage sampling method to select 300 children from four primary schools in Hong Kong (**Chan, Cheng, Fok et al., 1990**). A face-to-face interview and a clinical examination were conducted on these children. The children who were aged 9 to 11 and had participated continuously in the SDCS in the prior four years were classified as SDCS participants. The children in the same age group who had not participated in the SDCS in the past four years were classified as nonparticipants. The other children who were intermittent SDCS participants were excluded. Totally, there were 167 participants and 118 nonparticipants in the final analysis. It was found that the two groups of children had similar levels of oral health knowledge but proportionally more participants than nonparticipants brushed their teeth twice or more a day (80 percent versus 64 percent). However, the oral hygiene level of the participants was similar to that of the nonparticipants. Although the overall dental caries experience in the permanent dentition of the two groups of children was similar, compared to the nonparticipants, the participants had on average fewer decayed teeth (mean DT scores: 0.2 versus 0.6) and more filled teeth (mean FT scores: 0.6 versus 0.2).

Besides the above two studies, a number of large-scale oral health surveys have been conducted among the schoolchildren in Hong Kong. However, none of the surveys aimed to evaluate the SDCS. To have some appraisal of the possible effects of the SDCS on the oral health of the primary schoolchildren in Hong Kong, a comparison of the findings from three cross-sectional surveys conducted at three different time points was made. The first survey was conducted in 1980 when the SDCS had just started and the older primary schoolchildren had not participated

in the service (**Law, 1981**). The second survey was conducted in 1986, when the SDCS had just been extended to cover the senior grade children in primary school (**Lo, 1987; Lo, Evans, Lind et al., 1990**). The third survey was conducted in 2001, when the SDCS had been implemented for more than 20 years (**Department of Health, 2002**). The main focus of the comparison is on the dental caries status of the permanent dentition of the 11- and 12-year-old schoolchildren as measured by the DMFT index using similar diagnostic criteria.

THE 1980 SURVEY

A survey on the dental caries status of the Hong Kong primary schoolchildren was conducted in February 1980 before the full introduction of the SDCS. One of its purposes was to collect baseline data for future evaluation of the SDCS (**Law, 1981**).

Primary schoolchildren from 6 to 11 years of age were included, of which 6,765 children were selected by a two-stage stratified sampling method. First the schools were stratified by size (number of students) and a sample of schools was obtained from each stratum by random sampling. Then a sample of children was obtained with a uniform sampling rate of 1.5 percent in all selected schools. The clinical examiners were calibrated before the survey and the criteria for the dental examination were based on those recommended by the World Health Organization. Among the surveyed children, 1,140 were age 11. More than half (57 percent) of these 11-year-old schoolchildren had at least one permanent tooth with caries experience (DMFT>0). The mean DMFT score of this group of children was 1.5, with more than 90 percent of the caries-affected teeth remaining untreated (mean DT=1.4; MT<0.1; FT<0.1).

THE 1986 SURVEY

An oral health survey was conducted in 1986, six years after the start of the SDCS (**Lo, 1987; Lo, Evans, Lind et al., 1990**). During those six years, participation rate of the eligible primary schoolchildren in the SDCS had risen from 29 percent to 65 percent. In the 1986 survey, the children were selected by means of a two-stage replicate sampling method. A total of 56 schools were selected from the list of all primary schools in Hong Kong with a probability proportional to size (their student enrolment). Then, from within these schools, a predetermined fixed number of children were systematically selected. The clinical examiners were calibrated before the survey and the criteria for the dental examination were based on those recommended by the World Health Organization.

The subject response rate of this survey was 92 percent. In this survey, 257 children aged 11 years and 157 children aged 12 years were examined. The mean DMFT score of these surveyed children were 1.3 and 1.5 respectively, with 56 percent and 60 percent of them having at least one permanent tooth with caries experience (DMFT>0). The main component of the mean DMFT score was filled teeth (FT), contributing 53 percent to 69 percent, while untreated decayed teeth (DT) contributed 30 percent to 40 percent to the index score. It was also found that among the 9-to-11-year-old children examined, compared with the SDCS participants, the nonparticipants had on average fewer filled permanent teeth (mean FT: 0.6 versus 0.9) and more decayed teeth (mean DT: 0.4 versus 0.2).

The parents of the SDCS participants were asked to complete a short questionnaire on their satisfaction with the service. Results showed that 67 percent of the parents were either very satisfied or satisfied with the SDCS, and only 8 percent of the parents were dissatisfied (**Lo, 1987**).

THE 2001 SURVEY

The most recent oral health survey on schoolchildren in Hong Kong was conducted in 2001 (**HKDH, 2002**). The SDCS had been implemented for more than 20 years and the SDCS participation rate of the primary schoolchildren in 2001 was 88 percent. A two-stage sampling procedure was adopted and a total of 792 12-year-old children in 20 schools were examined. The oral health status of the children was assessed by calibrated dentists according to the criteria recommended by the World Health Organization.

It was found that the mean DMFT score of the 12-year-old children was 0.8 and 62 percent of the children did not have caries experience in their permanent teeth (DMFT=0). The major component of the mean DMFT score was filled teeth (FT=0.6) while the mean DT and mean MT scores were both 0.1.

CHANGES IN DMFT OF 11-TO-12-YEAR-OLD HONG KONG CHILDREN FROM 1980 TO 2001

Findings of the oral health surveys show that there had been a reduction in the dental caries experience of the permanent dentition of the Hong Kong schoolchildren between 1980 and 2001. The mean DMFT score of 11-to-12-year-old children decreased from 1.5 in 1980 to 0.8 in 2001. This is a 43 percent reduction over the 20-year period. The percentage of children who had a zero DMFT score increased from 43 percent in 1980 to 62 percent in 2001. There had also been a major change in the composition of the mean DMFT score of the children. The contribution of untreated decayed teeth (DT) to the DMFT score had dropped

from 93 percent in 1980 to 13 percent in 2001. During the same period, the FT/DMFT ratio had increased from 7 percent to 75 percent.

Since the introduction of the SDCS in 1979, it has been the major source of dental care service for primary schoolchildren in Hong Kong. This service has been mainly staffed by dental therapists. Dental caries in young children is affected by many factors and it is not possible to calculate precisely the contribution of dental service provision toward the reduction in dental caries experience of Hong Kong schoolchildren over the years. Despite this, the regular provision of preventive treatments, such as topical fluorides and fissure sealant, by the dental therapist to the participants of the SDCS can certainly help to reduce dental caries. The provision of dental restorative treatments by the dental therapists in the SDCS certainly is the main reason for the drastic reduction in the number of active decayed permanent teeth and the increase in filled teeth in the primary schoolchildren in Hong Kong over the years.

Section 10

SINGAPORE

Singapore is a parliamentary republic consisting of 63 islands off the southern tip of the Malayan Peninsula, with the largest and main island known as Singapore Island. It has a population of 5.1 million, only 3.2 million (63 percent) of whom are citizens, with the remainder being foreign workers or permanent residents. Three-fourths of the population is of Chinese descent, 13 percent Malaysian, and 9 percent Indian. Singapore has a high level of public education, a thriving economy and a robust health system. The health care system for the adult population is based on universal, compulsory savings, with subsidies for the poor, and affordable copayments for all services to minimize overuse.

AN INADEQUATE DENTAL WORKFORCE

> *At the turn of the 20th Century, the dental health of the people was in a deplorable state…. Extractions were often the only remedy…. Dentistry remained closed to the vast majority of the people…. The cost or private treatment was astronomical. There was no infrastructure in place to conduct public dental health services…. Ancillary dental workers could provide a change in skills mix in the provision of dental care so as to alleviate the acute shortage of dentists…. The lack of adequate treatment facilities and the growing need for qualified dental attention prompted the development of a Dental School and a Dental Outpatient Unit on General Hospital grounds, between 1929 and 1930.… Between 1929 to 1941, the staff comprised a professor, a lecturer and two tutors. They were assisted by one governmental dental officer, and between them, they were responsible for the teaching of students and dental services at the Dental School Clinic in Sepoy Lines (***Singapore Ministry of Health (SMH), 1996***).*

By 1939-41, seven to nine dentists graduated each year, with a Licentiate in Dental Surgery (LSD), but then the school was closed until the end of World War II (**National University of Singapore Dental School, 2011**). By 2009, the National University of Singapore Dental School enrolled 48 first-year dental students (**National University of Singapore Dental School, 2010**). By 2001, there were 987 dentists in Singapore, a ratio of 1:4,383 population (**Nash, Friedman, 2008**).

The postwar Singapore government recognized that even with the increased number of dentists there would still be too few to meet the needs of the population. "Two target groups were identified the children and the mothers. It was hoped that treatment provided at this level would raise a dentally-

conscious population and build up dental fitness. A ten-year Medical Plan for Singapore was first proposed in 1946. A School Medical and Dental Clinic was planned to provide medical and dental services for the children. Dental 'huts' would be built in tandem with the Ministry of Education's school development plan. Dental care for antenatal mothers and preschool children would be made available at the Maternal and Child Health clinics. Public water fluoridation as an anti-caries agent would be adopted…. Ninety-eight per cent of all children examined required treatment" (**SMH, 1996**).

Free dental care for children was to be provided by the School Dental Service in school dental clinics, eventually mostly by dental therapists. By 1975, "graduates of the Dental Nurses Training School [could] work in governmental school dental clinics, in primary [and secondary] schools, in maternal and child health centers, in outpatient dental clinics, in the police dental clinic, in mobile dental clinics and in the Dental Health Education Unit" (**Howe, 1975**).

BACKGROUND ON THE SCHOOL DENTAL SERVICE AND DENTAL THERAPISTS

The School Dental Service (SDS) was formed just after the Japanese Occupation with its first clinic at Tan Tock Seng Hospital with a dental officer to provide dental services to children. To ease the crush of patients, decentralized dental clinics in primary schools were built.

The first dental nurses in the 1950s were trained in Penang [Malaysia] and they were utilized to work in the dental clinics in primary schools. The Ministry of Health (MOH) later established the Dental Nurses Training School in 1962 which conducted the 3-year certificate programme to train Dental Nurses for the SDS. This training was later devolved to the SDS in 1990.

In February 2000, Dental Nurses were designated as Dental Therapists (DTs) and the Dental Nursing Programme was renamed the Certificate in Dental Therapy Programme. In 2001, with the institution of the Health Promotion Board (HPB), the SDS came under the purview of HPB.

*In 2003, the Certificate course further evolved into a Diploma course to give the profession added credence and professionalism….In late 2004, the Diploma in Dental Therapy course at NYP was further modified to an integrated dental therapist/hygienist diploma programme and renamed the Diploma in Dental Hygiene and Therapy in 2006. This programme further enhanced the training of DTs and the first batch of DT graduates from NYP had dual qualification in dental hygiene and therapy. This allowed them to practice both on children and adults" (***SMH, 2007***).*

A new classification has been adopted by the Singapore Dental Council: the Oral Health Therapist (OHT) (**Singapore Dental Council—SDC, 2008**). It consists of the three categories, namely:

- Dental Hygienist
- Dental Therapist
- Dental Hygienist/Dental Therapist

Their scope of practice is as follows:

A. Dental Hygienists
   - Cleaning and polishing of teeth
   - Scaling and root planning of teeth, including infiltration anesthesia
   - Topical Fluoride and fissure sealant application
   - Diagnostic radiography
   - Alginate denture impressions
   - Oral hygiene instruction

B. Dental Therapists
   - Cleaning and polishing of teeth
   - Scaling of teeth.
   - Topical fluoride and fissure sealant application
   - Extraction primary teeth of children 18 years of age or younger
   - Rubber dam application
   - Restoration (filling) of teeth of children 18 years of age or younger
   - Diagnostic radiography
   - Infiltration anesthesia
   - Alginate denture impressions
   - Oral hygiene instruction

C. Dental Therapists/Hygienists Cleaning and polishing of teeth
   - Scaling of teeth
   - Topical fluoride and fissure sealant application
   - Extraction primary teeth of persons of 18 years of age or younger
   - Rubber dam application
   - Restoration (filling) of teeth of persons of 18 years of age or younger
   - Diagnostic radiography
   - Infiltration anesthesia
   - Alginate denture impressions
   - Oral hygiene instruction

"Upon graduation, the DTs are posted to a school dental clinic where they worked with qualified senior DTs for at least a year before they are allowed to work independently. All the DTs also work under the supervision of dental officers.

This is to ensure that the DTs were competently trained and acquired a high standard of clinical skills to provide quality oral health care to the children" (**SMH, 2007**).

ROLE OF DENTAL THERAPISTS IN THE SCHOOL DENTAL SERVICE

"The School Dental Service provides basic dental treatment for all primary [and secondary] school pupils…upon their parents signing a consent form…. Dental treatment is provided free at the school dental clinics and mobile dental clinics. Pupils requiring more complex work beyond the scope of the dental therapists are referred for treatment at the School Dental Centre in Health Promotion Board" (**Singapore Health Promotion Board—SHPB, 2009a**). They may also be referred to hospital dental clinics and the dental school. Fees are charged for all procedures done outside the school dental clinics at reduced rates for permanent residents and Singaporeans under age 19.

> *In FY2009, SDS provided dental care for pupils in 176 primary schools, 161 secondary schools, 19 special schools and a few Madrasah schools. This was done through its 196 school dental clinics and 30 mobile dental clinics as well as HPB's dental center.*
>
> *With a team of 194 dental therapists, 202,782 Primary 1, 2, 4 and 6 pupils and Primary 3 and 6 pupils with high caries risk as well as 92,595 Secondary 1 and 3 pupils and Secondary 2 and 4 pupils with high caries risk were screened. Of these, 188,195 primary and 88,908 secondary school pupils were rendered dentally fit. A Decayed, Missing and Filled Teeth (DMFT) index of 0.70 was achieved among the 12-year-olds, with the 15-year-olds obtaining a DMFT of 1.1.*
>
> *Feedback from schools has been positive, and the services provided by SDS achieved a customer score of 96 percent, which is well above the 85 percent target set by HPB (***SHPB, 2010***).*

Each dental therapist is capable of "taking care of 1,400 to 1,700 students in Singapore. All the DTs are qualified either under the Certificate in Dental Nursing Programme**,** Certificate in Dental Therapy Programme or the Diploma in Dental Hygiene and Therapy Programme and at least 1 year's experience working with senior DTs before they work independently. The roles of the DTs include both clinical and administration and management. These include the following:

Clinical

i. *Screen all the students who participate in the school dental program*
ii. *Provide preventive treatment e.g. scaling, polishing of stains, application of fissure sealants, and fluoride therapy*

iii. Restore decayed deciduous and permanent teeth
iv. Perform pulp treatment on deciduous teeth
v. Extract deciduous teeth
vi. Provide comprehensive oral health education, e.g., chair-side oral hygiene instructions, tooth brushing drills, dental health exhibitions and talks
vii. Make referrals to dental officers when necessary

Administration & Management

*i. Record and update all clinical records in the School Dental Service *IT system (IDEAS: Integrated Dental Electronic Assessment for Students)*
ii. Institute infection control protocol in the dental clinic
iii. Ensure the smooth running of the school / mobile dental clinic
iv. Maintain cordial relationship with the schools

*"To ensure that DTs perform to the highest standards and administer professional and excellent dental service, annual audits are conducted to check on the DTs' infection control and clinical quality standards. DTs are also required to attend continuing professional education to maintain and improve their skills" (***SMH, 2007***).*

An area needing improvement is the handling of traumatic injury to teeth. One study revealed that "A high proportion of the [DT] respondents (94.6 percent) indicated a need for more knowledge…. As the front line providers of dental care, it is inevitable that they are the first to be approached to assist children who sustain orofacial injuries while in schools. Dental trauma is not uncommon in a school setting and has been estimated that one in every 200 school aged child will suffer from tooth avulsion annually…. Although oral injuries beyond the scope of dental therapists are referred to the dentist for his management, it is important that the dental therapists working in a school environment be equipped with sound knowledge on the management of traumatized teeth" (**Loh, Sae-Lim, Yian, Liang, 2006**).

ACHIEVEMENTS IN THE DMFT INDEX

The main factors contributing to the decrease in the DMFT Index are fluoridation of the community water supply, the participation of schoolchildren in the free School Dental Service staffed by dental therapists, and the universal compulsory health savings program that includes dental care. "The DMFT index has been improving consistently since the institution of the Singapore Dental Service (SDS). Instrumental in this is the role of the DTs in the SDS. The oral health status of children has improved most dramatically. Based on oral health surveys done in 1970, 1989, 1994, and 2003 the decayed, missing and filled teeth (DMFT) index of

12-year-old children has fallen from 3 in 1970, to 1.4 in 1989 to 1 in 1994 and to 0.54 in 2003. This has surpassed the goal set by the Ministry of Health of 1.2 by the year of 2000. Singapore has achieved one of lowest DMFT in the world"(**SMH, 2007**).

"In 2008, 238,157 primary school and 93,983 Secondary 1 and Secondary 3 pupils were screened, of which 226,382 (96 percent) and 90,010 (89 percent) respectively were rendered dentally fit. A Decayed, Missing and Filled Teeth (DMFT) index of 0.70 was achieved among the 12-year-olds, with the 15-year-olds obtaining a DMFT of 1.1" (**SHPB, 2009b**).

CONTINUING CAREER PATH OF DENTAL THERAPISTS

"Career prospects for dental therapists are promising as they can practice in varied settings such as the Field or Mobile Dental Clinics in SDS and in the training of student DTs. Motivated and good workers can progress to Senior Dental Therapists, Managers (Dental Therapy), Senior Managers (Dental Therapy), and Principal Dental Therapist" (**SMH, 2007**).

The combining of the dental therapy and hygiene programs has further advanced their career prospects. "With the Amendments to the Dentists Act, they will now be able to also work in the private sector under the direction of dentists" (**SMH, 2007**). They can also work in community outreach programs. For example, "Two mobile dental clinics from SDS were deployed for a week each at the Woodlands Community Centre (CC) and Chong Pang CC. Dental officers, oral health therapists, dental students and staff members of NUS rendered dental care comprising screening, scaling, oral hygiene instructions, dental restorations and extractions at a concessionary rate of $9 per attendance to the elderly and needy. Senior citizens on the Public Assistance Scheme were given free treatment" (**SHPB, 2009b**).

Thus, "Dental hygienists and therapists can practice in a variety of settings. These include the School Dental Service or in a private clinical practice as part of the dental team offering dental health services. They may also work in the research, sales or marketing sections of industries dealing with dental equipment or oral health products" (**Nanyang Polytechnic School of Health Sciences, 2011**).

Section 11

MALAYSIA

The South China Sea separates peninsular Malaysia from East Malaysia, part of the large island of Borneo that is shared with Indonesia and Brunei. Malaysia's combined land mass is about the size of New Mexico, with a population of more than 28.3 million, 71 percent of which live on the lower half of the Southeast Asia peninsula. It is a constitutional monarchy with an elective bicameral federal parliament and unicameral state legislatures, reflecting its British Commonwealth heritage. Native Malays make up 53 percent of the population; there are also 26 percent Chinese; 12 percent indigenous (including Bumiputeras, Orang Asli, Aborigines); 8 percent Indian; and 1 percent others. Islam is the dominant religion at 60 percent of the population. There rest are 19 percent Buddhist, 9 percent Christian, 6 percent Hindu and 5 percent other or none. Age distribution: 0 to 14, 30 percent; 15 to 64, 65 percent; 65-plus, 5 percent. The major language is Bahasa Melayu (standardized Malay), followed by Chinese, with English the de facto administrative language, and other ethnic dialects. The population is literate at 94 percent. Grades 1 to 6 are free and compulsory, with 90 percent attendance. The following five years of secondary education are free and optional, with attendance at 60 percent. In addition to its exports of petroleum, liquefied natural gas and palm oil, Malaysia is a significant producer of semiconductor devices; electrical goods, including solar panels; and information and communication technology products.

When Malaysia became an independent country in 1957, the population of 7 million was faced with an acute shortage in the dental workforce; a very high caries prevalence, described as "appalling"; and a young population, with more than 50 percent of the population under age 18 (**Malaysia Ministry of Health (MMH), 1999**). At that time, there were 20 dental officers and 26 assistant dental officers in government service, with another 50 dentists in private practice, who were concentrated in urban areas. The dentist-to-population ratio was 1:34,000. In addition, there were 400 "registered dentists" who, while having no formal qualifications for practicing dentistry, provided limited care; dentistry had not been legally recognized at that time. Local dentists were trained in Singapore (**MMH, 2003**). There was no school of dentistry in Peninsular Malaya in 1957 and their dentists were trained in Singapore. In 1970, the dentist-to-population ratio was 1:40,356. It was not until 1976 that the first class of 30 dentists graduated from the newly established Faculty of Dentistry at the University of Malaya in Kuala Lumpur. Two new public dental schools opened in 1998 (**MMH, 2005**). Also in 2000, to address the inequitable distribution between public and private dentists, the government implemented legislation that required all new dental graduates to work in the government dental service for three years before being admitted

to full registration by the Malaysian Dental Council and awarded a license to practice. In 2006, to further alleviate the shortage of dentists, the government approved the establishment of five additional dental schools, including, for the first time, private dental schools. By 2004 there were still more dentists practicing privately (1,439) compared with the public sector (1,111). Overall, the dentist-to-population ratio was 1:10,678 (**MMH, 2004a**). Currently there are 11 dental schools, both public and private. The dentist-to-population ratio varies from 1:8,779 in urban areas to 1:25,108 in remote areas. By 2011, there were about 4,000 active public and private dental practitioners registered, with a dentist-to-population ratio of approximately 1:1,687.

In the early years, in order to overcome the acute shortage of qualified dentists, dental nurses (dental therapists) were introduced into Malaysian dentistry in 1949 to serve schoolchildren exclusively. "Dental nurse" continues to be the accepted nomenclature for individuals now referred to as dental therapists in many other countries **(Malaysian Dental Training College, 2005**). At that time, 50 percent of the population of Malaysia was under 18, which corresponded to very high unmet treatment needs for caries in schoolchildren. The Malaysian Dental Training School was established in June 1949. Patterned after the New Zealand model and located in Penang, it was the first training program for dental nurses/dental therapists outside of New Zealand (**MMH, 1999**). The first class consisted of five students and was one year in length. The first principal of the Penang school, Chellie J. Sundram, made clear the function and limitation of the school dental nurse in the scheme of the profession: "It is understood that school dental nurses are not meant to be substitutes for the dental surgeon: just as the hospital nurse is not a substitute for the doctor or surgeon" (**MMH, 2003**).

In 1952, the training program was increased to a two-year curriculum plus a period of training in community clinics of one year and four months. The School trained 50 to 70 dental nurses a year in its early years. In 1965, the Dental Training School moved to a new permanent campus building, which it still occupies. Scholarships were established for all trainees in 1972, instead of a salary, with the requirement of five years of government service. That same year, the duration of training was altered slightly to a two-year curriculum, with one year of mentored practice in a community clinic. In 1987, the training period was again adjusted, with two years spent in the school's curriculum, followed by eight months of practice in a community clinic, returning to the school for final examinations. In 1996, the "Dental Nurse Certificate" was upgraded to a "Diploma in Dental Nursing." The size of the class enrolled increased from 120 per year to 160 per year in 1998. Post-basic courses in Pediatric Dentistry and Orthodontics were added in 1998 and 1999, respectively (**MMH, 1999**).

The school in Penang celebrated its Golden Jubilee in 1999 (**MMH, 1999**). In its first 50 years, the program had trained 1,498 dental nurses. Included in the total

were a significant number of dental nurses trained for other countries: Brunei (42); Singapore (21); Hong Kong (16); Nigeria (8); Western Samoa (4); Myanmar (3); Vietnam (3); and Japan (1) (**Malaysian Dental Training School, 1999**). Since its founding, it has now graduated more than 2,000 dental nurses from Malaysia, and many dental nurses from 19 other countries that have either been sponsored by the World Health Organization or their respective governments. A 2011 report from the Penang College's Director indicates that since its founding in 1949, 3,439 dental nurses/dental therapists have graduated from the program (**Penang Dental College, 2011**).

Further milestones of the Dental Training School from 1999 to 2005 included a post-basic course in Periodontics introduced in 2004 and a post-basic course in Maxillofacial Surgery. In 2003, the name of the school was changed from the Malaysian Dental Training School to the Malaysian Dental Training College. Training in the use of "high speed handpiece instrumentation" was introduced in 2004 (**Malaysian Dental Training College, 2005**).

Malaysia's famous cartoonist, Lat, published a book of cartoons for the Ministry of Health of Malaysia that reflected views of the Malaysian public on the contribution of the dental nurses in the School Dental Service. Lat himself lived in a rural village and had experienced the care of the school dental nurse as a child. Since the 1950s, school dental nurses have been responsible for the oral health of Malaysia's children since very few dentists existed. Lat's cartoons portray the nurses (therapists) role in caring for children in less than ideal circumstances, providing oral health instruction and treating dental disease (**MMH, 2004b**).

Dental nurses in Malaysia are all females and they are not permitted to practice in the private sector. As in New Zealand, essentially all children's dental care is provided by the dental nurses. They are only able to work under the general supervision of government dental officers. The Malaysian government supports free oral health care for the 3 million children in 7,583 elementary schools and the 2 million children in 2,111 secondary schools through its network of 1,969 public dental clinics. The public health service is empowered by law to provide dental examinations and treatment to all enrolled schoolchildren. However, treatment requires written consent from parents or guardians.

The scope of practice for dental nurses is limited to what would be considered primary care for children. Dental nurses provide oral health education, clean teeth of plaque and calculus, provide topical fluoride therapy, place fissure sealants, perform standard cavity preparations of primary and permanent teeth, pulp cap exposures and extract primary teeth. In some states where there is an acute shortage of dentists, they are permitted to extract permanent teeth (**MMH, 2006**). Malaysian dentists treat children primarily on referral by dental nurses when required care is beyond their competency and scope of practice. Essentially all of a

public dentist's practice is devoted to treating adults. Economic incentives resulted in public sector dentists migrating into private practice after a few years of government service. In contrast, the employment of most dental nurses remained stable until retirement age. In 1970, the majority of dentists (60 percent) worked in government programs. By 2004, the majority, 56 percent, were in private practice (**MMH, 2005**). Nonetheless, dental nurses will continue to be the primary provider of oral health care for Malaysia's children.

In 1995, Jaafar studied the impact of dental nurses on the dental health status of children (**Jaafar, 1995**). In two Malaysian states, Penang and Johor, the care by dental nurses was provided to 100 percent of elementary and secondary schools. Mean coverage for all states was 83 percent for primary schoolchildren and 43 percent for secondary students. Mean coverage for preschool children was 80 percent, with 14 percent coverage for expectant mothers. Jaafar reported the dental nurse/government dental officer/population ratio for schoolchildren was approximately 1 to 2,396, whereas the dentist-to-population ratio was 1 to 11,433, with a goal or target of a dentist-to-population ratio of 1 to 2,000-4,000.

Jaafar stated that the contribution of the dental nurses to improvement in the oral health of Malaysian schoolchildren was often underestimated, as public sector dentists treat predominately adults while dental nurses exclusively treat schoolchildren. The dental nurse-to-children ratio had already approached the target for the dentist-to-population ratio of less than 1 to 2,000. He stressed that dental nurses must be taken into serious consideration and concluded, "very few countries in the world can boast to have such a dedicated, well-motivated, well-organized, and well-covered system offering free dental service to all school children across the country."

Jaafar characterized the impact on School Dental Services as "short-term" and "long-term." He found that prevalence of the dmf and DMF teeth in 6-year-old preschool children had declined from 95.7 percent in 1971 to 89.3 percent in 1988. The mean df index declined only slightly from 6.3 to 6.2. However, in 12-year-old schoolchildren where dental nurses were deployed, the prevalence of DMF teeth declined from 83 percent to 72.1 percent; and the mean DMF index declined from 3.7 to 2.37—meeting the World Health Organization goal of a DMFT of three or less at age 12, despite the shortage of dentists. There were essentially no changes among 16-year-olds. Of particular note was that the components of the DMF shifted from a largely decayed component of the DMFT in 1971 to a filled component in 1988, indicating that the capacity to repair increased but not the capacity to prevent new carious lesions.

However, Jaafar cited the work of Holloway (**Holloway, 1975**) and Hunter (**Hunter, Hollis, Drinnan, 1980**) as demonstrating the need to refocus the work of dental nurses on prevention as had recently been done in New Zealand. He indicated that

Malaysia had already embarked on a refocusing of its School Dental Service on prevention, with emphasis being given to oral health education and tooth-brushing. Water fluoridation had begun in Malaysia in the 1960s. By 1994, 132 out of 200 (66 percent) water treatment plants were fluoridating the water. However, he cited evidence that only 56 (42 percent) were maintaining a satisfactory level of fluoride in the water for more than 10 months per year. He indicated that absent a change in orientation from treatment to prevention, the long-term impact of the work of dental nurses was not great. Among his recommendations were: "1) Limiting early restorative intervention; 2) Using fissure sealants judiciously to control cost-effectiveness; 3) Modifying cavity design with the aim of preserving as much tooth structure as possible; 4) Limiting repair and refill of slightly imperfect restorations; 5) Encouraging development of public policies to control sugar abuse."

Jafaar conducted a study evaluating the outcome of dental services for secondary schoolchildren as his research for a Ph.D. degree (**Jafaar, 1999**). The aim of the research was to evaluate the outcomes of the School Dental Service, staffed by dental nurses, on the oral health of 12-to-13-year-old children, using normative (objective) and subjective indexes as complementary measures. A further intention was to determine implications for health policy. The objective measures used were the prevalence of dental caries, periodontal disease and dental trauma. The subjective measure was oro-facial pain. The hypothesis regarding the subjective measure was that the prevalence of pain among 12-to-13-year-olds who had been certified dentally fit by the School Dental Service would be lower than those children who had not been so certified. The sample consisted of 1,492 Malay schoolchildren.

Almost one-third of the sample (31.2 percent) was caries-free (DMFT=0). The overall prevalence of dental caries experience was 68.8 percent (DMFT equal to or greater than 1). World Health Organization targets are that at 12 years of age, the DMFT should not be greater than 3. The majority in the sample had a DMFT ≤ 3. There were significant difference in those children who had been determined to be orally fit by the School Dental Service and those who had not on all the dependent variables. Two–thirds (66.4 percent) of the children determined to be orally fit had no decayed teeth. Those certified orally fit had a DMFT of 1.70±1.84 versus a DMFT for those not so certified of 2.45±2.54. (p 0.01). The orally fit had a lower DT (0.19 versus 1.42), and higher FT (1.46 versus 0.87) than those not certified by the School Dental Service as orally fit.

The Community Periodontal Index of Treatment Needs (CPITN) was used to assess periodontal health. Overall, 76.3 percent of the children had a CPITN score of 0—a healthy periodontium. Only one in 20 children had a least one bleeding site (4.8 percent); and one in five children (18.5 percent) had at least one quadrant of calculus. Slightly more than one-half (53.4 percent) of the orally fit children had a healthy periodontium (CPITN=0), while 68 percent of those orally unfit had a CPITN of 1.

The prevalence of trauma to the dentition was low, 2.6 percent. Only one tooth was affected in 80 percent of those with a history of trauma. Typically, less than one-third of the crown was affected.

The prevalence of pain in the four weeks preceding the examination was quite high, 27.3 percent. On the day of the examination, 26.2 percent (107 out of 408) were still experiencing pain. Overall, 107 out of 1,492 (7 percent) were experiencing pain. Of the 408 reporting pain in the four weeks preceding the examination, the types of pain were: spontaneous toothache 163 (10.9 percent); solicited pain 220 (14.7 percent); soft tissue pain 157 (10.5 percent); and tempro-mandibular joint pain 55 (3.7 percent). Those with oro-facial pain had higher DMFT and DT scores than those without pain ($p \leq 0.01$). Those with pain demonstrated a slightly lower FT score than those without pain. The majority of those with pain (60 percent) had been certified as "orally unfit." The majority of those with no pain in the past four weeks (55.7 percent) had been certified as orally fit by the School Dental Service. Jaafar concluded that oro-facial pain by those children certified as orally fit by the dental nurses of the School Dental Service was significantly lower than those not so certified.

Of particular interest to oral workforce development utilizing dental therapists is that Jafaar found that in Malaysia the presence of a fixed school-based clinic staffed by dental nurses/dental therapists is not associated with more orally fit children. More schoolchildren treated by mobile programs were certified as orally fit, 60.2 percent, as compared with those treated at static or fixed clinics, 27.6 percent ($p \leq 0.01$). Only 4.6 percent of those children treated privately were determined to be orally fit. There were more orally fit children from rural primary schools, 56.1 percent, compared with urban schools, 39.5 percent, ($p \leq 0.01$). These data suggest that the use of mobile "squareuads" are an efficient and effective strategy to produce orally fit children.

The perceptions and evaluations of Senior Dental Officers in Malaysia of the school dental nurse system and its role in the delivery of oral health care to children were studied in a Bachelor of Dental Science (BDS) research project (**Dolah, Bar, Jafaar, 2006**). The investigators employed a 41-item questionnaire administered to 66 senior dental officers attached to a government dental clinic. Results indicated that:

- 95 percent agreed that dental nurses were an indispensable component of the dental team and that the use of this approach to oral health care delivery was appropriate for Malaysia; 50 percent agreed that the workload of dental nurses was too heavy and that they were inadequately compensated;
- 60 percent agreed that dental nurses were willing to work in rural areas;

- 70 percent believed that the quality of the work of dental nurses was very good and that they have good communication skills;
- 80 percent acknowledged that dental nurses are effective in oral health education;
- 100 percent agreed that dental nurses increase the productivity of the School Dental Service;
- Between 82 percent and 95 percent of the respondents affirmed that the dental nurses can work without supervision and do not create a circumstance of unnecessary competition for dentists;
- 53 percent did not believe that the profile of practice of dental nurses should be expanded and 83 percent believed that the output of dental nurses should not be reduced;
- Essentially all the officers agreed that the dental nurse system of delivering care to children reduces the workload of dentists; helps improve the oral health status of children; enables dentists to concentrate on more complex tasks; and improves access to care in economically deprived rural communities.

The authors of the study concluded that it is the view of the Senior Dental Officers in Malaysia that:

- *Dental Nurses/Therapists are an indispensable part of the dental team;*
- *The Dental Nurse System is the main reason for improvements in oral health status of school children in Malaysia;*
- *The School Dental Nurse System was an appropriate and very useful system for developing countries like Malaysia;*
- *It is better to have more Dental Nurses rather than a dentist to treat schoolchildren; The Dental Nurse System can greatly enhance the coverage of schools in delivering primary oral health care especially in rural areas;*
- *It was not a mistake that the Malaysian government introduced the School Dental Nurse System in 1948.*

The oral health status of 12-year-old children in the urban and "rural" (suburban) areas constituting the city of Kuala Lumpur was investigated by Zakaria (**2010**). In 2010, 94 percent of the 12-year-old children in urban schools were caries-free, and 87 percent of the children in rural Kuala Lumpur schools were free of tooth decay. In the urban area, 3 percent had a DMFT of 1 and 3 percent had a DMFT index of 2. In the rural areas 7.5 percent had a DMFT of 1 and 5.5 percent had a DMFT index of 2. The author concluded that the school program staffed by nurses was highly successful in a metropolitan area and that the program resulted in a significant reduction in disparities in oral health between the economically advantaged and disadvantaged city populations. The School Dental Service reduced inequities that would otherwise have existed between these two groups due to the expense of obtaining dental care privately in dentists' offices, and therefore the inability of the economically disadvantaged to obtain care.

In a study of the quality of restorative care in a rural school in Malaysia, Asegali found that out of the 1,616 restorations on 404 schoolchildren, only 2.7 percent were of a clinically unacceptable quality and should be redone (**Asegali, 2010**). Of these, 4 percent were amalgam restorations. Class III composite restorations were the major problem, with 77 percent of the restorations being due to biomaterial and class of restoration. The main cause of failure of the Class III composite restorations was determined to be poor oral hygiene. The author concluded that the quality of restorations placed by dental nurses is good. The failures of the composite restorations are likely due to the technique sensitivity of the material and the failure in oral hygiene. The use of older composite materials is gradually being replaced with glass ionomer biomaterials.

A similar study was conducted regarding the need and reason for repeat restorations by Makhir (**2011**). He found that 8.2 percent of the restorations placed in 332 primary schoolchildren required replacement. As in Asegali's study, the primary need for replacement was with composite and glass ionomer restorations. Makhir suggested that better results could be obtained by improved moisture control, improved cavity preparation and, as with Asegali's assessment, improved oral hygiene. Makhir commented that in the field setting in rural areas, conditions are routinely less than ideal; thus the dental therapist's skills are tested to the maximum.

Nordin also conducted an investigation of the necessity of replacing restorations placed by dental nurses on permanent teeth in primary schoolchildren (**Nordin, 2011**). The main cause of failure was determined to be the development of caries secondary to the restorations. Other causes included fractured and dislodged restorations.

In 2004, there were 1,726 dental nurses working in Malaysia. The ratio of dental nurses to primary and secondary schoolchildren was 1 to 2,901 (**MMH, 2004**). Practicing dental nurses currently number 2,090. The systematic, incremental dental care system based in the schools and operated by dental nurses since 1985 has resulted in a sharp decline of untreated decayed teeth and a corresponding increase in restored teeth (**MMH, 2005**). The program has been so successful that by 2003 the school dental program reached 96 percent coverage of elementary and 67 percent of secondary schoolchildren. Only a few parents decline treatment by the dental nurses, primarily because they have a private dentist. Of those given care, 97 percent of elementary and 91 percent of secondary schoolchildren were rendered orally fit. The major contributing factor to this increase was in the coverage of elementary schools, which rose from 37 percent in 1984 to 90 percent in 2003 (**MMH, 2004**). This could not have been achieved except through the use of dental nurses. The services by dental nurses are provided in school dental clinics, mobile dental clinics, and by dental teams that use portable dental equipment. The goal is to render all schoolchildren orally healthy before they leave the school system. Recently dental nurses have begun caring for preschool children as well.

The impact of the School Dental Service staffed by dental nurses has been significant. The caries experience of 12-year-olds in 1975 as measured by the DMFT Index was 3.8 teeth. By 1997, it had been reduced to 1.6 teeth. Data indicate that 10 percent of 12-year-old children have severe caries experience (**MMH, 2003**). Between 1998 and 2004, the percentage of caries-free 12-year-olds increased from 48.6 percent to 56.1 percent (**MMH, 2004**).

Periodontal health of children has also improved, attributable to the work of the dental nurses in the School Dental Service. In 1990, 16.9 percent of 15-to-19-year-olds had a CPITN score of 0; in 2000, the number had increased to 25.9 percent (**MMH, 2005**).

The dental profession initially opposed the use of dental nurses, presumably for fear of substandard quality of treatment and the possibility of competition. However, there have been no reports of serious injuries or record of litigation or malpractice claims against dental nurses over the 60 years of their existence. Competition with private-practicing dentists does not occur, as they treat different segments of society. Dentists are trained primarily to treat adults, while dental nurses constitute the oral health delivery system for children.

Section 12

THAILAND

Thailand, with a population of 67 million, is situated in the center of the Indochina peninsula. The kingdom previously known as Siam has a land mass approximating the size of France. About two-thirds of the population is rural and concentrated in the rice-growing regions. More than 75 percent of the population is of Thai origin, 12 percent of Chinese, and 3 percent of Malay ancestry. Age distribution: 0 to 14, 22 percent; 15 to 64, 70 percent; 65-plus, 8 percent. More than 90 percent of the population is Buddhist. Thai is the predominant language, though there are many dialects, with English the second language of the better-educated. Accordingly, the literacy rate is 95 percent. Public education is free and compulsory through age 14, and free but voluntary through age 17. Thailand is one of the world's largest producers of rice, and its largest exporter (more than 6.5 million tons annually). It manufactures and exports footwear, jewelry, cars, computers and electrical appliances, as well as rubber and various minerals. Tourism is also a major industry, representing 6 percent of the economy.

In 1960, the World Health Organization (WHO) sent Dr. R. Harris as a dental consultant to the Thailand Ministry of Public Health. Among his recommendations was to emphasize children's dental health and to establish dental clinics in primary schools. In 1967, the WHO sent Dr. G.H. Leslie, director of the Dental Health Division of New Zealand, to serve as a consultant for six months to help develop a school-based program comparable to the New Zealand School Dental Nurse Service.

The first school for dental nurses was established at Chonburi in 1968, with the consent of the Dental Association of Thailand. Female dental nurses would be trained in a two-year curriculum that followed graduation from high school; private practice was prohibited. Dental nurses were required to work under the Ministry of Public Health, and were to be stationed at public primary school dental clinics to care for preschool and primary schoolchildren up to age 14. Their scope of practice included: dental examination; preventive dentistry, including oral health education and prophylaxis; restoration of carious teeth; extraction of both primary and permanent teeth; and referral to dentists for cases beyond their scope of practice. Ten dental nurses graduated in the first class at the Chonburi school (**Laddawan, 1967**). A second school for dental nurses was established at Khon Kaen in 1978. It accepted a class of 50 students annually. Currently, there seven schools training dental nurses in different regions of Thailand, under the auspices of the Thailand Ministry of Public Health (**Thai Society of Dental Nurses, 2006**).

During the past 40 years, the dental nurse training curriculum has undergone four major revisions. The first was in 1986 when there was a demand for the development of a career ladder in order that dental nurses could further their study in order to obtain a bachelor's degree in public health (**Chonburi Institute of Public Health, 1986**). The new two-year curriculum consisted of 84 credits, divided into general education (social sciences, humanity, linguistics, sciences and mathematics), 24 credits; dental core courses (nutrition, health education, pharmacology, occupational health, dental anatomy, oral pathology, dental materials, oral surgery, oral diagnosis, preventive dentistry, community dentistry and operative dentistry), 56 credits; and elective courses, 4 credits. The dental core courses emphasized children's dentistry.

The second revision occurred in 1994 when there was a major movement to expand the functions of health centers and to provide primary dental care at health centers (**Thailand Ministry of Public Health (TMPH), 1994**). There was a strong demand to locate dental nurses in health centers throughout the country, rather than place them in primary schools as they had been originally. Thus, the dental nurse curriculum had to be revised to include public health courses in order for the dental nurses to be able to work in an integrated manner with other health workers at the health centers. Dental courses in the curriculum were reduced; however, operative dentistry was still a core course. There was no longer emphasis solely on children's dentistry. Additionally, men were also permitted to participate in the dental nurse program.

The third revision was in 2002 when a national health policy was developed to include universal health care and a national education policy was established to provide an education that was more student-centered (**TMPH, 2002**). At that time, 300 dental nurses were graduating annually from seven dental nurse training schools. The curriculum consisted of 79 credits in over two years. The curriculum content included: 17 credits in general education; 24 credits in public health; 33 credits in dental courses; and 3 elective credits. Each course had to include: didactic courses; laboratory, clinical, or field experience; and self-study components. The dental core emphasized preventive dentistry, restorative dentistry, oral surgery and community dentistry.

The last curriculum revision was in 2010, which upgraded the dental nurse curriculum to a four-year bachelor's degree, with emphasis on prevention and health promotion (**TMPH, 2010**). The structure of the curriculum is similar to all bachelor's degree programs and consists of total 140 credits as follows:

- General education: 30 credits
- Public health: 45 credits
- Dental courses: 59 credits
- Elective courses: 6 credits

The 59 credits in the dental courses include:

- Basic Dental Courses: 15 credits
- Dental Anatomy, 3 credits
- Oral Diagnosis and Pathology, 4 credits
- Operative Dentistry, 4 credits
- Dental Surgery, 3 credits
- Preclinical Dentistry, 2 credits
- Clinical Dentistry: 10 credits
- Integrated Clinical Dentistry I, 4 credits
- Integrated Clinical Dentistry II, 4 credits
- Clinical Seminars, 2 credits
- Preventive Dentistry: 4 credits
- Oral Health Promotion: 20 credits
- Oral Epidemiology, 3 credits
- Oral Health Promotion in pregnancy and for preschool children, 3 credits
- Oral Health Promotion for school-age children, 4 credits
- Oral Health Promotion for targeted populations, 2 credits
- Dental Public Health System, 3 credits
- Dental Public Health Seminar, 2 credits
- Research Project for Oral Health Promotion, 3 credits
- Public Health Field Work: 10 credits
- Public Health in community field work, 4 credits
- Dental Public Health field work, 3 credits
- Dental Public Health field work, 3 credits

The current four-year dental nurse curriculum focuses on health promotion rather than focusing on clinical care, as did the previous curriculum. The intention is to prepare a dental nurse who is competent in promoting oral health as well as providing clinical care.

Dental nurses in Thailand must practice under the supervision of dentists at country's public hospitals or health centers. There is no licensure for the dental nurses; they cannot practice in a private clinic or hospital. Registration of dental nurses is officially with the Ministry of Public Health, and informally with the Thai Dental Nurse Association.

Currently dental nurses practice under the 1996 Regulations of the Ministry of Public Health (**TMPH, 1996**). Their scope of practice is as follows:

Preventive Dentistry
- topical fluorides
- sealants
- prophylaxis and scaling

Emergency Care
- initial emergency dental care to eliminate pain
- screening and referral

Curative Care
- diagnostic examination and screening
- simple tooth restoration with restorative material
- simple extraction for noncomplicated and nonrestorable teeth

While the introduction of dental nurses in Thailand was based on New Zealand's School Dental Nurse Service—that is, trained to serve primary schoolchildren mainly in school-based clinics—the first oral health manpower planning in 1986 changed the role of dental nurses to include primary dental care for all age groups. Treatment was limited to prophylaxis, restorations and extractions, and occurred in district community hospitals (**Thailand Dental Association, 1986**). With changes to a universal health care system, more dental nurses have been located at the health centers and involved more in health promotion as well as clinical treatment (**TMPH, 1998**).

At public community hospitals, dental nurses are expected to spend 30 percent to 50 percent of their time on oral health promotion and preventive care, especially for preschool and primary schoolchildren (**TMPH, 2009**). The changed training and practice model of dental nurses in Thailand corresponds to the integration of the training and practice of dental therapists and hygienists in other countries. While the majority of the care by Thai dental nurses is clinical, there is a deliberate intention to increase the focus on prevention and health promotion. (**TMPH, 2010**).

Reports indicate that the clinical dental treatment provided by dental nurses is well-accepted and is of good quality, primarily due to its limitation in scope (**Tawesak, 1988**). The intense in-service training of earlier dental nurses in the care of only children ensured quality care for the children. Postoperative complications were and are uncommon, due to the limited scope of practice. There is some concern that an increasing number of adults with complicating systemic disease may result in an increase in postoperative issues (**Thai Dental Council, 2010**).

Studies on the effectiveness of dental nurse in providing dental care are positive, both by the dental nurses themselves as well as their supervisors (**Wijaranaphiti, 2006**). Dental nurses are noted for the exceptional work they accomplish in oral health promotion. At the health centers, they integrate oral health into the general health promotion activities. The limited career path opportunities have resulted in a number of dental nurses leaving the field to study as public health nurses. This provided the reason for an alteration of the dental nurse curriculum from two to four years in 2010. It is an attempt to provide dental nurses with comparable opportunities as the other public health nurses and workers (**TMPH, 2010**).

Dental nurses have improved access to dental care for the Thai population, from their introduction in 1968 until the present. There has been an increase in the number of dentists since 1968; the current dentist-to-population ratio is 1:6,000. However, the majority choose to practice in urban areas, creating an access-to-care issue for the rural population, which is 60 percent of the population of Thailand. Deploying dental nurses at the district community hospitals and health centers throughout the country has significantly improved access to care (**Wijchawuth, 2008**). Public health dentists working with dental nurses at public hospitals and in the provincial heath offices of the Ministry of Public Health understand and appreciate the role of dental nurses as members of the oral health care team and acknowledge their value in both clinical dental care and in oral health promotion (**Khumeungsitti, 2009**). The Thai public accepts the care of the dental nurse, as there are few other options in rural areas, which is where the deployment of dental nurses has the greatest impact. In urban areas, there is a greater tendency for individuals to seek care in the private sector from dentists; therefore, dental nurses do not have as great an impact in urban areas. The public understands that dental nurses work under the supervision of dentists in the public sector, and that referrals are made when the patient's needs exceed the competencies of the dental nurse (**TMPH, 1996)**. The Thai Dental Council has recently developed a workforce plan that indicates an increasing need for dental nurses to serve as members of the dental team, since dentists will have to spend increasing amounts of time caring for complex cases and for patients with compromised health circumstances (**Thai Dental Council, 2011**). Additionally, dental nurses are required to fill their unique role of oral health promotion for the Thai public.

There has been a recent proposal that would permit dental nurses to work in the private sector with dentists, assuming a role comparable to an oral health therapist (dental therapist/hygienist), and becoming affiliate members of the Thai Dental Council as well. However, the Dental Association of Thailand does not support such a proposal, wanting dental nurses to continue to be limited to working solely within the Ministry of Public Health (**Thai Dental Council, 2011**).

Section 13

AFRICA

SOUTH AFRICA

The Republic of South Africa is at the southern tip of the African continent, bordering both the Atlantic and Indian oceans. It has a population of 55.6 million and is the 25th-largest country in the world. Nearly 80 percent of the population is of black African ancestry, 9 percent is white, 9 percent "colored" and 2.6 percent Indian/Asian. Age distribution: 0 to 14, 31 percent; 15 to 34, 37 percent; 35-plus, 32 percent. There are 11 official languages, the most common being Zulu (24 percent), Xhosa (18 percent) and Afrikaans (13 percent). Although English is the language of business and science, it is spoken by only 8 percent of South Africans. School education is compulsory for children aged 7 to 15, yet 12 percent of the population is illiterate. Life expectancy for the black population is only 49 years, compared to 71 for whites. Although the income level of the black population is improving, more than half live in poverty, compared with 2 percent for whites.

South Africa has had a tumultuous history, achieving effective independence from Great Britain in 1931 as the Union of South Africa, leaving the British Commonwealth in 1961 to become the Republic of South Africa, and rejoining the renamed Commonwealth of Nations in the mid-1990s. Racial segregation, introduced by Dutch and British colonizers and later known as apartheid, was not abolished until 1993 when the African National Congress (ANC), under the leadership of Nelson Mandela, assumed control of the government, which it has maintained since.

Though classified by the World Bank as an upper-middle-income economy, South Africa has a mixed economy with a high rate of poverty and low GDP per capita. Unemployment is extremely high and South Africa is ranked in the top 10 countries in the world for income inequality. The country has a well-developed heavy industrial production sector, which includes motor vehicles and parts, railway rolling stock, synthetic fuels, and mining equipment and machinery. It is also a major exporter of precious metals. Agriculture accounts for only 2.5 percent of its economy, with major crops in citrus and deciduous fruits, corn, wheat, dairy products, sugarcane, tobacco, wine and wool.

Limited Access, Scope of Dental Disease, Shortage of Oral Health Care Providers

"Oral health services in the public and private sectors are delivered by dental practitioners, oral hygienists, dental therapists, technicians and assistants. Like most of the health services in South Africa, a major deterrent to the availability of oral health services has been the inability of poor communities to pay for oral health services. This is made worse by the fact that most oral health providers work in the private sector…. Oral diseases, especially dental caries and periodontal diseases, are among the most common diseases affecting South African society. More than 90 percent of adults in South Africa suffer from dental caries, and 93.5 percent from periodontal diseases. It is worth noting that oral diseases are increasing among major sections of the population, especially the disadvantaged and urbanized groups" (**South Africa Department of Health (SADH), 1997**).

"According to the 1999-2002 National Children's Oral Health Survey, the prevalence of dental caries in South African children, although low according to these World Health Organisations' standards, has still remained relatively high for some age groups (e.g. the caries prevalence of 60.3 percent for the 6-year-olds). A major concern has been the large amounts of untreated caries that exists in young children and this varies between 45 percent and 60 percent amongst the nine provinces. The Western Cape has the highest amount of untreated caries with almost 80 percent of children requiring some form of oral health intervention such as extractions or restorations" (**van Wyk, Louw, du Plessis, 2004; Bhayat, Yengopal, Rudolph, Govender, 2008**).

"The greatest need for the treatment of dental caries in South African children was for preventive services, restorations and extractions. The DMFT for the 12-year-old group in South Africa decreased from 2.5 in 1982 to 1.1 for the current survey. Of the same group, 20.2 percent of the children presented with definite signs of dental fluorosis. The Dental Aesthetic Index was used to assess the prevalence of malocclusion and 32.3 percent of 12-year-old children needed definitive orthodontic treatment" (**van Wyk, 2004**).

There are approximately 5,300 dentists registered with the Health Professions Council of South Africa (HPCSA), barely one per 10,000 population; 648 dental therapists, a ratio of 0.13 per 10,000 population; and, while only 194 oral hygienists are employed in the public sector, there are about 1,000 in private practice, still too few to serve the population (**SADH, 2011b; Nash, Friedman, 2008**). Even these ratios may be overstated. "For many years newly qualified dentists [and dental therapists] from South Africa ... go and work overseas to gain experience. Many never return, resulting in a loss to the country, in terms of money spent in subsidized training, funded by the taxpayer. In the U.K. alone,

there were 1,753 South African dentists working in October 2002. Large numbers of S..A trained dentists are also registered in Canada, Australia and New Zealand" (**South Africa Economic Background, 2011**).

Capsule History of Dental Therapists

Hugo (**2005**) provides a history of dental therapists in South Africa*:*

> *Dental Therapists have been trained since 1975 at the Medical University of Southern Africa (MEDUNSA), University of Durban Westville (now the University of KwaZulu-Natal–Westville Campus). The aim was to train dental workers for rural and underserved areas. MEDUNSA used to produce 35 Dental Therapists per year and University of Durban Westville 10 per year. Since 2003 MEDUNSA has reduced the intake to 15 students per year.*
>
> *The initial aim of the programme was to increase rural people's access to oral health. From the start of the programme there were insufficient posts in the public service and the then Medical and Dental Council allowed dental therapists to work in private practice. This resulted in competition between dentists and dental therapists and concerns about the quality of care provided by dental therapists in private practice.*
>
> *Many of the dental therapists who did not get jobs drifted to the urban areas. A study in 2003 found that close to 80 percent of dental therapists live in urban areas; 70 percent of them went on to become dentists; and several of them went into health management positions.*
>
> *The situation became more difficult with compulsory community service for dentists. Newly qualified dentists work in rural areas in the country and there is more pressure on the availability of posts....*
>
> *A separate board in the HPCSA was created for the dental therapists and oral hygienists. That means that two different boards in the HPCSA regulate oral health. There are discussions between the two boards to look at collaboration and the possible creation of a single board for oral health.*
>
> *Many students in dental therapy want to become dentists but usually do not have the required matric grades to qualify for the dentistry dental course. When they are admitted into the full dentistry course after working as dental therapists, they have performed well. With the present integrated course in dentistry, dental therapists have to start the dentist course in the first year which makes their overall training long and expensive.*

> *These developments contributed to the decision at MEDUNSA to reduce the number of dental therapist students from 35 to 15 per year…. There are [in 2005] 418 dental therapists registered with the Health Professions Council of South Africa (HPCSA) but only 137 are employed in the public service. There are 314 posts [leaving 177 vacancies (56 percent)] in the public service.*
>
> *The most common reasons for this [private versus public sector] choice are the financial rewards and the freedom to work in urban areas rather than the rural and remote areas for which the public sector has the greatest responsibility (***Bhayat, Yengopal, Rudolph, Govender, 2008***).*

Thus, the original intent of providing oral health care to rural and underserved population in public programs has been weakened as government salaries compare unfavorably with private practice income. Lack of adequate publicly funded positions result in many dental therapists practicing in the private sector.

Timeline of Dental Therapy Developments

The following chronology is from the Dental Therapy Association of South Africa (DENTHASA) (**2011**).

1975 — Establishment of the dental therapist program to address the needs of rural black and coloured populations of the country. The first graduates, approximately 25, were black and only the two black universities trained dental therapy students: University Of Kwa- Zulu Natal, and Medical University of Southern Africa (MEDUNSA), since merged with the University of Limpopo.

1976 — Developed a three-year bachelor of science degree program, allowing treatment of both adult and child patients, although restricted to working for the state in government clinics and hospitals in rural settings. Both black and Indian students were enrolled. The majority of the Indian graduates were from the University of Durban Westville and the majority of black graduates were from the MEDUNSA campus. This was representative of the demographic and sociological impact of apartheid at the time.

1977 — First dental therapists graduated, with practice restricted to underserved rural areas.

1980 — Rules changed to enable them to work in urban areas at Public Health Clinics under the supervision of a dentist (**American Dental Hygienists' Association—ADHA, 2009**).

1985 — Between 35 and 40 dental therapists were being graduated annually from both institutions. Many graduates then went on to complete their studies in dentistry and graduated as dentists. Others sought overseas employment. The attrition rate in the dental therapy profession continues to this day due to the poor academic and clinical development or growth of the profession as well as career pathways that are viewed as dead end.

1993 — Rules changed to allow unsupervised practice after one year of practice supervised by an approved dentist (**ADHA, 2009**).

1994 — Dental therapists were legally allowed to establish their own independent private practices, although opposed by the South African Dental Association (SADA). It was the result of a shortage of funds for the government/public sector to employ the increasing number of dental therapists. Today, more than 80 percent of dental therapists are in the private sector, with over 60 percent in independent practice.

1997 — SADA asked Parliament to put a hold on the training of dental therapists and recommended conversion of existing dental therapists to dentists. By this time, the Dental Therapy Association of South Africa (DENTHASA) had been formed and a Dental Therapy Board was created in the Health Professions Council of South Africa (HPCSA). The Board, with support from DENTHASA, convinced the Government to reject SADA's recommendations by documenting the cost and health benefits of dental therapists providing basic preventive and curative oral health care for the public.

2000 — SADA recommended that the Health Professions Council of South Africa (HPCSA) and Parliament discontinue the training of Dental Therapists and do away with the profession based on their findings (**Naidoo, 2005**).

2006 — DENTHASA activities include:

- Launching of a professional quarterly journal;
- Creating the Dental Therapy Federation of Africa; Advocating Masters and PhD degrees in dental therapy;
- Negotiating for equality in fees charged or regulated in the private sector;
- Representing the profession as a stakeholder in oral health within South Africa; Boosting the confidence, morale and hope of the profession throughout Africa;
- Developing and expanding the scope of practice of dental therapy and designing CPD courses and additional training for practitioners, thus improving clinical abilities.

2006 — Four mobile dental clinics (mounted on trucks) obtained by Gauteng Department of Health (**Hlongwa, 2006**).

2010 — SADA recommended against proposed increases in dental therapists scope of treatment. "If all of the proposed changes were included, then the profession of dental therapy might as well be scrapped and those resources shifted to the training of dentists" (**South African Dental Association, 2010**).

Rationale for Dental Therapists

"The oral disease profile suggests that most treatments could be undertaken by oral hygienists or dental therapists. It should be possible to fill a vacant dentist's post in the public service with two dental therapists, or one dental therapist and a hygienist. This will improve staffing levels at clinics" (**SADH, 1997**).

"The total cost of recruiting, training and deploying a dental therapist is half that of a dentist—one dentist post can be converted to two dental therapist posts, creating more accessible service [in the public or governmental sector] whilst utilizing existing budgets" (**Naidoo, 2009**).

Furthermore, the South African Department of Health recommends that "A defined minimum package of oral health care should be provided to the priority groups listed above. This [basic oral health care] package should consist of an annual examination, bitewing radiographs, cleaning of teeth, simple 1-3 surface fillings, fissure sealants and emergency relief of pain and infection control.…"(**SADH, 1997**)**.** To meet this need, the government intends to increase the training of dental therapists from 25 a year to 600 in order to provide access to basic oral health care for its population. "Dental therapists are critical to provision of PHC (oral health). Current production levels must be increased and training must occur at every dental school" (**SADH, 2006a**). It should be noted, however, that the South African Dental Association opposed the increase, suggesting "an immediate moratorium on training of dental therapists until all stakeholders had debated these issues (**Singh, 2011**).

Scope of Dental Therapists' Practice

Bhayat (**2006**) reported:

> *The DT degree is offered as a … [three] year programme at the University of Limpopo (MEDUNSA campus) and Kwa-Zulu Natal. Qualified DTs are able to perform the following procedures:*

- *Dental examinations/consultations and treatment planning*
- *Referrals to dentists, dental specialists and medical doctors*
- *Dental extractions*
- *Dental restorations*
- *Scaling and polishing*
- *Preventive treatment (fissure sealants and fluoride applications)*
- *Oral hygiene instructions*
- *Taking of dental impressions*
- *Taking of radiographs, and*
- *Diagnosing of hard and soft tissue lesions in the oral cavity.*

Ethical Rules of Conduct: A dental therapist:

a. *shall confine himself or herself to clinical diagnosis and practice in the field of dental therapy in which he or she was educated and trained and in which he or she has gained experience, regard being had to both the extent and the limits of his or her professional expertise;*
b. *shall communicate and co-operate with dentists, dental specialists, dental therapists and other registered practitioners in the diagnosis and treatment of a patient;*
c. *shall not conduct a private practice unless he or she has met the requirements of the board and practised for at least one year under the control and supervision of a dentist or another dental therapist approved by the board;*
d. *shall refer the following cases to a dentist or dental specialist for treatment:*
    i. *pulpal exposure, excluding the emergency treatment thereof;*
    ii. *impacted teeth; and*
    iii. *oral diseases and dental abnormalities, such as tumours, mucosal diseases;*
e. *shall not remove the roots of teeth by any way other than the use of hand instruments or make any incision into the soft tissues during such removal; and*
f. *shall not manufacture or repair dentures or other dental appliances which involve the taking of impressions (***SADH, 2006b***).*

Pending Compulsory Community Service

"There is a shortage [and maldistribution] of human resources to meet the oral health needs of communities in South Africa. The workload of the limited personnel has been expanded by the introduction in 1994 of free oral health services at public oral health facilities in primary health care settings. This policy has resulted in an increase in patient attendance although the number of personnel has remained fairly stable….

"In December 1997, former State President of South Africa Nelson Mandela signed the Health Professions Amendment Act which endorsed the concept of compulsory community service (CCS) for all health professionals. The introduction of CCS was to address the following issues (**SADH, 1996**):

- To improve the provision of health services to all citizens in South Africa
- To improve the clinical skills of newly qualified health professionals
- To allow the acquisition of knowledge and further their knowledge obtained from the universities
- To change behaviour patterns and stimulate critical thinking of newly graduated professionals
- To address the problem of the emigration of qualified health professionals
- To address the lack of doctors/dentists working in public service rural hospitals
- To develop clinical skills appropriate for practicing in rural areas and
- To increase the human resource capacity in the public sector

"CCS is a year long service rendering period in which newly graduated health care professionals are placed at public sector facilities…." Though introduced into the health service by the South African government to address the shortage and maldistribution of health professionals within the public sector, and looked upon favorably by most students, CCS has not yet been applied to new dental therapist or oral hygiene graduates (**Bhayat, 2006; Bhayat, Yengopal, Rudolph, Govender, 2008**).

The Political and Economic Turmoil of Dental Therapy in South Africa

The government of South Africa is advocating an increase in the training of dental therapists from 25 annually to 600. Simultaneously, it is recommending a reduction in the training of dentists. As previously noted, the rationale is that a dental therapist can be trained at half the cost of a dentist. Based on the size of the population and its extensive oral health care needs, it makes more sense to train more dental therapists in less time and at less cost if access to adequate oral health care is ever to extend to the traditionally underserved segments of the population. To achieve this goal, all the dental schools will have to develop dental therapists' training programs.

The dental profession, as represented by the South African Dental Association (SADA), is strongly opposed not only to the expansion of dental therapists, but also to their existence. It has in the past advocated elimination of their training programs and conversion through additional training of existing dental therapists to dentists.

While opposition to dental therapists at the initiation of dental therapists in other countries is ubiquitous, once the programs have been established, more often than not, the dental professions have been impressed with their performance and come to support them, especially as they are usually employed in the public sector.

Thus, what distinguishes South Africa from most of the countries with dental therapists is that the majority of dental therapists here have settled in urban areas where they either have their own individual private practices or are employed by dentists. There are still relatively few practicing dental therapists, approximately 450 compared to 3,000 dentists.

Issues of the South African Dental Association

Unsupervised independent private practice is a hazard to public safety. Once having completed the mandatory year of practice under the supervision of an approved dentist, the dental therapist can practice independently without supervision. There is evidence of dental therapists providing treatment beyond the scope of their competency such as permanent crowns, bridges and dentures. Dental therapists employed by unprincipled dentists have also directed them to perform services for which they are not qualified (**South Africa Health Professions Council, 2009**).

Unfair competition stems from dental therapists claiming publicly to be the equivalent of dentists. They may also undercut fees, charging much less for expensive procedures, which put legitimate dentists at a disadvantage. Dental therapy should be eliminated as a profession rather than extending its scope of treatment. As quoted previously, "If all of the proposed changes were included, then the profession of dental therapy might as well be scrapped and those resources shifted to the training of dentists" (**South African Dental Association, 2010**).

It is not in the public interest to reduce the number of dentists, already in short supply, in favor of dental therapists.

Issues of Dental Therapy Association of South Africa: A Brief Overview

In South Africa:

- It is discriminatory for the dental profession not to recognize dental therapy as a profession.

- It is discriminatory that a dental therapist's registration fee is higher than a dentist's (**South Africa Health Professions Council, 2011**).
- It is discriminatory that dental therapists do not receive equal pay for equal work. There is no representation by dental therapists on governing and policy boards of medical/dental schemes.
- DENIS (Dental Information Systems), which manages dental claims for seven or more schemes, is governed by a committee made up exclusively of dentists.
- Medical schemes discriminate by providing reduced coverage and fees to dental therapists. Dentists monopolize faculty positions in the dental therapy schools.
- Financial institutions discriminate against dental therapists, by limiting or denying business loans.
- Corporate companies sponsor SADA and oral hygiene but not dental therapy educational programs.
- Withdrawal by dental schools of accreditation of dental therapy courses, thereby disallowing credit towards their further training to become dentists, is prejudicial and violates the Skills Development Act of South Africa.
- Discriminatory rules and regulations on the basis of unjustified findings are unconstitutional and are unprogressive in creating a healthy relationship between service providers and schemes – most importantly our patients.
- Apathy, disillusion, and lack of leadership are widespread among dental therapists and threaten the integrity and future of the profession (**Naidoo, 2005; Naidoo, 2009**).

The Future

Notwithstanding these issues, it is the policy of the South African government to increase the annual training of dental therapists, in recognition that a dental therapist can be produced at half the cost of a dentist and yet provide most of the care mandated as the minimal package of oral health care for the population (**SADH, 1997**).

It is essential that the concerns of the dental profession be addressed as the dental therapist program expands, in particular that dental therapists do not transgress beyond their scope of competency. For the program to achieve its full potential, it is also essential that the concerns of the dental therapy profession for greater participation in their education and training, for elimination of discriminatory practices, and for appropriate representation on regulatory agencies be recognized and resolved.

TANZANIA

Conquered by Germany in the late 19th Century, Tanzania became a British protectorate after World War I, and has remained in the British Commonwealth since achieving independence in 1961. The United Republic of Tanzania, formed by the union of Tanganyika and Zanzibar in 1964, is located in the lower third of Africa, east of the centrally located Democratic Republic of the Congo, south of Egypt and Somalia, with its eastern border along the Indian Ocean. It is roughly the size of Texas and New Mexico combined (378,000 square miles) and has a population of 42 million, only 3 percent of which derives from Zanzibar. Zanzibar is essentially self-governing with its own president, legislature and bureaucracy and has 15 percent representation in the republic's unicameral Parliament.

Tanzania is one of the oldest populated areas, dating back over 2 million years. Africans make up 99 percent of the population, with the other 1 percent consisting of Asians, Europeans and Arabs. Zanzibar has a more mixed population of Arabs and African. About 30 percent of Tanzanians are Christian, 35 percent Muslim, and 35 percent hold indigenous beliefs. Almost the entire population of Zanzibar, 99 percent, is Muslim. Kiswahili, especially, and Arabic are the common languages, with English the language of business, government and education.

Tanzania is a poor country. Although medical care is free, life expectancy is only 53 years due to a high infant mortality rate, widespread AIDS, malaria and other diseases, and an inadequate health care infrastructure. Education is compulsory for seven years, until children reach the age of 15. Less than 70 percent of the population is literate in any language, but this should improve as tuition and fees have been reduced or eliminated for primary education.

Agriculture is the largest sector of the economy, producing coffee, tea, cotton, cashews, sisal and cloves. The industrial sector is one of the smallest in Africa, specializing in dairy and meat processing, textiles, leather tanning and plastics. There are only a few large factories producing cement, steel, iron and aluminum sheets, and bottling beverages. Water and electricity shortages limit productivity, and exports of manufactured goods is small. Tourism, one of the main sources of foreign currency, which is required for importing essential goods, has been hard hit by the worldwide financial crisis.

Oral health care in Tanzania is provided by dental therapists, assistant dental officers and dental officers (dentists). Training of dental therapists has taken place in Tanzania since 1955, but was interrupted for a 10-year period from 1961 to 1971. The Tanzania-Danish International Development Agency initiated training in Mbeya and Tanga in the early 1980s, with the curriculum being of three years' duration. Prior to the initiation of these programs, 41 dental

therapists had practiced in Tanzania. (A dental school was established in the Muhimbili Medical Centre in 1979, financed partly by the Finnish Development Agency. The curriculum is of five years duration).

The first two years of the dental therapist curriculum were integrated with the training of medical assistants, with the final year being specifically focused on clinical dentistry. At that time, both schools enrolled 12 students per year; later this was increased to 24 per year. The basic three-year training program emphasizes oral health promotion, clinical examination, preventive dentistry, atraumatic restorative technique (ART) and simple extractions (**Poulsen, Fubusa, Gember et al., 1999).** Although trained to work for the government in clinics, health centers and district hospitals, dental therapists are also able to work in private practices. They are not limited to caring for children, and in fact, most treat adults due to the pattern of demand for dental services.

At the end of the three-year basic course, and generally with three to five years of experience, dental therapists may seek admission to the School for Assistant Dental Officers in Muhimbili Medical Centre in Dar es Salaam (**Mosha, Mgalula, 1996**). Ten students are admitted every two years (**Poulsen, Fubusa, Gember et al., 1999**). The additional two years of training increases the dental therapist's profile of practice and practice skills; on completion dental therapists qualify as assistant dental officers. An assistant dental officer can perform restorative care for all carious lesions, extractions including impactions, initial periodontal therapy and fabrication of partial dentures.

Poulsen et al. studied the distribution of dental therapists and assistant dental officers who had been trained under the Tanzania-Danida Dental Health Program between 1981 and 1993 (**Poulsen, Fubusa, Gember et al., 1999**). During that time, 169 individuals had been trained, 131 as dental therapists and 38 as assistant dental officers; 21 percent were female. Sixty- three percent were working in government clinics, with the remainder practicing in nongovernment settings and private dental practices.

Mosah and Mgalula (**1966**) studied the views of all three categories of oral health workers (dental therapists, assistant dental officers and dental officers) concerning the relevance of their training to their duties. They found no significant differences among the three groups with regard to the importance of specific topics in their respective curricula. Traditional clinical topics were considered the most important areas in their work. The majority of oral health workers believed that their education prepared them fairly well for their work responsibilities.

A Tanzania Ministry of Health report in 2002 indicated that 150 dental therapists were practicing (**Tanzania Ministry of Health, 2002**).

A 1993 study of the oral health status of Tanzania children found that the only 25 percent to 33 percent of 5-to-6-year-olds had experienced dental caries, with a mean dmft of less than 1.0. The DMFT for 12-year-olds was also low, with an average of 1.5, but it rises with older adolescents. The filled (f/F) component was negligible in all age groups (**Mosha, Ngilisho, Nkwere et al.**)

A recent study by Carneiro et al. (**2011**) investigated the oral health knowledge and practices of secondary school students. They found that 88.4 percent of the students had adequate knowledge of causes, prevention and signs of dental caries; 96.8 percent on the causes and prevention of periodontal disease; and 98.1 percent on the importance of dental checkups. The adequacy of tooth-brushing was 72.4 percent. The study concluded that the students had an adequate knowledge of oral health, but a low level of oral health practices.

Tooth extractions make up most of the dental care because patients fail to seek treatment until dental caries is advanced. Additionally, restorative dental materials are not readily available in government dental clinics due to their cost. Yet, in countries like Tanzania, with an emerging economy, "patient satisfaction" can be attained even with therapy such as tooth extraction, and patients are very satisfied with the care they receive from dental therapists. Many extractions take place in rural health centers and are completed by a Rural Medical Aide (RMA). These individuals have completed a three-year course in general medicine focused on primary health care. A two-week in-service program was established to train RMAs to extract teeth. A study of patient satisfaction with their care indicated that 92.7 percent of the patients were satisfied **(Ntabaye, Scheutz, Poulsen, 1998**).

BOTSWANA

Botswana is approximately the size of Texas with a sparsely distributed population of 2 million. It is landlocked and surrounded essentially by South Africa on its southern border, Zimbabwe on the east and Namibia on the west. The Kalahari desert covers up to 70 percent of its land surface. A protectorate of the British since 1885, it achieved independence as a parliamentary democracy in 1966, remaining a member of the Commonwealth. Botswana is ranked as the least corrupt nation in Africa by Transparency International, ahead of many Asian and European countries. It is the world's largest producer of gem-quality diamonds, and mines other natural resources in copper, nickel, coal, salt and gold. Cattle and livestock are also major sources of sustenance. While the country is still poor, it has one of the fastest-growing economies. Yet its life expectancy is 58 years. HIV/AIDS is prevalent, estimated at 24 percent of the adult population. Health care resources are minimal, but improving. The government has a comprehensive program involving free or cheap generic antiretroviral drugs as well as an information campaign designed to stop the

spread of the virus. Botswana has reduced HIV transmission from infected mothers to their children from about 40 percent to just 4 percent.

While no literature relative to dental therapists could be identified prior to 1982, in that year Erikson (**1982**) reported on an assessment of the dental therapist training program. Erikson and Condon (**1983**) followed the assessment with recommendations for improvements in the program. In the article reporting on their recommendations, they indicated that the DMFT Index relative to dental health was good, with the Index for 35-year-olds being approximately 2.0, much lower than comparable populations in Norway, Australia and New Zealand. However, Baerum (**1979**) found that gingivitis was common, affecting 50 percent of the population, with more that 40 percent of the individuals 35 years of age having severe periodontitis.

According to Erikson and Condon, Botswana decided to concentrate on dental therapists as being its principal dental health personnel. The country held that the education of dental therapists should be intimately related to and reflect the general aims for dental health in society; thus, these aims should be reflected in the skills developed in dental therapist training programs. The focus of the curriculum recommendations was on prevention programs, particularly in schools; the ability to diagnose oral diseases and treatment plan accordingly; the development of clinical skills, particularly extractions, simple periodontal treatment and simple restorative work; and the ability to register and record epidemiologic dental health data.

The curriculum recommended was for three years, in which five students would be accepted. A Cambridge school certificate (university qualification) would be a requirement of entry. Introductory courses in the natural sciences were to constitute the main first-year curriculum and were to be offered with other paramedical students. Courses on clinical topics associated with clinical training were to constitute the bulk of the training in years two and three.

In 1987, Baerum (**1987**) conducted a further epidemiological study and found that 50 percent of the urban males and 78 percent of the rural males in the 35-year-old age group were caries-free. However, the high sugar consumption rate that was occurring increased the population's risk for dental caries in the future.

Fylkesnes and Malthare (**1988**) reported that dental therapists were expected to spend only approximately 25 percent of their time doing clinical work. Their clinical care is limited to Class I amalgams, scaling and polishing of teeth, and simple extractions, all on both children and adults. The remainder of their time was to be used to teach and facilitate efforts of other health workers in organizing community oral health education programs. All dental therapists in Botswana were stated to be employed in the public sector.

ZIMBABWE

Zimbabwe, with a population of 12.5 million, is a landlocked nation in southern Africa, north of Botswana, east of Mozambique, south of the Democratic Republic of the Congo, and west of Angola. Formerly the British colony of Southern Rhodesia, Zimbabwe became independent in 1980 following decades of violent internal conflicts. These continued to plague the country, leading to its suspension from the British Commonwealth in 2002, followed by its formal withdrawal from the Commonwealth. The country, poor in many respects, is rich in natural wildlife and minerals and one of the largest producers of platinum and diamonds. Agriculture and tourism also contribute to its economy. The health care system is in disarray. HIV/AIDS adult prevalence rate is more than 14 percent. Infant and maternal mortality are among the highest, and life expectancy, at 42 years, is among the lowest in the world. Yet, Zimbabwe can boast one of Africa's highest literacy rates at 92 percent, and after decades of decline, its economy is showing signs of improvement.

An article on infection control among dental therapists in Zimbabwe provides some information regarding the practice of dental therapists there (**Chidzonga, Makoni, Mahomva, 2006**). The descriptive cross-sectional study used a self-administered questionnaire which was administered to dental therapists practicing in Zimbabwe Government Oral Health Clinics. Questions dealt with infection control practices in the procedure rooms, the disinfection of working surfaces, the use of an autoclave and the sterilization of handpieces. The questionnaire also covered issues of personal protection through the use of protective wear and vaccination against hepatitis B, as well as knowledge of one's HIV status.

A total of 35 dental therapists, predominately male, were identified as working in government hospitals. The dental therapists were evenly distributed throughout the 10 administrative provinces of Zimbabwe, with the exception of Bulawayo, where there were no responses. All the dental therapists were trained in Zimbabwe. The majority were between the ages of 31 and 40, with a spread of working years of six months to 22 years.

Only 20 percent of the dental therapists had been tested for HIV; 91.7 percent had not been vaccinated against Hepatitis B. Glove use was universally practiced, at 100 percent; 92 percent used face masks; 66.7 percent used protective eyewear; 87.5 percent wore protective garments; 95 percent autoclaved/chemoclaved high-speed handpieces; 83.3 percent autoclave/chemoclaved slow-speed handpieces.

Documents characterizing the training and practice of dental therapists in Zimbabwe were unable to be obtained.

Section 14

CARIBBEAN

The Caribbean is an arc of islands stretching more than 2,000 miles in the Atlantic Ocean from the southern tip of North America (Florida) to the north coast of South America (Venezuela). It encompasses more than 7,000 islands, called the West Indies, delineating the Caribbean Sea. Some of the smaller islands are relatively flat, whereas the larger ones like Cuba have rugged, towering mountain ranges. The climate is tropical and the islands have such a wide diversity of animals, fungi and plants that they have been recognized as unique terrestrial and marine ecosystems, ranging from cloud forests to cactus scrublands.

The total population is 42 million. About 70 percent of the population resides on the six larger islands: Cuba (11. 2 million); Dominican Republic (10.9 million); Haiti (10 million); Puerto Rico (4 million); Jamaica (2.7 million); and Trinidad and Tobago (1.3 million). Most of the islands are racially diverse and of mixed African and European race. Puerto Rico and Cuba have a European majority background, but also include sizable Amerindians and West Africans, whereas the majority of the Dominican Republic population is largely a mixture of West African, Spanish and Amerindian ancestry. Other ethnic representations are Indian, Chinese, Lebanese and Syrian.

Reflecting its past European imperialist domination, the main Caribbean languages are Spanish, English, French and Dutch, as well as Haitian Creole and other Creole dialects; and Papiamento, which is a mixture of Spanish, Portuguese, Dutch, English and French, with some Arawak Indian and African influences. Christianity, also imported by Europeans, is the major religion, but not to the exclusion of Hinduism, Islam, Rastafari, Santeria and Voodoo, among others.

The Association of Caribbean States was established in 1994 and now numbers 30 of the major island nations. There is also the Commonwealth of the Caribbean, composed of about 20 English-speaking states. The political structure of the region is diverse, ranging from communist-style Cuba to more capitalist British-style parliamentary governments characteristic of the Commonwealth Caribbean. The larger islands have diverse agricultural, fishing, mineral and manufacturing industries, with tourism a major attraction throughout the region.

TRINIDAD AND TOBAGO

Trinidad and Tobago is a twin-island nation in the Caribbean with a population of 1.3 million.

Much of the historical information here is from Naidu, Ramroop and Rafeek's (**2010**) "An Historical Overview of Dentistry in Trinidad and Tobago," with references included from that publication.

In 1957, there were 85 dentists in Trinidad, increasing to 93 by 1962. However, in 1972 the number had dropped to 55 dentists. Of these, 39 were in the private sector and 16 worked in government service, resulting in a private dentist-to-population ratio of 1 to 18,200 and a government dentist-to-population ratio of 1 to 62,500 (**Ashraph, Govin, 1989**). A dental division headed by a dentist existed in the Ministry of Health. Government dentists (dental officers) worked in public health center clinics throughout the country. Free dental care was provided to children and emergency care for adults (**Atwell, 1972**).

During the 1970s, the government expressed an interest in a more organized dental service for children through the use of dental auxiliaries, as was occurring in other parts of the world. The concept was developed by Dr. Ruby Atwell-Ferguson, a dental graduate of Edinburgh. With the support of the New Zealand government, she visited the dental nurse training program there. She also visited similar schools that trained dental nurses in Asia, as well as the New Cross hospital program in London. Dr. Atwell-Ferguson's thesis for a master's degree in public health from the University of Toronto was a proposal to establish a dental nurse training program in Trinidad and Tobago. She outlined a two-year curriculum with the awarding of a certificate in dental nursing on its completion.

Atwell-Ferguson's vision for the betterment of local dental services, and for the entry of more women into the profession, was clear: "The training and utilization of dental nurses will not only increase the dental personnel but also provide another form of employment for the young women of Trinidad and Tobago" (**Atwell, 1972**).

Dr. Atwell-Ferguson became the first principal of the school when it opened in 1976 (**Trinidad and Tobago Ministry of Health, 1977**). In 1978, the first dental nurses graduated from the program, several coming from other Caribbean countries. Approximately 12 trainees from Trinidad and Tobago were enrolled each year with five from other West Indian islands. The exclusive focus of the graduates was on children. They were able to practice with indirect supervision by a dentist. This new dental provider required that legislation be passed to permit them to practice. Passage of legislation was slow, causing frustration for dental nurses and the public; however, the Dental Act of 1980 finally provided the

necessary authorization for the practice of dental nurses (**Trinidad and Tobago Dental Profession Act of 1980**). Section 35 of the Act specifies: "1) a dental nurse is qualified to treat children only and such treatment shall be carried out in facilities or services operated by government or under the direct or indirect supervision of a dentist in private clinics; 2) a dental nurse who contravenes the provision of this section is liable on summary conviction to the removal of his name from the roll; 3) in this section 'children' means under the age of twelve years."

The training school for dental nurses was relocated from Port of Spain to a new facility in Arima in eastern Trinidad in the 1980s. Through funding from the Pan American Health Organization, three dental nurse tutors were trained by a team of foreign dentists, completing their training in 1987. A review of the first 10 years of the service of dental nurses concluded that they had significantly improved the dental manpower in Trinidad and Tobago, and played an important role in dental health education. However, the report indicated there were too few dental nurses, they were unevenly distributed, and they were in need of continuing education (**Steele, 1988**). The school was reactivated in 1995 with a revised curriculum. Two more classes of dental nurses were graduated, with the last class graduating in 2000.

As specified by law, a dental nurse may only treat children age 12 and under. The scope of practice includes (**Trinidad and Tobago Arima School for Dental Nurses, Undated**):

- Obtaining a medical history
- Examination
- Diagnosis and treatment planning
- Oral prophylaxis
- Topical fluorides
- Preparation and restoration of carious teeth
- Extraction of deciduous teeth
- Recognition of malocclusions and other conditions beyond scope of practice with referral
- Dental health education for children and mothers attending antenatal clinics
- Maintaining dental records and preparing reports
- Sterilization of equipment and checking functioning of dental equipment

The need for increasing the dental manpower beyond dental auxiliaries led to the University of the West Indies' development of a dental school, with the first students being enrolled in 1989. It followed the British curriculum and was the only English-speaking dental school in the Caribbean. By 2010, the school had graduated 300 dentists, the majority from Trinidad and Tobago.

A national survey was conducted of the working practices and job satisfaction of dental nurses in Trinidad and Tobago in 2001 (**Naidu, Gobin, Ashraph, Newton**

and Gibbons, 2002). Surveys were sent to 50 dental nurses, with responses received from 37 (35 males and two females) for a response rate of 76 percent. The average age of the dental nurses was 38.8 years. The average time since qualifying as a dental nurse was 15.6 years. One-half of the dental nurses had received additional training since graduation. The majority of the respondents, 26 individuals (68 percent) were employed by the Ministry of Health; 11 were employed by regional health authorities, and one worked in a private practice.

All dental nurses performed a wide range of clinical and administrative duties, as well as providing dental health education. Among the most commonly performed duties were: dental health education; clinical examinations; dietary counseling; application of topical fluorides; administration of local anesthesia; simple and complex restorations; and temporary dressings. Dental radiographs were used infrequently, by only 8 percent of the dental nurses; fissure sealants were placed regularly by 26 percent. The paper did not indicate how regularly extraction of deciduous teeth was undertaken by the dental nurses.

Respondents were asked to indicate whether they had taken a "career break," with such a break defined as a period of time away from work for one month or longer. Seventeen respondents (45 percent) had done so, with maternity leave or child-rearing being the reason for 94 percent of them.

On a scale of 1 to 10, the mean job satisfaction was 5.2 ± 2.3, with a median value of 5. Despite this relatively low job satisfaction, 24 respondents (64 percent) believed they were valued members of the dental team. The most valued aspects of their work were caring for children and dental health education. The least rewarding aspects were poor salary and working conditions, and lack of a career path.

An oral health survey of Trinidad and Tobago schoolchildren was conducted in 2004 (**Trinidad and Tobago Oral Health Survey, 2004**). The major finding was a shift in population, with a relatively high prevalence of 6-year-old children and a marked reduction in 12-year-olds since the last survey in 1989. A meeting of all stakeholders, including dental nurses, held to discuss the findings of the report resulted in the suggestion that dental nurses should expand their activities to work with the families of infants and young children in the home environment, similar to the district health visitors. Additionally, spending more time by providing feeding and weaning advice in antenatal and postnatal clinics was recommended.

Naidu, Prevatt and Simeon (**2006**) reported the results of the 2004 oral health survey in the *International Journal of Pediatric Dentistry*. The dmft for 6-to-8-year-olds was 2.32, with most of the index being carious teeth. The DMFT values for 12-year-olds and 15-year-olds were 0.61 and 1.06 respectively. Thirty-eight percent (38 percent) of the 6-to-8-year-olds, 66 percent of the 12-year-olds, and 55 percent of the 15-year-olds were caries-free. Seventy percent of the sample had treatment

needs, with 42 percent requiring restorations, 33 percent fissure sealants and 13 percent extraction of teeth. A significant improvement was noted in the 12-year-old age group from 1989 to 2004, with a decrease in the DMFT from 4.9 to 0.6. It was postulated that the reduction was due to an increased awareness of dental health by the public, which included increased use of fluoride toothpaste and increased dental visits by children.

A comparison was conducted of the degree of career satisfaction of dental nurses/dental therapists among these members of the workforce in the United Kingdom, New Zealand and Trinidad and Tobago (**Naidu, Newton, Ayers, 2006).** A logistic regression analysis indicated that dental therapists in New Zealand were almost twice as likely to express high levels of career satisfaction compared with those in other countries. Dental therapists in Trinidad and Tobago had significantly lower job satisfaction than those in the United Kingdom and New Zealand.

A draft of the country's "Oral Health Plan" outlined action areas required to address oral health priorities (**Trinidad and Tobago Ministry of Health, 2010a**). The role of dental nurses as vital members of the oral health team was reaffirmed. The document included statistics summarizing the clinical care activities of dental nurses from 2000 to 2009. During that time interval, the number of appointments increased from 26,493 to 29,534; extractions increased from 2,348 to 2,558; amalgam restorations declined from 3,286 to 1,787; composite restorations increased from 234 to 861; prophylaxis increased from 12,6450 to 16,183; topical fluorides increased from 7,720 to 9,497; and fissure sealants increased from 0 to 204.

The Ministry of Health published "The Oral Health Policy for Trinidad and Tobago" in 2010 (**Trinidad and Tobago Ministry of Health, 2010b**). The policy confirmed that comprehensive oral health care services for the nation's children should be maintained and strengthened.

Accordingly, the Regional Health Authorities are required to employ dental nurses as part of the dental workforce. A recurring theme in the document is the requirement for decentralization of primary dental health care to ensure equity in care delivery. Dental nurses are to become part of a devolved service delivery system based in the Regional Health Authorities. This should enable more effective deployment of dental nurses to communities that continue to have poor access to dental care.

JAMAICA

Jamaica is an island in the Caribbean Sea south of Cuba, about 581 miles from Florida. It is slightly smaller than Connecticut, with an estimated population of 2,868,000 and an ethnic composition of 91% African, 1.3% Chinese, 0.2% White

and 7.3% "mixed." The population is 88% literate and has a life expectancy of over 73.4 years.

A former British colony, Jamaica achieved independence and a parliamentary democracy in 1962, remaining a member of the Commonwealth of Nations. Its main exports are alumina, bauxite, sugar, bananas, citrus fruits and products, rum, and coffee. Tourism and remittances from overseas Jamaicans are a major source of income. Due to the poor economy, 200,000 Jamaicans emigrate annually, mostly to the United States since the United Kingdom restricted emigration in 1967.

Dental nurses/dental therapists began training in Jamaica in 1970 with the opening of the Dental Auxiliary Training School, which followed amendments to the Dental Practice Act permitting dental nurses to provide specific dental services with supervision by dentists (**Spohn, 1996**).

In late 1995, professor Eric Spohn of the University of Kentucky conducted a site visit of the dental nurse and dental assistant training programs. He reported that 20 students were being admitted annually to the dental nurse program. The program was of two years' duration and both oral and clinical examinations were conducted by the Board of Dental Examiners prior to certification to practice.

"Dental nurses are by law only able to work in the Jamaican Government Dental Services Program, and there are currently 160 posts available. Dental nurses treat children from preschool to age 15. There are 6 levels of rank in the dental nurse career path. Dental nurses work under indirect supervision of a clinical dentist. The dental nurse is technically not able to diagnose or to prescribe medications and works under a treatment plan approved by a supervising dentist. The dental nurse provides preventive and restorative services which are defined by the dental practice act. In reality, the dental nurses often must make diagnostic decisions as they provide day to day services and, therefore, requires training in many procedures equivalent to the training of a dentist. Examples are subjects such as operative dentistry, oral examination, diagnostic procedures, cardiopulmonary resuscitation, administration of local anesthesia and select oral surgical procedures" (**Spohn, 1996**).

Spohn concluded his report saying, "In general, the training program is providing an adequate level of training for the dental nurse students."

Currently, the Dental Nursing/Therapy training program is a component of the School of Oral Health Sciences, one of the four schools of the College of Health Sciences at the University of Technology in Jamaica (**Jamaica University of Technology, 2011**). The program awards a Bachelor of Science degree in Dental Nursing/Therapy. It is designed to "prepare graduates to perform high quality promotive, preventive and curative oral health care. Specifically, the dental

nurses/dental therapists will be able to recognize dental and gum diseases, carry out fillings, expose dental radiographs, extract baby teeth, do prophylaxis (cleaning) only on child patients. They will also be able to plan and deliver dental health education talks."

Irving McKenzie, the director of dental services for the Jamaican Ministry of Health, responded to a survey in 2007, providing information regarding the practice of dental therapists in Jamaica (**McKenzie, 2007**). He reported that dental nurses/dental therapists can perform the following: clinical examinations; exposing radiographs; diagnosing of radiographs; prophylaxis; coronal scaling; topical fluoride treatments; sealants; local anesthesia (infiltration and nerve block); amalgam and composite restorations; extraction of deciduous teeth; and atraumatic restorative treatment (ART). The total number of dental nurses practicing in Jamaica at that time was 150. They practice under the general supervision of a dentist, working only in government clinics, and caring only for children and adolescents. He reported that on a scale of 1 to 5, with 1 being very dissatisfied and 5 being very satisfied, the public and the profession would rate their satisfaction with dental therapists at 4. There had not been any reported injury or damage as a result of the care provided by the dental nurses/therapists, and no dental nurse/therapist ever had his or her certificate to practice removed or suspended.

BAHAMAS

Officially known as The Commonwealth of the Bahamas, The Bahamas is one of the most prosperous countries in the Caribbean region, with tourism representing 60% of its GDP, and financial services 15%. Consisting of thousands of small, low lying islands and "cays," only about 30 of which are habitable, The Bahamas are slightly larger than Connecticut and Rhode Island combined. It became a British Crown Colony in 1717, finally achieving independence in 1973 with the establishment of a bicameral parliamentary government. It remains a member of the Commonwealth of Nations.

Its population of 354,000 is 85% African, 12% European, mostly British and American descendents of Loyalist from the American Revolution, and 3% Asian and Hispanic. Over 98% of the population is literate and has a life expectancy of nearly 70 years.

Bahamian law provides for the practice of dental nurses (**Commonwealth of the Bahamas, Undated**). Dental nurses are enabled by law to perform the following services upon completion of a course of study approved by the Bahamas Dental Council:

- Teaching and giving advice on oral hygiene and mouth care;
- Inspection and examination of the mouth and charting of findings;
- Topical application of anti-cariogenic agents to the teeth;
- Scaling, cleaning and polishing teeth;
- Exposure and processing of dental X-ray films;
- Administration of anesthetics, excluding nerve block or conduction anesthesia;
- Fillings not involving exposure of dental pulp and preparation for such fillings;
- Extraction of deciduous teeth, including preparation and after care.

ANGUILLA

The population of Anguilla is 9,000. Anguilla dental nurses are responsible for providing oral health care for children until they reach 18 years of age (**Adewakun, Amaechi, 2003; 2005**). At the time of Adewakun and Amaechi's study, children's dental care was being provided by three dental nurses employed in public service and supervised remotely by the one dentist on the island. Adewakun (**1997**) reported the caries prevalence in Anguilla to be 56.4 percent of children, with mean DMFT scores of 0.16 at age 6; 2.29 at age 12; and 3.29 at age 15. Adewakun and Beltran **(2003)** found the prevalence of early childhood caries to be 50 percent.

An assessment of consistency and conformity in caries assessment among the dental nurses after training was conducted by Adewakun and Amaechi (**2003, 2005**). They found that almost perfect inter- and intra-examiner agreements were attained at calibration and throughout the survey, concluding that the dental nurses were able to conduct valid and reliable child oral health surveys when adequate and appropriate training is provided.

Section 15

PACIFIC ISLANDS

Finau (**1996**) reported on oral health and personnel needs in the Pacific in an article in the Australian Dental Journal. He described the oral health status, dental personnel and dental services provided in each of the 22 nations of the South Pacific Commission (SPC). The SPC is an intergovernmental organization established in 1947 to provide assistance to the development efforts of Pacific Island countries. The Commission provides technical assistance, training and information in a variety of areas, including economics, rural development, health, agriculture, community education and fisheries. Five non-Pacific nations are members of the Commission in support of it: the United States, New Zealand, Australia, France and the United Kingdom.

Finau reported that all countries have dental workforce shortages, with most countries undertaking training of auxiliary dental personnel to meet service demands. A total of 257 dental therapists existed in 14 of these Pacific Island countries, with dental therapists practicing in American Samoa (2); Cook Islands (7); Federated States of Micronesia (21); Fiji (42); Kiribati (5); Marshall Islands (9); Northern Mariana (4); Papua New Guinea (104); Solomon Islands (13); Tokelau (3); Tonga (8); Vanuatu (6); Wallis and Futuna (2); and Samoa (16). He reported that there were dental therapists' training programs in Fiji, Tonga, Papua New Guinea and Samoa, with all accepting students from other countries. He cited a South Pacific Commission Report of 1990 that stated there was a need for 51 dental therapists per year from 1991 to 1995. In nations with affiliation with the United States, the number was 30 dental therapists a year for three years.

Documents relative to the practice of dental therapists were able to be obtained from only three of the 14 Pacific Island countries: Fiji, Papua New Guinea and Samoa.

FIJI

The Republic of Fiji was established in 1970 after being granted independence by Great Britain. It extends over 322 islands in the South West Pacific, east of Australia and north of New Zealand. Only 10 percent of its 75,000 square miles of territory is land, mostly volcanic mountains covered by tropical forests. A third of the islands are populated, numbering nearly 950,000, consisting mostly of 51 percent Native Fijians of Melanesian and Polynesian ancestry and 38 percent Indo-Fijians, the latter descendants of contract laborers imported

from India by British colonials in the 19th century. The other 5 percent are of European, other Pacific Island and Chinese ancestry. Age distribution: 0 to 14 years, 31 percent; 15 to 64, 65 percent; 65-plus, 4 percent. Fijians are 92 percent literate, with more than 85 percent of children age 6 to 13 attending primary school, which is free, but not compulsory. For the most part, Fijian and Indian children attend separate schools, mirroring the major political division in the country. Fiji's top five export commodities are fish, mineral water, garments, timber and gold, followed by sugar, coconuts and ginger. Tourism, with nearly half a million visitors annually, is the major source of revenue. However, the country's need for basic imports leaves Fiji with an annual trade deficit.

The first group of dental hygienists/therapists graduated from the Fiji School of Medicine in 1973. As a result of the establishment of this new program, the former dental hygienist program, which had begun in the 1960s, was discontinued (**Daunivalu, 1992**). Those who had previously trained as dental hygienists were offered a conversion course of one year's duration and awarded a certificate in dental hygiene/therapist. The offer for the conversion ceased in 1975. The first enrollment in the combined dental therapist/hygienist program was in 1976. According to Daunivalu, two-thirds of the content came from the previous dental hygienist curriculum and one-third from the curriculum for the dental officer diploma (D.S.D.) in dental surgery.

In 1985, the dental officer (dentist) training program was discontinued and undergraduate dental students were sent to either the University of Otago in New Zealand or the University of Adelaide in Australia to study for dentistry. This created a workforce problem in Fiji, and the three-year diploma for dental therapists, previously known as the dental hygienist/therapist, was upgraded to enable dental therapists to assume independent responsibility for managing clinics (**Daunivalu, 1992**).

Davies (**1990**) reported that the staffing and facilities for teaching dental personnel in Fiji had deteriorated over time.

Davies and colleagues (**1993**) designed an innovative curriculum for the Fiji School of Medicine to enable dental personnel to proceed through a sequence of educational modules on a career path leading from a dental assistant through other auxiliary grades to a dentist with a Bachelor of Dental Science degree (B.D.S.). The courses were formulated to be relevant to the pattern of oral diseases in Fiji and the Pacific Islands; additionally, the curriculum was designed with an emphasis on oral health promotion and prevention. The modular structure permitted exit and re-entry at each level, with members of the oral health team able to progress from one level to another with full credit for their previous experience.

In 1995, Tuisuva, Smyth and Davies (**1995**) provided a more detailed description of the curriculum, which had begun in 1993. The initial year was designed for dental assistants and consisted of nine modules of instruction focusing on dental assisting skills. The original intention had been for the dental hygiene curriculum of six modules to be studied over six months of the second year. However, it proved inadequate and the dental hygiene curriculum was extended to a full year. Similar difficulties were reported for the dental therapist curriculum. It had been planned to commence at the end of the six-month program in dental hygiene and to consist of five modules in the second semester, with the intention that at the end of the second year a person would graduate as a dental therapist; or they could continue a third year to qualify as a "senior dental therapist." Tusisuva et al. reported that the students could not develop the necessary clinical skills in one semester, so the senior dental therapist model was abandoned with the five additional modules of that course added to the regular dental therapist curriculum. The effect of these changes was that the period of training for dental hygienists was extended to two years, consisting of one year of dental assisting and one year of dental hygiene. The dental therapists training was extended to three years, with one year of dental assisting, six months of dental hygiene, and 1½ years of dental therapy. The modular curriculum provided for dental technology as well, with an individual to become a dental technician by completing the one-year dental assisting course, followed by two years of training in dental technology. Finally, dental therapists could enroll for years four and five (with 22 modules) to earn a Bachelor of Dental Surgery degree.

Evaluation of the program in 1998 resulted in changes, due primarily to deficiencies in financial, human and facility resources (**Tuisuva et al., 1999**). The dental assisting program was abandoned. Exit points in the modular curriculum became: dental hygienist at two years; dental therapist at three years; and dentist at five years. The recommendation was also made that the dental hygiene and dental therapist programs be combined with a focus on public health.

Between 1991 and 2007, the program produced 273 graduates: 102 dental hygienists; 67 dental therapists; and 91 dentists (**Satur, 2011**).

Fiji dental therapists were described in the August 2007 inaugural issue of The Dental Herald: The Official Newsletter of the Fiji Para-Dental Association (**Fiji Dental Herald, 2007**), which stated that "dental therapists have played significant roles in promoting oral health in Fiji. They have stood at the forefront of preventive dental programs in schools and both urban and rural communities.… They are treated as second class dental workers along with other para-dental staffs."

Dental therapists in Fiji are not registered workers and are only employed by the government through the Ministry of Health. Six dental therapists were reported

to have continued in the modular curriculum and earned the B.D.S. degree. In 2007, an additional seven dental therapists were enrolled in the curriculum leading to becoming a dentist.

Job satisfaction, motivation and work practices of dental therapists in Fiji have been reported (**Ralovo, Pushpaangaeli, 2007**). Questionnaires were sent to 54 dental therapists. Approximately 50 percent of the dental therapists indicated they were satisfied with their work; the dissatisfaction was particularly strong among young and middle-aged dental therapists. There was dissatisfaction with their working conditions (44 percent), salary (65 percent); management of their supervisors (46 percent); and opportunity for advancement (77 percent). Work as a dental therapist was found stressful by 65 percent of the respondents.

PAPUA NEW GUINEA

Papua New Guinea (PNG), occupying the eastern half of the second-largest island in the world, New Guinea, is a parliamentary democracy about the size of California, with a population of 6.2 million. The western half, with 1.5 million population, is under the domain of Indonesia.

New Guinea achieved independence from Australia in 1975, but has remained in the British Commonwealth, with close ties, economically and geographically, to Australia, which is only 100 miles away. The indigenous population, one of the most heterogeneous in the world, lives in several thousand small communities, speaking more than 800 distinct languages, and intercommunicating in Melanesian Pidgin. English is the language of education and commerce. Approximately 75 percent of the country's population relies primarily on subsistence-based agriculture. The minerals, timber and fish sectors are dominated by foreign investors. Life expectancy is 66 years. HIV/AIDS infection is spreading and expected to exceed 200,000 in 2012. Malaria is the leading cause of illness and death. Health care is hampered by the shortage of personnel and the difficult mountainous terrain.

Following a 1958 survey of children in PNG, it was recommended that a school dental service be established and staffed by dental nurses (**Davies, 1991**). Further, it was recommended that special attention be given to the prevention and treatment of caries in primary schoolchildren (**Williams, 1958**). Davies reported that the tooth loss due to dental caries is negligible in rural areas of PNG, and does not become significant until the age of 35 in urban areas. After age 35, the major cause of tooth loss is periodontal disease. He reported that only about 6 percent of the total population and 8 percent of the school population use dental services, with the predominate demand being for simple restorations and extractions. Amaratunge and Pouru (**1987**) reported that dental caries occur

most often in the pits and fissures of schoolchildren. Among the dissatisfactions of dental therapists in their work was the lack of opportunity to expand their knowledge and skills through continuing education courses and the lack of a clear career pathway.

Oral health care in PNG is provided by the government and is carried out by a relatively small workforce of less than 200 individuals, primarily dental therapists supported by a small number of provincial dental officers (dentists) (**Jago, 1991**). Dental therapists are based either at a health center or a provincial hospital, and visit community schools to examine and treat children. In spite of the priority given to children, the Department of Health reported that in 1984, 30.6 percent of the nation's school population was examined, and of those, less than a third (28.9 percent) received some form of treatment (**PNG Department of Health, 1986**).

In his article "Getting Dental Services to the Rural 85 Percent," Jago argued that, based on the size of the workforce and the use of services, dental services are basically "invisible" (nonexistent) for the overwhelming proportion of the population of PNG. He then advocates for the training of community health workers and "aid post orderlies" to be trained in basic dental care. He recommends that they be taught the rudiments of dental health education and preventive dentistry, as well as the ability to provide basic clinical services, including recognizing normal from abnormal, and scaling and extraction of teeth, with all other required dental needs being referred to the nearest health center for care by a dental therapist or dentist.

SAMOA

The Independent State of Samoa, known as Western Samoa until 1997, is located halfway between Hawaii and New Zealand in the South Pacific Ocean and includes the two largest western Samoan islands, Upolu and Savai'i, and seven small islets, for a total land area of 1,133 square miles, which is slightly smaller than Rhode Island. (By comparison, American Samoa is 76 square miles, slightly larger than Washington, D.C.) Samoa was a protectorate of Germany since the early 19th century; New Zealand took over in 1914, at the beginning of World War I, and administered the islands until 1962, when Samoa gained independence as a parliamentary democracy, with remaining close ties to New Zealand and membership in the British Commonwealth. Tourism, coconuts, small-scale manufacturing and fishing are Samoa's main industries. The principal exports are coconut products, nonu fruit (considered to have significant medicinal application) and fish. Its main imports are food and beverages, consumer goods, industrial supplies and fuel.

Ninety-two percent of its 402,000 population is Samoan, 7 percent Euronesian (persons of European and Polynesian blood) and less than 1 percent European and Asian. The population is almost entirely literate and has an average life expectancy of 72 years: 69 years for males and 75 years for females. Sixty percent are Protestant, 19 percent Catholic and 14 percent Mormon, along with a smattering of other religions. Ancient beliefs, particularly in regard to the traditional customs and rituals of fa'a Samoa, remain strong in both adopted religions and politics.

According to Camrass (**1975**), the chance arrival of a New Zealand dental nurse to Western Samoa, who was allowed to practice in a school under the supervision of a dental officer, permitted the population to become accustomed to the concept of a school dental nurse. He reported that "within a year, the backlash of treatment for approximately 1,000 children had been dealt with."

Under the auspices of the World Health Organization, three Western Samoan women were sent abroad in the early 1970s to become dental nurses; two studied at the School of Dental Nursing in Penang, Malaysia, and the third at the School of Dental Nursing in Auckland, New Zealand (**Camrass, 1975**).

In June 1974, the first school dental center operated by a Polynesian school dental therapist was opened, with the wife of the prime minister participating in the ribbon-cutting. Camrass commented that the opening marked a milestone in Western Samoa's public health program. The clinic was said to initially serve 850 girls. He went on to say, "The use of school dental therapists working independently, although within range of a dental officer's assistance, is an advanced but essential concept in the delivery of dental services."

Section 16

OTHER NATIONS

SRI LANKA

The Democratic Socialist Republic of Sri Lanka, formerly known as Ceylon, is a 25,000-square-mile island off the southeastern coast of India. It came under British rule in the 1830s and achieved independence in 1948. Its 21.3 million population is made up of 74 percent native Sinhalese, 18 percent Tamils of Indian descent, 7 percent Muslims of Moorish and Malaysian descent, and 1 percent others. Age distribution: 0 to 14 years, 26 percent; 15 to 64, 67 percent; 65-plus, 7 percent, with an average life expectancy of 75 years. Most Sinhalese are Buddhist, the predominant religion, and most Tamils are Hindu; both have large Christian minorities, mainly Roman Catholic.

Although the official languages are Sinhala and Tamil, English is widely used for education, scientific and commercial purposes. More than 92 percent of the population is literate in its local language. The youth literacy rate is 98 percent, and computer literacy, 35 percent. Primary school enrollment rate is more than 99 percent, due in no small part to education being compulsory until age 14. Although Sri Lanka is largely an agricultural country, producing and exporting tea, rubber, coffee and sugar, the industrial sector is growing in food processing, clothing and telecommunications. Tourism is a major part of the economy. Nonetheless, Sri Lanka's income inequality is severe, particularly between rural and urban areas. About 15 percent of the country's population remains impoverished.

The School Dental Service in Ceylon was established in 1949 by Dr. Kartigasu, who was the only woman dentist in Ceylon. She began the program by assuming responsibility for two school clinics in addition to her work at the Dental Institute. In 1951, she added two additional school clinics and devoted herself full-time to the four schools, one of which had 2,000 students. The children's ages ranged from 4 to 18. Colombo was the only place in Ceylon with school dental clinics; however, it was the intention to inaugurate a new and extended school dental service based on the New Zealand model (**NZSDS Gazette, 1952**).

The current system of a School Dental Service was established in 1953 with the assistance of the government of New Zealand under the Colombo Plan for Economic Development in South and Southeastern Asia (**NZSDS Gazette, 1954**). Six people were sent from Ceylon to New Zealand to train as school dental nurses in 1952. They graduated in 1953 and before returning to Ceylon, they spent a period of time in school clinics in New Zealand to gain experience (**NZSDS Gazette, 1953**).

Training of school dental nurses began in 1955. As with the concept of the School Dental Service, the curriculum of New Zealand was transplanted to Ceylon. The enrollments in the first two classes were 15 and 16, respectively. In 1957, the numbers were increased to 24, and continued at that level for many years. In 1997, enrollment increased to 46 students a year. Instruction was in English initially; however, with the introduction of Sinhalese as the country's official language, the curriculum was translated into Sinhalese in 1969. A WHO-sponsored workshop in 1986 reviewed the curriculum for revisions to produce dental therapists qualified to meet the oral health care needs of children (**Sri Lanka Dental Therapist Training School, 1986**). The Sri Lanka Ministry of Health specifies the scope of practice of dental therapists and the circumstances in which they may practice. Practice is limited to primary care for schoolchildren and preschool children, ages 3 to 13 (**Sri Lanka Ministry of Health, 1986**). Their scope of practice includes:

- Dental health education, including instruction in oral hygiene; Screening and examination;
- Preventive procedures, including scaling and polishing;
- Silver amalgam restorations on posterior teeth, with priority for permanent teeth; Restoration of permanent anterior teeth where the pulp is not involved and the incisal edges are not involved;
- Extraction of primary teeth.

The Ministry of Health reported that in the year 2000 there were 280 school dental clinics in Sri Lanka staffed by 461 school dental therapists (**Sri Lanka Ministry of Health, 2000**).

In spite of the existence of a School Dental Service, Ameratunga found in a sample of the Kandy area that only 30 percent of the 15-year-old children recalled visiting a school dental clinic (**Ameratunga, 1982**). Only 1.7 percent could remember receiving oral hygiene instructions from a school dental therapist. On the other hand, 23.3 percent recalled receiving oral hygiene instructions from schoolteachers, and 14.2 percent from a dentist or physician. Ameratunga concluded that the degree of utilization of the School Dental Service was very modest and that it was more likely to remain an emergency service, unless measures were taken to expand it. Tillaivasm reported that in 1985, only 5.5 percent of the school population received regular dental care (**Tillaivasm, 1987**).

The imperative of prioritizing preventive dentistry for Sri Lanka was stressed in an essay in the International Dental Journal in 1996 (**Saparamadu, 1996**). Saparamadu reported on the first ever National Oral Health Survey conducted in 1984. There was a high prevalence of dental caries in the primary dentition of Sri Lankan children. The dmft of 6-year-olds was 4.4 (d=4.0, f=0.1, m=0.3). The disease prevalence in the permanent dentition of 12-year-olds was relatively low with a DMFT of 1.9 (D=1.7, F=0.1, M=0.1). In spite of the existence of the School

Dental Service, only one decayed primary tooth in 44 had been restored at age 6, and only one in 19 permanent decayed teeth had been restored at age 12. In order to achieve desired oral health goals, the plans were for the School Dental Service to concentrate on the permanent dentition in children, managing disease in the primary dentition with a minimal-care approach, with nonintervention whenever possible.

Saparamadu reported that in 1996 the approach was for the school dental therapists to move beyond their fixed school clinics on a planned schedule, visiting satellite schools, screening children, providing oral health education and treatment. This enabled oral health promotion to come to the children, rather than expecting the children to be brought to the clinic. The goal was to provide increased coverage to the population, especially in rural areas where public transportation was not readily available. This would allow an integrated approach to health care in a clinic where other health care workers were present.

Primary schoolteachers were also being trained in oral health in a series of workshops. Close links were being developed between the School Dental Service and the training of primary schoolteachers, with dental therapists providing the instruction in oral health care for the teachers.

A study was conducted in the district of Ratnapura to evaluate a specific aspect of the School Dental Service, the "Outreach Programme," as well as aspects of the School Dental Services prevention of dental caries and periodontal disease. The oral health status of the schoolchildren in that district was assessed by clinical examination of their oral hygiene, treatment received and treatment needed. A self-administered questionnaire was used to gather information on knowledge, attitude and practices (**Konthesigha, 1996**).

The study documented an enhanced coverage of the target population as a result of the Outreach Programme. It has substantially reduced the amount of untreated dental caries in comparison to the control group. Nevertheless, untreated carious lesions remained high even in the group participating in the program. It appeared that the school dental therapists had participated enthusiastically in the outreach program, but at the expense of their school-based activities. Konthesigha highlighted the need to reappraise the outreach program based on the results of the study.

Fernando evaluated the School Dental Service staffed by dental therapists in the Western Province of Sri Lanka for as the research component of her doctoral dissertation (**Fernando, 2006**). She evaluated five major dimensions of the School Dental Service: efficiency, effectiveness, adequacy, equity and quality of service. Seventeen indicators were used to assess these dimensions, with all indicators having been validated by the consensual opinion of 10 experts in the field of dental public health.

The study was conducted in 20 school dental clinics that were selected on a random basis with the population proportion sized to represent the three districts of the province. Efficiency and effectiveness measures were assessed in these 20 clinics. Adequacy and equity were measured in the context of the total population of children between 3 and 13 years of age, as well as the number of school dental therapists working in the province. The quality of service was assessed by obtaining the necessary sample size for each of the nine indicators on quality.

It was found that the mean cost of providing care per dental visit was the equivalent of $1 U.S. School dental therapists provided care to approximately 95 percent of the children in the school in which their clinic was located. More than 95 percent of the required care for children could be completed by dental therapists. However, only 65 percent of the required extractions had been accomplished.

School dental services were not distributed equitably in the province. The mean school dental therapist to the population eligible for services was 1 to 5,084. In some areas, there were years with no availability of dental therapists. In other areas where there was a dental therapist-to-population ratio of 1 to 1,425, children were adequately served. The availability of the dental workforce was insufficient in the three districts of the province under study, only one- half of WHO standards being met by the School Dental Service. The Colombo district had 70 percent of the standard, whereas the Gapaha district had 60 percent. Districts with no availability of a school dental therapist stood in sharp contrast, with some districts reaching 128 percent of the standard.

The majority of children, 65 percent, who had been exposed to dental health education instruction by the school dental therapists possessed positive attitudes toward oral health, as well as good oral health habits—75 percent. Sixty percent possessed sound knowledge of oral health.

The proportion of necessary restorations performed by the dental therapists was 65 percent; 98 percent of the extractions were judged to be satisfactory. Some dental therapists were unable to make judgments as to the need for removal of calculus by scaling; approximately 60 percent of the children scaled were judged to have had it accomplished satisfactorily. Almost 25 percent of the clinical records were determined to be incomplete.

The knowledge of the school dental therapists was generally satisfactory, with more than 70 percent obtaining a test score of 70 percent. Knowledge was deficient regarding treatment options at different stages of the carious process and causes of restoration failure.

The majority of the school dental clinics selected for the study had adequate physical facilities, and 80 percent of the school dental therapists expressed overall

satisfaction with them. However, 50 percent were not satisfied with the dental equipment and 80 percent were not satisfied with the dental supplies. Seventy percent rated their work as very good, and the remainder as good or fair. Since the external evaluation of the care was not judged to be of high quality, apparently the dental therapists lacked the criteria to evaluate the quality of their clinical care.

Yes, 80 percent of the patients were strongly appreciative of the care received. However, 20 percent indicated that the dental therapists could have been "kinder." An overwhelming majority of the recipients of the care provided by the School Dental Service, 90 percent, were satisfied with their perceived quality of care, and 60 percent held the opinion that the service should remain as it was, without change.

SEYCHELLES

Seychelles is a constitutional republic consisting of an archipelago of 115 granitic and coral islands, most of which are very small and uninhabited. Mahe, one of the two largest islands (the other being Praslin) contains about 75 percent of the 91,000 population and is resident to its capital city, Victoria. Located in the Indian Ocean about 1,000 miles east of Kenya, the archipelago has an area of only 171 square miles, about 2.5 times the size of Washington, D.C.

The islands were first inhabited by French settlers in the mid-18th century. Africans freed from slave ships were brought to Seychelles by the British, who took control from the French in the early 19th century. Independence was granted in 1976, with Seychelles remaining a member of the British Commonwealth. For nearly two decades, the country was under one-party rule. In 1993, a multiparty system was adopted under a new constitution.

Small numbers of Indians and Asians migrated to the country, which is best described as Creole. Creole is the native language of 94 percent of the population, but French is also spoken, and English is the official language of government and commerce. More than 90 percent of the population is Christian, mostly Catholic, with Hindus at 2.1 percent and Muslims, 1.1 percent. Education is compulsory through Grade 10, and the literacy rate is 96 percent. Free health services are provided the population, an inheritance from the socialist programs of its first government.

Canned tuna is the major export, fish being the only natural resource of the islands. Its agriculture is sparse: coconuts, copra, sweet potatoes, tapioca, bananas, cinnamon and vanilla. The major trading partners are the United Kingdom, France, Japan, South Africa, Spain and Saudi Arabia, with tourism also a major attraction and source of income.

"The Seychelles Dental Service" was the title of a comprehensive review of oral health care in Seychelles (**Ernesta, Dogley, Arissol, Pothin, 2004**). While the Seychelles Dental Service dates to the 1920s, the importance of child oral health became apparent in 1974, when the Seychelles Dental Service began retaining dental therapists to take responsibility for care of children. The School Dental Service is a major unit of the dental section of the Ministry of Health and is staffed by a principal dental therapist with 27 dental therapists working in district health centers and on school campus.

In 1971, two women joined the dental service after being trained as dental nurses in New Zealand. From that time forward, dental therapists were trained in New Zealand or Tasmania. In 1979, a full-time dental hygienist joined the dental service. Since dental therapists and hygienists were both under the auspices of the School Dental Service, it was found to be more cost-effective to have dental therapists carry out the duties of both dental therapists and hygienists.

According to Ernesta et al., the School Dental Service is responsible for dental public health across the population, with the unit consisting entirely of dental therapists. The primary responsibility is provision of dental care from birth to age 20, with secondary responsibilities being dental hygiene services for adults. Organization of the School Dental Service is such that dental therapists are responsible for the community in which they work and for ensuring that progams targeting different groups are implemented. Most care is provided in district health centers. There are a total of 32 dental surgeries, with 13 allocated for adult care and 19 for the School Dental Service. The 19 SDS surgeries serve a population of 29,500 individuals under the age of 21, for a dental therapist-to-patient ratio of 1 to 1,553.

In 1987, with assistance from the Australian Development Assistance Bureau, local training of dental therapists began at the School of Health Studies in Seychelles, with the curriculum combining both dental therapist and hygienist training. The course of study is three years, with eight students accepted in the program annually. Locally trained dental therapists make up 85 percent of the dental therapist in the School Dental Service. Without a dental school in Seychelles, general dentists and dental specialists are trained abroad.

According to Ernesta et al. (**2004**): "The Seychellles Dental Service strives for optimum professional standards of care. In the face of limited resources, materials, equipment, and personnel are all selected and monitored carefully to ensure maximum performance and cost effectiveness. Assessment and quality assurance are carried out through routine visits in clinical setting by management, which helps to identify areas in need of improvement. Regular monthly meetings and seminars are organized for the DTs and dentists and, in conformity with the standards set by the Ministry of Health, the Service appraises the performance of its staff at least once every two years."

A child survey conducted revealed that about 50 percent of children visited the dental service regularly, either once or twice a year, with the other half not visiting or only when in pain. DMFT/deft data indicated a gradual decrease in dental caries as age increased. However, less than 25 percent of 12-year-olds were caries-free.

Ernesta provides an abstract of a study by Arissol in 1998 (assumed to be unpublished) titled "Reorganization of the Seychelles School Service." The study found that while dental therapists were happy in their choice of career, they also believed that they were not receiving the level of support or being given the recognition they deserved by their superiors. Recommendations included a revision of the structure to provide opportunity for more career development and consequently better job satisfaction.

BRUNEI

Brunei is a small Islamic monarchy with one border facing the South China Sea and the opposite border closed in against Malaysia. At 2,226 square miles, it is about the size of Delaware, with a population of 400,000, consisting of Malay (67 percent), Chinese (11 percent), indigenous (3 percent) and other (19 percent). Its official language is Malay, with English the language of commerce. Chinese as well as indigenous dialects are also spoken. Islam is the official religion, but Buddhism, Christianity and other faiths are well-tolerated.

Brunei became a British protectorate in 1888. In 1959, a new constitution was written declaring Brunei a self-governing state, while its foreign affairs, security and defense remained the responsibility of the United Kingdom. Then, on Jan. 1, 1984, Brunei became a fully independent state and member of the British Commonwealth. The ruling sultanate has remained in the same family for 600 years. Brunei's wealth stems from its massive oil and natural gas resources, allowing the government to provide free health care for its population in public hospitals and health clinics located throughout the country. Malaria has been eradicated and cholera virtually eliminated. Life expectancy is 76 years. While overall health care is better than in most countries, in 2006 the Minister of Health reported that the nation had yet to reach the standard of dental health set by the World Health Organization.

In Brunei, a dental therapist is an individual who is on the frontline in looking after the care of children (**Brunei Darussalam Ministry of Health (BDMH), 2008a**).To become a dental therapist, one must be a Brunei citizen, at least 18 to 25 years of age, and unmarried. Dental therapists are employed in the government dental service and work in school-based clinics providing care for children.

They perform examinations, preventive dentistry, fillings and extractions. Amer reported that Brunei had 31 dental therapists in 1981 (**1986**). Currently there are 74 dental nurses employed by the government (**BDMH, 2008b**).

Dental therapists are involved in oral health promotion and education, health administration, public health including epidemiology, and the provision of clinical services to school-age children. Brunei has a collaborative relationship with King's College in London for the training of dental therapists/hygienists. As of 2012, 14 therapists/hygienists had been trained there. Additionally, six dental therapist/hygienist tutors have been trained by King's College to teach in the Brunei dental therapy school that trains approximately 12 dental therapists each year.

GUYANA

Guyana borders the Atlantic Ocean between Venezuela and Suriname. It is one of the smallest countries in South America, nearly the size of Idaho. It achieved independence in 1966 from the United Kingdom and became a republic after much political turbulence in 1970, with Dr. Cheddi Jagan, formerly a dentist, as the first president. Guyana is a member of the British Commonwealth and the Caribbean Community. Its population of about 750,000 is comprised of descendents of East India (44%), Africa (30%), mixed ethnicities (17%), Aboriginals or American Indians (9%), and a few thousand Europeans and Chinese. English is the official language, but Spanish and Portuguese are spoken in the Bush and rainforest, along with Guyanese Creole and other dialects. Its main economy is comprised of agriculture (sugar, rice, fruits and vegetables), fishing, mining (gold, bauxite, diamonds), timber, and textiles.

Education is compulsory, with 93% attendance through high school. Life expectancy is 64 years for men, 69 years for women. In terms of morbidity, the most common reported disease is dental caries, followed by malaria. AIDS/HIV and STD morbidity is on the rise. Initially there was a commitment to provide free health care, but there has been insufficient funding to cover all costs so that more people are seeking care in the private sector.

The laws of the government of Guyana provide for a "dentist extender" (**Guyana Dental Registration Act, undated**). The act provides for an individual to register with the Dental Council as a "dentist extender" who is: 1) a citizen of Guyana, spouse of a citizen of Guyana or a resident of Guyana qualified to be so registered; 2) able to communicate satisfactorily in English; 3) a fit and proper person to perform the services of a "dentist extender." The person must complete a course of training approved by the Dental Council and pass the approved examination. The dentist extender, in addition to such dental services as may be prescribed, may provide dental care to a child who has not attained 18 years of age, as long as the

care is provided in health establishments operated by the government and the care is under the supervision of a registered government dentist. Services that may be provided include: teaching and giving advice on oral hygiene and care of the mouth; exposure and processing of dental radiographs; administration of local anesthesia; fillings not involving exposure of the dental pulp and preparation for such fillings; scaling, cleaning and polishing of teeth; topical application of anti-cariogenic agents to the teeth.

The Ministry of Health of Guyana operates the Dr. Cheddi Jagan Dental Centre as a site for the dental auxiliary training programs (**Guyana Ministry of Health, Undated**). Three levels of training exist for the dental therapist/dentist extender: community dental therapist program, dental extender certificate program and dental extender diploma program. The two dental extender programs are designated Dentex training programs.

The objective of the community dental therapist program is to train individuals to promote oral health and provide school and community oral health education/prevention programs, as well as provide preventive service, while supporting dentists and dentist extenders in other basic services for children, including extraction of primary teeth, fillings of Class I cavities with zinc oxide and eugenol, silver amalgam and glass ionomers. The job description of the community dental therapist includes:

- Planning and developing oral health education; Performing all duties related to infection control;
- Developing caries preventive programs; Supporting fluoridation;
- Performing basic curative dental services;
- Examination, extraction, temporary and permanent fillings on deciduous teeth, with referral of more complicated cases to dentist extenders (Dentex) and dentists; Administrative duties;
- Support surveillance system;
- Assist dental surgeons and specialists;
- Under special circumstances in remote areas where there is no dentist, and under conditions authorized by a dental officer, the community dental therapist could support the delivery of care to adults.

Admission to training as a community dental therapist requires that the individual: holds a dental assistant certificate; is a mature student, 26 years of age or older; and has a minimum of two years' experience in a related field. The program is 18 months in duration, with a six-month internship.

The objective of the Dentex Certificate Program is to provide a dental auxiliary who is competent in all primary oral health services for children, and to address the scarcity of dental workers in remote areas. More basic course work is required

for admission than for the community dental therapist, and the person must hold a Community Dental Therapists certificate. The stated objective of the Dentex Diploma program is to "train a category of dental auxiliary personnel highly competent in the delivery of all primary oral health care services for children, and also capable of carrying out simple emergency services for oro-facial trauma, while providing basic prosthetic care for person in need of such care, mainly in the hinterland areas."

The Dentex Diploma curriculum is three years in length (seven semesters), with 3,055 hours of training.

SURINAME

Suriname (formerly Dutch Guiana) is the smallest independent country in South America, bordering the Atlantic Ocean, French Guiana, Guyana and Brazil. Formerly a colony of the British and then the Dutch, and previously known as Dutch Guiana, Suriname achieved independence as a constitutional democracy in 1975. After a period of much political and economic turbulence, including a military coup and dictatorship from 1980 to 1987, a new constitution was adopted and a democratic government reestablished, followed again briefly by a military dictatorship and then an elected administration in 1991. Suriname is a member of the Caribbean Community and the Association of Caribbean States, as well as many other international organizations. Dutch is the official language, with English widely spoken.

The population of approximately 493,000 is remarkably mixed: Hindustani (also known locally as "East Indians"), 37 percent; Creole (mixed white and black), 31 percent; Javanese, 15 percent; "Maroons" (descendants of African slaves), 10 percent; Amerindian, 2 percent; Chinese 2 percent; white, 1 percent; other, 2 percent. Its religions are: Hindu, 27 percent; Protestant (predominantly Moravian), 25 percent; Roman Catholic, 23 percent; Muslim, 20 percent; and indigenous beliefs, 5 percent. Suriname's natural resources include bauxite, for producing aluminum; gold; and oil, which make up its major exports. Other exports include timber, rice and bananas. Major imports are manufactured goods, including processed foods and machinery. The Netherlands has been Suriname's biggest donor of development assistance grants since independence, but has been surpassed by the United States as a trade partner.

Most Surinamers live in the narrow, northern coastal plain. Each ethnic group preserves its own culture, and many institutions, including political parties, follow ethnic lines. Informal relationships vary: The upper classes of all ethnic backgrounds mix freely, while social relations of others tend toward ethnic groupings.

According to Guile and colleagues (**1981**), in 1974 the Ministry of Health decided that training an auxiliary workforce was necessary in order to meet the health care requirements of the country. From this plan, the idea of training specialized personnel to provide dental care for children emerged. The authors reported that "the experience of New Zealand, Australia, England, Jamaica, Tanzania and others provided sufficient evidence that a program for dental nurses was feasible and desirable. It was demonstrated by these programs that the expense of training a dentist could be avoided while attaining basic manpower requirements."

Construction of a school for dental nurses was constructed with funds from a Netherlands development aid fund and was begun in 1975. The course of study began on March 1, 1976, with 12 students enrolled. The objective of the Youth Dental Provider (*Jeugdtandverzorgster*) or dental nurse was to train an individual who, with three years of training, could provide basic dental care to preschool and schoolchildren to age 18.

The curriculum was identified as linking theory and practice. In the practical courses the following skills were taught in direct patient care: 1) perform oral examination and chart present status; 2) obtain medical and dental history; 3) prepare treatment plan; 4) teach patient preventive care and plaque control; 5) perform plaque control procedures; 6) take impressions for study models; 7) perform prophylaxis and pumice polish; 8) perform fluoride treatment; 9) expose, process and interpret radiographs; 10) give infiltration and block anesthesia; 11) apply rubber dam; 12) make basic cavity preparation; 13) place matrix band; 14) place base; 15) place amalgam alloy; 16) condense, care, and check occlusion of restoration; 17) place composite resin; 18) finish restoration; 19) polish amalgam alloy; 20) extract primary teeth; 21) place and remove temporary restorations; 22) extract permanent teeth; 23) diagnose and treat emergencies.

The third year of the program was added to make the length of training equivalent to that of a registered nurse. The authors indicated that there were a total of 2,327 hours in the first two years of the training program, with an additional 1,170 hours in the third internship year. Because of the relationship with the Free University in Amsterdam, many of the courses were said to be patterned from the Dutch system. A characteristic of the program was the extensive exposure to general medicine and pediatrics, based on the thinking that the dental nurse must know the child medically before performing dental care.

An objective in deploying dental nurses was to have one dental nurse and one dental assistant to provide regular services to 1,000 schoolchildren. At the time the article was being written and published, three school-based clinics were operational and 15 more were being constructed. Three government dentists were providing indirect supervision of the dental nurses.

In a discussion section, the authors indicate that the Suriname program is of three years' duration versus the typical two years; that dental nurses can give block anesthesia; and that they are able to extract permanent teeth.

The Suriname Dental Association accepted dental nursing, as its members were aware of the enormous backlog of unmet needs among schoolchildren.

The Youth Dental Foundation (*JTV*, *Stichting Jeugdtandverzorging*) continues to care for children up to age 18. *JTV* has 40 dental units in 26 clinics. Annually, about 40,000 children and 5,000 adults are treated at 30 locations throughout the country and 15 units at a treatment center in Paramaribo. Since the establishment of the training program, 140 dental nurses have completed the curriculum. In 2008, the foundation provided 137,433 treatments to patients.

There are currently 48 dentists in Suriname, with a dentist-to-population ratio of 1:12,000. Dental nurses in practice total 76, with a dental nurse-to-population ratio in the coastal region of 1:55,000.

Section 17

SUMMARY AND CONCLUSIONS

HISTORY AND DISTRIBUTION OF DENTAL THERAPISTS

As is well known, the concept of using dental therapists in the oral health workforce began in New Zealand in 1921, with the establishment of a two-year training program for dental nurses to staff a national School Dental Service. This research indicates that dental therapists are currently members of the oral health workforce in 54 countries and territories around the world. This report contains and reviews documents of 26 of them: Anguilla, Australia, Bahamas, Botswana, Brunei, Canada, Fiji, Guyana, Hong Kong, Jamaica, Malaysia, Netherlands, New Zealand, Papua New Guinea, Samoa, Seychelles, Singapore, South Africa, Sri Lanka, Suriname, Tanzania, Thailand, Trinidad and Tobago, United Kingdom, United States and Zimbabwe.

No documents could be located or identified for the remaining 28 countries and territories. However, there is reliable evidence—verbal reports from knowledgeable persons—that dental therapists practice in 16 of these countries. They are: Barbados, Cook Islands, American Samoa, Federated States of Micronesia, Grenada, Kiribati, Marshall Islands, Nepal, Palau-Belau, Solomon Islands, Tokelau, Tonga, Vanuatu, Vietnam and the Northern Mariana Islands. There is suggestive evidence that dental therapists practice in the other 12 countries: Belize, Benin, Burkina Faso, Costa Rica, Gabon, Gambia, Laos, Mali, Malawi, Myanmar, Togo and Swaziland.

Early adopters of the concept in the 1950s and ’60s included Malaysia (1948), Sri Lanka (1949), Singapore (1950), Tanzania (1955) and the United Kingdom (1959). In the 1960s and ’70s additional countries added dental therapists to their oral health workforce, including Australia (1966), Thailand (1968), Jamaica (1970), Canada (1972), Fiji (1973), Seychelles (1974), South Africa (1975), Trinidad and Tobago (1975), Suriname (1976) and Hong Kong (1978).

It is interesting to note that as the use of dental therapists spread throughout the world, it seemed to follow a pattern of implementation in countries that, like New Zealand, had previous association with the British Empire and subsequently joined the Commonwealth of Nations. Of the 54 countries employing dental therapists, 33 are members of the Commonwealth of Nations.

In 2002, the Netherlands expanded the training of dental hygienists to include skills traditionally associated with the New Zealand dental therapist. In 2005, the

United States introduced dental therapists to care for Alaska Natives in remote tribal villages. In 2009, the state of Minnesota authorized the training of dental therapists to provide dental care for underserved segments of its population.

Dental therapists are present in both developed and developing countries. Five of the top six countries of the world on the Human Development Index use dental therapists in their oral health workforce: Australia (2), Netherlands (3), United States (4), New Zealand (5) and Canada (6). The country holding the top position in the index is Norway, which does not have dental therapists. Other countries employing dental therapists in the top 50 countries of the index are Hong Kong (13), Singapore (26), United Kingdom (28), Brunei (33) and Barbados (47).

TRAINING/EDUCATION OF DENTAL THERAPISTS

New Zealand pioneered the development of dental therapists, with the first class of 29 school dental nurses graduating from a two-year post-high school vocational training program in Wellington in 1923. They were trained to provide dental care for elementary schoolchildren, and were deployed to serve in a public School Dental Service.

Vocational training in a two-year curriculum has been the traditional approach for training dental therapists with the awarding of a certificate or diploma on completion. In a few countries, the training of dental therapists has expanded to curricula of three or four years in length.

Gaining knowledge of the basic biomedical sciences supporting dental practice, and the acquisition of perceptual motor skills, tend to be the focus of the initial period of a curriculum, with intense clinical training subsequently taking place. A strong emphasis on community oral health promotion and disease prevention is common.

New Zealand, Australia, and the United Kingdom have integrated the training of dental therapists and dental hygienists in a three-year (27 months) program. The Netherlands has expanded their training of dental hygienists to include the skills traditionally associated with dental therapists; the curriculum is four years in length. Singapore also provides opportunity for integrated training of dental therapists and dental hygienists. Continuing education modules are available in some countries, enabling dental therapists to add skills to their scope of practice.

United States

After two cohorts of Alaskans (11 students) trained to become dental therapists at the Faculty of Dentistry at the University of Otago in New Zealand, training was moved to Alaska. The Alaska dental therapists are officially known by U.S. Public Health Service specifications as Dental Health Aide Therapists (DHATs). Students studying to become dental therapists are now receiving the first year of their two years of formal training in Alaska at the University of Washington's DENTEX Training Center in Anchorage. The second year is at the Yuut Elitnaurviat Dental Training Clinic in the rural community of Bethel. After approximately 3,000 hours of training, dental therapists must complete 400 hours in a directly supervised preceptorship. The post-secondary vocational training program is operated by the Alaska Native Tribal Health Consortium (**Williard, Fauteux, 2011**).

Two university-based programs exist to educate dental therapists in Minnesota. The program at the Metropolitan State University in St. Paul, MN, is a graduate degree program (master's degree) of two years' duration to train a dental hygienist as a dental therapist. Requirements for admission include a baccalaureate degree in dental hygiene. The education program will permit an individual to practice as an Advanced Dental Therapist. The program at the School of Dentistry at the University of Minnesota is currently a baccalaureate degree program open to high school graduates and those with college credits. Completing the four-year curriculum permits practice as a dental therapist, though not as an Advanced Dental Therapist. Provision also exists for a master's degree in the university's plans, which would enable a graduate to practice as an Advanced Dental Therapist (**Glasrud et al., 2009**).

New Zealand

The first cohort of 29 dental therapists graduated in 1923. Considerable changes have taken place over the 90-year history of the New Zealand dental therapist (**Brooking, 1980; Saunders, 1964**).

Until 1999, dental therapists received two years of post-high school vocational training. As a result of numerous political and economic factors, dental therapists now train in a university- based three-year curriculum that leads to an Oral Health degree, which enables them to register with the Dental Council of New Zealand as both a dental therapist and a dental hygienist (**Satur, Moffat, in Tsang, 2010**). The two universities offering the program are the University of Otago and the Auckland University of Technology.

Australia

Tasmania and South Australia established the first schools to train dental therapists for their state's dental programs in 1966 and 1967, respectively; nine schools were established in Australia by 1973. Qualification for practice as a dental therapist at that time consisted of a 1,500-to-2,100 hour tertiary course of vocational training over two years, with prerequisite university level entrance requirements including studies in English and biology (**Satur, Moffat, in Tang, 2010**).

In 1996, the Diploma in Oral Health Therapy in either dental therapy or dental hygiene was established at the University of Melbourne. Graduates could add the other auxiliary skills by undertaking a one-year fee-paying program with lateral entry into the second year of the Diploma program and graduate with two Diplomas in Oral Health Therapy, thus allowing practice as both a dental therapist and a dental hygienist (**Department of Health and Community Services, 1995**). By the early 2000s, the majority of the dental therapist training programs were transitioned into the university, many in existing dental schools, with the additional dental hygiene content to establish oral health therapy graduates.

Today, qualification for practice as an oral health therapist requires a bachelor's degree-level course of education and training over three years, with applicants for the courses requiring university-level entrance and prerequisite studies in English and biology (**Australian Dental Council, 2011**).

United Kingdom

The first training program for dental therapists opened at New Cross in London in 1959. Today, 21 organizations train dental therapists in the United Kingdom. The course of study is at least 27 months, and the scope of practice includes the duties permitted of a dental hygienist as well as that of a dental therapist (**GDC, 2004, 2009**).

Canada

In 1972, Canada opened two separate schools for dental therapists. One was located in Fort Smith, Northwest Territories, to train dental therapists to provide care for Canadian aboriginal children (**Davey, 1974**). The second school, located in Regina, Saskatchewan, was part of a provincial program to provide school-based care to all of the province's children (**Keenan, 1975**). Both schools focused on vocational training over a two-year period of study in a standardized curriculum.

Netherlands

Since 2002, dental hygienists' (including dental therapist competencies) education in the Netherlands has been extended to four academic years and now culminates in a bachelor's degree in Oral Health Therapy (**Heuvel et al., 2005**). After completing the four-year program, students have the opportunity to further advance toward a master's degree.

Hong Kong

The training of dental therapists began in 1978 and the training program has remained a three- year certificate curriculum (**Wong, 1981**).

Singapore

The Ministry of Health established the Dental Nurses Training School in 1962, which conducted the three-year certificate program to train dental nurses for the School Dental Service. In 2004, the Diploma in Dental Therapy curriculum was modified to form an integrated dental therapist/hygienist diploma program, and renamed the diploma in dental hygiene and therapy. This change allowed dental therapists to practice both on children and adults as well as work in a greater variety of settings including private clinical practice, research sales or marketing sections of dental industries (**Singapore Ministry of Health, 2007**).

Malaysia

Dental nurses (dental therapists) were introduced into Malaysian dentistry in 1949 in order to overcome the acute shortage of qualified dentists. The first class consisted of five students and was one year in length. In 1952, the training program was increased to a two-year curriculum plus a period of training in community clinics of one year and four months. In 1972, duration of training was altered to a two-year curriculum, with one year of mentored practice in a community clinic. In 1987, the training period was again adjusted, with two years spent in the school's curriculum, followed by eight months of practice in a community clinic. In 1996, the Dental Nurse Certificate was upgraded to a Diploma in Dental Nursing (**Malaysia Ministry of Health, 1999**).

Thailand

The first school for dental nurses was established in 1968. Female dental nurses were trained in a two-year curriculum that followed graduation from high school (**Laddawan, 1967**). During the past 40 years, the dental nurse training curriculum has undergone four major revisions. The first was in 1986 when there was a demand for the development of a career ladder to allow dental nurses to obtain a bachelor's degree in public health (**Chonburi Institute of Public Health, 1986**). The second revision occurred in 1994, when there was a major movement to expand the functions of health centers and to provide primary dental care at health centers. The curriculum had to be revised to include public health courses that enabled the dental nurses to work in an integrated manner with other health workers at the health centers (**Thailand Ministry of Health, 1994**). The third revision was in 2002, when a national health policy was developed to include universal health care; the curriculum consisted of 79 credits over two years (**Thai Ministry of Public Health, 2002**). The last curriculum revision was in 2010, which upgraded the dental nurse curriculum to a four-year bachelor's degree with emphasis on prevention and health promotion (**Thai Ministry of Public Health, 2010**).

South Africa

Dental therapists have been trained since 1975 in a three-year bachelor of science degree program, allowing treatment of both children and adults (**ADHA, 2009**).

Tanzania

Training of dental therapists has taken place in Tanzania since 1955 with a curriculum of three years duration. At the end of the three-year basic course, and generally with three to five years' experience, dental therapists may seek admission to the School for Assistant Dental Officers. The additional two years of training increases the dental therapist's profile of practice and practice skills. On completion, dental therapists qualify as assistant dental officers. An assistant dental officer can perform restorative care for all carious lesions; extractions, including impactions; initial periodontal therapy; and fabrication of partial dentures (**Poulsen et al., 1999**).

Trinidad and Tobago

The first school of dental therapy opened in 1976 and consisted of a two-year curriculum with the awarding of a certificate in dental nursing upon completion (**Trinidad and Tobago Ministry of Health, 1977**).

Jamaica

Dental therapists began training in Jamaica in 1970. The program was of two years' duration. Currently, the four-year dental therapy training program is university-based and graduates receive a bachelor of science degree in dental nursing/therapy (**Spohn, 1996**).

Fiji

The first group of Fiji dental therapists graduated in 1973 with a three-year diploma in dental therapy. An innovative curriculum was designed for the Fiji School of Medicine to enable dental personnel to proceed through a sequence of educational modules on a career-ladder path from a dental assistant through other auxiliary grades to a dentist with a bachelor of dental science degree. The modular structure permits exit and re-entry at each level, with members of the oral health team able to progress from one level to another with full credit for their previous experience. Exit points in the modular curriculum are dental hygienist at two years; dental therapist at three years; and dentist at five years (**Tuisuva, Smyth, Davies, 1995**).

Sri Lanka

Training of school dental nurses began in what was then known as Ceylon in 1955. The New Zealand two-year curriculum was adopted by Ceylon (**Sri Lanka Dental Therapists Training School, 1986**).

Seychelles

In 1987, local training of dental therapists began at the School of Health Studies in Seychelles, with the curriculum combining both dental therapist and hygienist training. The course of study is three years (**Ernesta et al., 2004**).

Guyana

Three levels of training exist for the dental therapist/dentist extender: community dental therapist program; dental extender certificate program; and dental extender diploma program. The two dental extender programs are designated "Dentex" training programs (**Guyana Ministry of Health, undated**).

Admission to training as a Community Dental Therapist requires that the individual holds a dental assistant certificate; is a mature student, 26 years of age or older; and has a minimum of two years of experience in a related field. The program is 18 months in duration, with a six-month internship.

Admission to the Dentex Certificate Program first requires completion of a Community Dental Therapists certificate. The Dentex diploma curriculum is three years in length and is 3,055 clock hours. Its objective is to provide a dental auxiliary who is competent in all primary oral health services for children, and to address the scarcity of dental workers in remote areas.

Suriname

The school of dental therapy opened in 1976 with the intent of producing an individual who could provide basic dental care to preschool and school-aged children with three years of training (**Guile et al., 1981**).

LEGISLATION, REGISTRATION AND LICENSURE

Literature on legislation, registration and licensure of dental therapists is sparse for most countries. Since most countries limit dental therapists to governmental service, they are not necessarily licensed or registered. Their scope of practice regulates their provision of care, with responsibility for supervision and review designated to their respective ministries of health.

Legislation and registration/licensure vary from country to country. National, state or provincial legislation authorizes the practice of dental therapists. Regulation is generally by dental councils (dental boards). In the many countries where dental therapists are public employees in school dental services, they are certified and regulated directly by the government's ministry of health, or their employing service. In a few countries where more autonomy for practice is granted, dental therapists are licensed as professional practitioners, just as dentists are.

United States

In 1949, "an emergency law, necessary for the immediate preservation of the public health and convenience," was adopted by the Massachusetts legislature. It directed the Department of Public Health to institute a five-year program at the Forsyth for training feminine personnel who were hygienists to receive two years of training, after which they would be permitted to prepare and fill cavities in children's teeth under the supervision of a dentist in a dispensary or clinic approved by the Commissioner of Health (**Massachusetts Law, 1949).** Under pressure of the dental associations, the law was rescinded a year later (**New York State Dental Association, 1950**).

In 1970, an experiment to train dental hygienists in restorative skills was initiated at the Forsyth Dental Center under the leadership of John W. Hein and Ralph R. Lobene. No problems arose for the experiment between 1970 and 1973. However, in 1973 the Massachusetts Board of Dental Examiners ruled that the drilling of teeth by hygienists was a violation of the Dental Practice Act. The ruling was supported by the Massachusetts attorney general and Forsyth was forced to close its experiment in June of 1974. However, by this time it had been demonstrated that hygienists could be taught to provide restorative dental services, effectively, efficiently and in a cost effective manner.

Dental therapists were recognized for purposes of demonstration projects in earlier versions of the Indian Health Care Act, first passed by the U.S. Congress in 1976, and the Health Reform Act of 2010. In 2005, the Alaska Native Tribal Health Consortium (ANTHC), with the approval of the Indian Health Service and financial support of charitable organizations, employed the first six Dental Health Aide Therapists (DHATs) trained in New Zealand (**Nash, Nagle, 2005; Williard, Fauteux, 2011**). The American Dental Association and the Alaska Dental Society sued ANTHC, which is the employer of the DHATs, and the individual DHATs themselves on the basis that they were engaged in the illegal practice of dentistry, as defined by the state's licensing board. The dental associations dropped the suit when Alaska's attorney general ruled that the DHATs practicing under federal legislation and were not subject to state law. Accordingly, the Alaska DHAT program was sustained (**Smith, 2007**).

The DHATs receive certification after a six-month preceptorship under the supervision of dentists. The supervising dentist(s) establishes their scope of practice by listing in "standing orders" those services they may perform under general supervision. Other services in their scope of practice may only be performed under direct or indirect supervision. Recertification is required periodically (**Williard, Fauteux, 2011**).

In 2009, the Minnesota Dental Practice Act authorized creation of two categories of dental therapists: a dental therapist (DT) and an advanced dental therapist (ADT) (**State of Minnesota Revised Statutes, 2009**). The statute provides that a DT may only work with a dentist on-site, while an ADT may work with the general supervision of a dentist. The scope of practice differs only in that an ADT may extract mobile permanent teeth and prescribe limited medications. As the DT and ADT legislation was passed to address problems of access to care, these two new members of the dental team are required to practice in defined settings, specifically those serving low-income and underserved populations. The first seven dental therapists graduated in 2011. Licensure is required with the Minnesota Board of Dentistry.

The Pew Center on the States issued a brief describing "The Minnesota Story: How Advocates Secured the First State Law of Its Kind Expanding Children's Access to Dental Care" (**Pew, 2010a**).

New Zealand

Prior to 2004, dental therapists in New Zealand could only practice in public health services, such as the School Dental Service, hospital dental departments and later, for Maori health providers. Dental therapists are now licensed and regulated professionals under the jurisdiction of the Dental Council of New Zealand, which is also responsible for regulating dentistry, dental hygiene and dental technology.

New Zealand passed the Health Practitioners Competence Assurance Act in September of 2003 (**NZMH, 2003**). Subsequently, the Dental Council of New Zealand issued a Notice of Scopes of Practice and Prescribed Qualifications pursuant to the Act (**DCNZ, 2005**). The council detailed the Scope of Dental Therapy Practice and prescribed qualifications for registration. The council issued Competency Standard and Performance Measures for Dental Therapists (**2003**).

Australia

As early as 1964, the Australian state of New South Wales (NSW) passed legislation amending its Dentists Act to allow for dental therapist practice, but could not generate sufficient support for funding to establish a training program (**Franki, 1997**). Tasmania and South Australia established legislation in 1965 and 1972, respectively, followed by the other states and territories between 1967 and 1972 (**Satur, 2002**).

Each state and territory developed its own regulatory framework and legislation for practice, although all were based on the New Zealand School Dental Nurse model. In some states (Tasmania, South Australia, New South Wales, Queensland), dental therapists were exempted from the Dentists Acts. In Victoria and Western Australia, they were licensed by the Dental Acts to practice, with subordinate legislation or regulation defining the scope of practice and the requirement for control, direction or supervision by a dentist. Legislation at that time limited the employment of dental therapists to government-run public dental services, specifically School Dental Programs, with the exception of Western Australia, which permitted dental therapists to work in private practices. Legislation also limited their patient groups to schoolchildren (**Satur, 2002**).

Without exception, all states and territories have regulated dental therapists under the same legislation as dentists.

Between 1998 and 2001, in most states and territories, the regulation of dental therapists was brought into line with that of dentists; they were registered as health practitioners, and employment limits were removed (**Satur, 2002**).

In 2010, the National Practitioners Registration Act provided for generic practice standards applicable to all dental practitioners, administered by a single national Dental Board (**Dental Board of Australia, 2010**).

United Kingdom

The General Dental Council is the regulatory body for dentistry in the United Kingdom. Dental therapists were introduced in the early 1960s, with employment restricted to the School Dental Service. The General Dental Council has responsibility for registering dental therapists. In 1993, it appointed a Dental Auxiliaries Review Group (DARG), which recommended a number of changes, including that dental therapists should be able to work in all sectors of dentistry. Its recommendations were finally enacted by the council in 2002 (**General Dental Council, 1998, Hartridge, 2010**).

The government set out its new policy for dentistry as "NHS Dentistry: Delivering Change." The policy highlights the role of hygienists and dental therapists allowing dentists to work differently and freeing up their time so that the skills of the whole dental team are used more appropriately (**Department of Health, 2004**).

Since 2008, all Dental Care Professionals—as dental personnel other than dentists are now termed, including dental therapists—are required to undertake statutory continuing professional development courses (**General Dental Council, 2011a**).

Canada

Dental therapists currently practice in Canada. In Saskatchewan, dental therapists are regulated and all dental therapists are required to be registered and licensed with the Saskatchewan Dental Therapists Association. In Manitoba, dental therapists who completed their training at Saskatchewan's Wascana Institute dental therapy program may work in private practice under direct supervision of a dentist, as long as they are registered with the Manitoba Dental Association. In all other Canadian provinces, dental therapists are directly employed by the federal government to provide dental care for aboriginal people living on First Nations reserves. The provinces of Quebec and Ontario currently do not employ dental therapists. Dental therapists working for the territorial governments of the Yukon, Northwest Territories and Nunavut must be registered and licensed by the local regulatory authority.

Other Nations

The **Netherlands** government is responsible for the legal basis of dental hygienists/dental therapists based on the level of their competencies. They are licensed after graduation and regulated by the health department. The government is responsible for the intake of dental hygiene schools. According to Dutch law, "new-style" dental hygienists can practice independently without a dentist's supervision. A "formal mandate" from a dentist is required only for "restricted treatment modalities," such as preparing teeth for restorations, local anesthesia and radiographs, all of which are components of dental hygienists' competencies (**Jerkovic, van Offenbeek, Slot, van der Chaus, 2010; Nederlandse Vereniging van Mondhygiënisten, 2011**).

The **Hong Kong** government trains and employs dental therapists. Most of them practice under the supervision of dentists in the School Dental Care Service clinics (**Hong Kong Government, 1974; HKDH, 2011a**). They are not permitted to work in the private sector.

The **Singapore** Dental Council registers dental therapists and the dental hygienists/dental therapists. Dental therapists also register with the School Dental Service for employment. Annual audits are conducted of their clinical quality standards and they are required to attend continuing professional education. "With the Amendments to the Dentists Act, [combined dental hygienists/dental therapists] will now be able to also work in the private sector under the direction of dentists." They can also work in community outreach programs (**SMH, 2007**).

In **Malaysia**, dental nurses, as dental therapists are termed, are mainly employed by the School Dental Service providing treatment to schoolchildren under 18. They are not permitted to work in the private sector. Upon completion of their training, they register with the Ministry of Health's School Dental Service for employment, where they work under the general supervision of dentists (**MMH, 2004)**.

Thailand requires dental therapists to practice under the supervision of dentists at the country's public hospitals or health centers. There is no licensure for dental nurses; they cannot practice in a private clinic or hospital. Registration of dental nurses is officially with the Ministry of Public Health, and informally with the Thai Dental Nurse Association. Currently, dental nurses practice under the 1996 Regulations of the Ministry of Public Health (**TMPH, 1996**).

The **South Africa** Health Professions Council created a separate board for registration and licensure of dental therapists and oral hygienists (**Hugo, 2005; South Africa Health Professions Council, 2011**).

Trinidad and Tobago authorized the practice of a dental nurse/dental therapist in the Dental Act of 1980, specifying that "1) a dental nurse is qualified to treat children only, and such treatment shall be carried out in facilities or services operated by government or under the direct or indirect supervision of a dentist in private clinics; 2) a dental nurse who contravenes the provision of this section is liable on summary conviction to the removal of his name from the roll." (**Trinidad and Tobago Dental Profession Act of 1980, 1980**).

In **Jamaica**, the dental nurse/dental therapist comes under the purview of the Dental Practice Act, which permits them to provide specific dental services. They are allowed to practice in the Government Dental Services Program under the general supervision of a dentist, working only in government clinics, and caring for children and adolescents (**McKenzie, 2007**).

The **Sri Lanka** Ministry of Health specifies the scope of practice of dental therapists and the circumstances in which they may practice. Practice is limited to primary care for preschool and schoolchildren aged 3 to 13 (**Sri Lanka Ministry of Health, 1986**).

In **Fiji**, dental therapists are not registered workers and are employed only by the government through the Ministry of Health.

The government of **Guyana** provides for a "dentist extender" to register with the Dental Council who is: 1) a citizen of Guyana, spouse of a citizen of Guyana, or a resident of Guyana qualified to be so registered; 2) able to communicate satisfactorily in English; 3) a fit and proper person to perform the services of a dentist extender (**Guyana Dental Registration Act, Undated**).

Dental therapists in **Papua New Guinea** are regulated by the Department of Health and based either at a health center or a provincial hospital (**PNG Department of Health, 1986**).

PRACTICE SETTINGS AND SCOPES OF PRACTICE

Historically, dental therapists have been deployed in public schools to provide dental care for children, following the pattern established by the New Zealand School Dental Service in 1921. By far, the majority of dental therapists are women, although men are beginning to enter the field. As the use of dental nurses/dental therapists spread, some countries moved from school-based to community-based clinics, but with the focus remaining on caring for schoolchildren. Although some countries are expanding the role of dental therapists to include limited adult care, this study documents that children's dental care continues to be the most common assignment of dental therapists in the global oral health workforce.

More than 50 countries and territories worldwide use dental therapists, many—if not most—in school-based programs. Following is a list of the countries included in this review in which dental therapists are public employees serving children in a school dental service: New Zealand; Australia**;** Hong Kong**;** Singapore**;** Malaysia**;** Jamaica**;** Trinidad and Tobago**;** Bahamas; Anguilla**;** Papua New Guinea**;** Sri Lanka**;** Seychelles**;** Brunei Darussalam**;** Guyana; Samoa**;** and Suriname**.**

In each of these countries, the dental therapist's scope of practice for treating children is essentially the same. It includes basic procedures for providing primary care: examination; oral health education; prophylaxis; preventive procedures including topical fluoride application and fissure sealants; local anesthesia; restorative treatment (fillings); extraction of primary teeth. To the extent there is variation among countries, it is relative to issues of: infiltration anesthesia only or block anesthesia also; extracting only primary teeth or also permanent teeth; use of stainless steel crowns; and the ability to perform pulpotomies.

Understanding the scopes of practice and practice settings of dental therapists in New Zealand and Australia is somewhat more complex, due to the recent movement to an integration of the training of dental therapists and dental hygienists, with the new designation of "oral health therapist" (**Tsang, 2010**).

New Zealand has been the leader in using dental therapists to provide school-based dental care for schoolchildren and preschoolers. However, due to the decline in dental caries, fewer schools need full-time dental therapists and the trend is toward centrally located community- based health care "hub" centers. In 2000, a forum titled "Improving the Oral Health of All New Zealanders" was

organized by the Dental Council of New Zealand and the New Zealand Dental Association (**NZDJ, 2000**). Among the several recommendations were that there was an urgent need to address training, employment and operational issues of the dental therapist workforce; and that legislative changes were necessary to provide more flexibility in the employment of oral health care providers. At the forum, Robin Whyman (**2000**) of the New Zealand Dental Association stated that "pre- and primary school dental services need to be redeveloped, with less emphasis on a school base for much of the dental care. Mobile clinics could provide examination and simple, medium-volume dental care. A redeveloped system should incorporate dentists working alongside dental therapists, and the development of larger, community-based clinics …"

A School Service Facilities Discussion Document was developed for the Ministry of Health (**NZMH, 2003**). Among the recommendations was that District Health Boards identify which school clinics should be retained and make decisions about other settings where services might be provided, such as mobile clinics or central bases. The "National School Dental Service Review: Final Report" was published by the Dental Health Boards in 2004 (**NZMH, 2004**). It advanced a variety of service delivery models that were configured to best meet the needs of the local community. These include co-location of school dental clinics with Primary Health Organizations, thus further reinforcing the vision of the Primary Health Care Strategy of the Ministry of Health. A movement toward community-based clinics could be supported by an outreach model ("hub and spokes") rather than fixed school clinics.

The Health Practitioners Competence Assurance Act (**NZMH, 2003**), implemented in 2004, provided for an increase in the scope of practice for dental therapists, enabling dental therapists to treat children and adolescents up to age 18, as well as to work in private practices with a consultative relationship with a dentist. The act also specified that dental therapists be considered "independent clinicians." The Dental Council, in its "Scopes of Dental Therapy Practice" (**DCNZ, 2003**), stated specific additional qualifications for performing pulpotomies, taking and interpreting periapical and bitewing radiographs, preparing and placing stainless steel crowns on primary teeth, and adult care in dental therapy practice.

Since 2006 at the Auckland University of Technology, and 2007 at the University of Otago, all dental therapy students are enrolled in bachelor's degree programs that lead to qualifications as dental therapists and dental hygienists. These dually trained individuals will be able to work in the School Dental Service, hospital dental departments, universities, and private general and orthodontic practices. When treating individuals up to age 18, they will be working primarily as dental therapists. They will be able to work independently, but must maintain a consultative relationship with a dentist. When providing care for adults, they will

be working primarily as dental hygienists under the clinical guidance of a dentist. Dental hygiene is the only scope of practice approved for oral health graduates treating adults, absent dental therapists' adult competency certification.

Australia has undergone a change in the education and practice of dental therapists similar to New Zealand. Up until 2000, dental therapists in most states in Australia were limited to public sector employment with the School Dental Service, providing care for children and adolescents, 0 to 18 years of age, in collaborative and referral relationships with dentists. Their scope of practice includes: examination, diagnosis and treatment planning; radiology, oral health education; preventive services such as prophylaxis, fluoride therapy, fissure sealants and dietary counseling; preparation of cavities in primary and permanent teeth and restoration with amalgam and composite; and pulpotomies and extraction of primary teeth.

Scope of practice differs slightly from state to state. In some jurisdictions, dental therapists are also able to place stainless steel crowns, perform pulpotomies on permanent teeth, restore incisal edge fractures, fabricate mouth guards and extract permanent teeth. Since 1971, dental therapists in Western Australia have been permitted to work in private settings, providing care for all ages under prescription of a dentist (**Tsang, 2010**).

Recommendations had existed for a number of years relative to integrating the roles and scopes of practice of dental therapists and dental hygienists. These were based on recognizing that there were significant overlaps in education and skill areas for dental therapists and dental hygienists; that economies in education and improved team dentistry approaches could be achieved by integrating education; and that it would enable flexibility in the use of their skills for populations with significant dental needs (**Barmes, 1983; Wright, 1993; DHCS, 1995; Wright, 1995**). Australia now has three-year bachelor's degree programs that graduate oral health therapists who combine the scopes of practice of the traditional dental therapist and dental hygienist. As in New Zealand, oral health therapists tend to work in the public sector when utilizing their dental therapist skills, and in the private sector in the traditional role of a dental hygienist. A 2005 study indicated that 79 percent of the dental therapists in Australia worked in the School Dental Service, and 21 percent in private practices (**Satur** et al.). Among 48 oral health therapists surveyed between 2005 and 2008, 48 percent were working in the private sector, 21 percent in the public sector and 27 percent in both sectors (**Setiawan et al., 2009**). Currently, in all states and territories in Australia, dental therapists may, with additional training, also provide care for adults, although to date there is only one accredited training program available for that purpose (**DBA, 2011**).

In the **United Kingdom**, dental therapists were initially employed in the public sector through the National Health Service. However, from 2002, dental therapists have been permitted to work in general practices and to extend their duties, treating both children and adults. As a result of this expansion, half of dental therapists work in general practices, with 31 percent working in public programs (**Godson et al., 2009**).

Federal dental therapists were first introduced to **Canada** in 1972 with the objective of providing dental care for First Nations and Inuit children living in Canada's northern realms (**Davey, 1974**). Care was provided in community-based clinics. Dental therapists were also introduced to the province of Saskatchewan in 1972 with the objective of providing dental care for all children living in the province (**Saskatchewan Department of Public Health, 1972**). Care was provided by dental therapists working in school-based clinics. Although both Canadian dental therapy programs have closed, dental therapists continue to practice in some provinces of Canada. In Saskatchewan, they are employed in a variety of settings, including private practice, teaching institutions, for tribal councils, and some regional school-based programs. In Manitoba, dental therapists who graduated from the Wascana Institute in Regina, Saskatchewan, before it closed, are able to practice in private dental offices under the direct supervision of a dentist. In all other Canadian provinces, dental therapists are employed by the federal government to provide care primarily for First Nations and Inuit children.

The **Netherlands** is committed to increasing the relative numbers of hygienists so that the "new-style" dental hygienist will provide routine oral care and the dentist can function as an "oral physician" treating more complex cases. The new-style hygienist's training has been extended to a four-year course in "oral health therapy" leading to a bachelor's degree, combining dental hygiene and dental therapy, but retaining the designation as dental hygienists. The dentist's training has been extended from five years to six years (**Heuvel et al., 2005**; **Widström, Eaton, Luciak-Donsberger, 2010**).

In **Thailand**, the deployment of dental nurses, as dental therapists there are still called, was initially in primary school clinics (**Laddawan, 1967**); however, over time there was a strong demand to locate dental nurses in health centers throughout the country, rather than place them only in schools (**Thailand Ministry of Public Health (TMPH), 1994**). Dental nurses currently practice in public hospitals and health centers (**TMPH, 2010**). A recent proposal would permit them to work in the private sector with dentists, assuming a role comparable to a dental therapist/dental hygienist. However, the Dental Association of Thailand does not support such a proposal (**Thai Dental Council, 2011**).

Generally, **African countries** have used dental therapists more broadly in the workforce, not focusing on school programs and children, but rather have

positioned them in district hospitals, health centers and remote government clinics, caring for both children and adults. In Tanzania (**Poulsen, 1999**), Botswana (**Fylkesnes, Malthare, 1988**), and Zimbabwe (**Chidzonga et al., 2006**), all dental therapists work in the public sector. Evidence suggests that the focus is on prevention, with therapeutic interventions being largely extractions.

When dental therapists were introduced in South Africa in 1975, they were limited to public service and to treating children. Since 1994 and the change in governments, dental therapists have been permitted to practice in the private sector within a defined scope of practice regulated by the Health Professions Council of South Africa (**Hugo, 2005**). Bhayat and colleagues (**2008**) reported that "the most common reasons for this [private versus public sector] choice are the financial rewards and the freedom to work in urban areas rather than rural and remote areas for which the public sector has the greatest responsibility." Thus the original intent of providing oral health care by dental therapists for rural and underserved populations in public programs has been weakened.

OVERSIGHT, SUPERVISION AND SAFETY OF CARE

The literature consistently emphasizes oversight and supervision of dental therapists by dentists to protect the public. The literature reviewed did not document any issues of safety or harm as a result of care provided by dental therapists.

United States

In opposing the Forsyth Experiment, Asgis (**1950**) asserted in the New York Journal of Dentistry that it would lower the quality of care for children, open a wedge for unqualified persons to practice dentistry, dismember the dental profession and bring about sublevel dentistry. In other words, the proposed Dental Nurse Operator threatened the safety of the public and the profession.

While opposing dental therapists, the American Dental Association reemphasized that "all duties involving intra-oral patient services … shall be performed under direct supervision of the dentist.... Development of new categories of dental auxiliaries is not accepted" (**ADA, 1973**).

Lobene countered, "The advanced skills hygienist working under the direct supervision of a dentist provided services of high quality, equal to those of dentists working under the same conditions of peer-review" (**Lobene, 1979**).

In his report of the New Zealand School Dental Service in the Journal of the

American Dental Association, Friedman explained that "dental therapists do not claim to be dentists, any more than physician assistants, nurse practitioners, and midwives claim to be physicians. Each functions within the parameters of specific training, under the supervision of dentists and physicians respectively" (**Friedman, 1972**).

In authorizing their training, Minnesota mandates that a dental therapist may only work with a dentist on-site, while an advanced dental therapist may work with the general supervision of a dentist (**State of Minnesota Revised Statutes, 2009**).

The American Academy of Pediatric Dentistry "supports the use of mid-level dental providers who perform or assist in the delivery of specified reversible procedures and certain surgical procedures under the general supervision of a dentist, provided such arrangements have been thoroughly evaluated and demonstrated to be safe, effective, and efficient and do not compromise quality of care" (**American Academy of Pediatric Dentistry, 2010**).

Garcia and colleagues asserted that among the workforce models envisioned, "The Dental Therapist Model has the strongest evidence for success, having been evaluated on numerous occasions over the past 5 decades and in multiple countries. It has been shown to be effective in bringing safe, high-quality oral health care to underserved communities, and is likely the most cost-effective model, in part given its limited, post-high school education requirements" (**Garcia, 2010**).

Williard details the direct supervision by dentists of Alaska's dental health aide therapists in their education and training preceptorship and their indirect supervision once they are located in remote villages. "Communications technologies such as telehealth carts and electronic health records can enhance supervision by facilitating the secure transmission of radiographs and patient data, but in actual practice, most remote contact occurs via the telephone. During visits to the remote clinics, supervising dentists can perform audits of paper charts. At corporations with electronic dental records, dentists can perform these audits remotely" (**Williard, Fauteux, 2011**).

New Zealand

One would expect the literature on the New Zealand School Dental Service and its use of dental therapists to have much to say about oversight, supervision and safety. It seems, however, that these features are a given because of the known rigid structure of the service. Dental therapists were previously trained to adhere strictly to the protocols and standing instructions for each individual, based on

their capability. Prior to 2004, supervision was provided by Senior or Principal Dental Officers and dental nurse inspectors (at a ratio of about one dentist to 50 school dental nurses, at least in the 1970s), with the purpose of ensuring that dental therapists did not work beyond their skills (**Leslie, 1971; Friedman, 1972**).

Dunning provided further detail: "The dental nurse program is administered by 14 districts in the country. A typical district is in charge of one principal dental officer, whose duties are chiefly to maintain the proper scope and quality of clinical service. He is assisted by one or two nurse inspectors…. If this seems to be scant supervision, it is adjusted to what experience has shown to be a desirable level. The former director said, 'I would rather have five well-coordinated principal dental officers than 50 dentists teaching their individual ideas….' " This statement implies a degree of military discipline in the division of dental health that is desirable and acceptable (**Dunning, 1972**).

In the 1990s, Roddick, a principal dental officer of the School Dental Service, noted that the expenditures on employing dentists to supervise dental therapists had been reduced. In 1996, the available time for public health dentists to supervise dental therapists averaged 63 minutes per week per dental therapist in two districts and 5.7 minutes per week per dental therapist in three districts. This was time for consultations of medically compromised clients, reading and reporting on radiographs, clinical visits to consult on problems, dental therapists' continuing education, and with service planning and development (**Roddick, 1998**). There was no mention of adverse consequences in the reduction of supervisory time.

Roddick pointed out that the great majority of dental therapists have always worked for state- funded organizations—for example, the School Dental Service, under the direction and supervision of a Principal Dental Officer, being required to follow "standing instructions and protocols." Most worked alone, sometimes in clinics several hours' drive from the District Office and the Principal Dental Officer (**Roddick, 2004**).

Since the implementation of the Health Practitioners Competence Assurance Act of 2003, the Dental Council of New Zealand is the statutory body for maintaining self-regulation of the dental professions. Its primary role is to promote and protect the public interest by ensuring that all oral health practitioners (including dentists and dental specialists) are safe and competent to practice. Although dental therapists practice independently (children and adolescents aged 0 to 18 years), in both public and private clinics, they can seek advice from or refer to the dentist with whom they have a written professional agreement. Dental therapists in New Zealand are also able to treat adults, but only if they are registered in that scope of practice and work under the clinical guidance or direct supervision of a dentist (dependent on which prescribed qualification they have for that scope of practice.)

Australia

In Australia, dental therapists were initially licensed by or practiced under exemption from Dentists Acts, and they worked under regulation requiring the control, direction or supervision of a dentist. At the time of the establishment of dental therapists, there were generally three mechanisms of regulation applied to practice. Licensing by the Dental Boards prescribed the required entry level qualifications; practice regulation defined the areas or scope of practice; and the requirement for supervision or control by a dentist provided a third layer. Dentists (designated as dental officers) were employed directly by the School Dental Services to provide clinical support, referral pathways and oversight of practice.

Roder observed, however, that "The degree of supervision of the school dental nurses, and the checking of each completed patient by a dentist, now appears not only unnecessary and wasteful of dental manpower, but may serve as a dispiriting activity for the nurse ..." (**Roder, 1972**).

Research should be sponsored on the role and impact of dental auxiliaries, in particular the "extent to which each auxiliary might, under supervision and in relation to specific services, compliment or substitute for a dentist" (**National Health and Medical Research Council, 1993**).

In Tasmania, dental therapists were unhappy with the demand for supervision and prescription under the "Adult Trial" amendments, while dentists were unhappy with the concept of dental therapists treating adults (**Australian Dental Association, Tasmania Branch, 1998**).

A study in 1998, carried out by the Victorian Dental Therapist Association, argued that employment limits on their practice should be removed, scope of practice defined by education, and that direction and supervision should be replaced by words that respected their autonomy and skills (**Victoria Dental Therapists Association, 1998**).

The Australian Dental Association argued to retain direction, supervision, and control of auxiliaries by dentists and to retain limits on numbers of operatives to prevent over servicing (**Australian Dental Association, Victoria Branch, 1998**).

Tasmania produced the most liberal regulatory model. It treated dental therapists and hygienists in the same way as dentists. They could practice independently, and own their own practices as long as they established a documented agreement with a dentist to provide consultation and referral when required. They were to practice in a scope that was defined by their educational preparation, competency, and how recently they began practice. There was no defined list of duties or services (**Dental Board of Tasmania, 2001**).

Satur found that the regulation of dental therapists and hygienists was greater than that applied to dentists and other health professions, resulting in less flexible utilization of their skills. Alternative models of regulation would allow wider use of their skills, more effective use of public sector funding, increased access to services, and a greater focus on preventive care (**Satur, 2002**).

In Victoria, the first Codes of Practice promulgated for dental therapists and hygienists replace the words "supervision, direction and control" with the requirement to work in a "consultative and referral relationship with a dentist" that had to be documented (**Dental Practice Board on Victoria, 2002**).

New South Wales, the only state to have retained the limits on dental therapist employment, required that they provide care for children under 18 years of age, and work under practice oversight, which allowed autonomous practice on a day-to-day basis (**Dental Board New South Wales, 2004, 2007**). In Queensland, an external consultant was engaged to inform the process; supervision of practice was retained; however, the interpretive words stated that dental therapists could practice autonomously with a dentist available, but for hygienists, prescription of care was required (**Price Waterhouse Coopers, 2000; Dental Board, Queensland, 2006**). South Australia, in 2007, produced subregulations that required supervision of practice in the private sector and allowed autonomous practice in the public sector (**Dental Board, South Australia, 2007**). The Australian Capital Territory required professional supervision of a dental therapist's practice and a team approach to dental therapists' diagnosing and planning their own care within a consultative and referral relationship with a dentist (**Australian Capital Territory Dental Board, 2008**). Western Australia retained its limits and the distinctions between school dental therapists and those working in private practice (**Parliament of Western Australia**, **2005**). In 2007, NSW removed the limits on employment for dental therapists, finally bringing them into line with the other states and territories and created, for the first time in Australia, a category of registration for Oral Health Therapists (**New South Wales Center for Oral Health Strategy, 2008**). In 2009, Victoria removed the requirement for prescribed care for those ages 18 to 25 and allowed dental therapists to diagnose and prescribe their own care autonomously within a documented consultative and referral relationship with a dentist for people up to the age of 25. The list of skills was removed, with scope of practice to be defined by educational preparation, how recently entered practice, and competence (**Dental Practice Board, Victoria, 2007; Victoria Dental Therapist Association, 2007; Dental Practice Board, Victoria, 2009**).

In July 2010, the national Dental Board of Australia (**2010**) was established to regulate the provision of dental services in Australia. Dentists, specialists, dental therapists, hygienists, and prosthetists were regulated by one board with mixed membership. It defined dental hygienists, dental therapists and oral health therapists as those who "exercise autonomous decision making in

those areas in which they have been formally educated and trained. They may only practice within a structured professional relationship with a dentist. They must not practice as independent practitioners. They may practice in a range of environments that are not limited to direct supervision." Under this legislation dental therapists and dental hygienists are able to own practices in Australia.

United Kingdom

Almost all dental therapists are employed in the National Health Service and serve in the Community Dental Service (formerly the School Dental Service) and hospitals where they practice under the supervision of dentists. However, dental therapists now can work in dental offices in the private sector. All the work of dental therapists has to be carried out under the direction or prescription of a dentist (**GDC. 2007**).

Canada

Federal dental therapists working in First Nations and Inuit communities practice under the indirect supervision of a dentist:

"An important component of the quality control system built into the dental therapy program is periodic evaluation by dentists of the quality of selected procedures performed by the dental therapists. Accordingly, unlike dentists, dental therapists carry out dental procedures aware that the end results are subject to future assessment by a dentist" (**Trueblood, 1993**).

Dental therapists employed during the period of Saskatchewan's province-wide, school-based dental care program for children worked under the indirect supervision of a dentist. Dental therapists currently working in the province of Manitoba practice under the direct supervision of a dentist.

Other Nations

In the **Netherlands,** the dental hygienist/dental therapist is allowed to work independently from a dentist. One-third of dental hygienists own their own practices, with patients having free access to the practices. No supervision by a dentist is required. Only when the dental hygienist needs to execute restricted treatment modalities (cavity preparation, local anesthesia, exposing of radiographs) is an order by a dentist required.

In **Hong Kong's** School Dental Service, dental therapists work in large district-based school dental clinics under the direct supervision of government dentists (**Wong, 1981**). A typical school dental clinic has a senior dental officer as the head and is assisted by two dental officers. There are about 30 dental therapists and a small number of dental surgery assistants working in an open clinic (**Department of Health, 2011a**).

Singapore requires at least one year's experience working with senior dental therapists before dental therapists can work independently in school dental clinics, though still under the indirect supervision of dentists (**Singapore Health Promotion Board, 2010**).

In **Malaysia**, dental nurses/dental therapists are only able to work in the School Dental Service under the general supervision of government dental officers (**Malaysia Ministry of Health, 2004**).

In **South Africa**, dental therapists are permitted to open their own private practices or to work for other dentists. However, they must meet "the requirements of the board and practice for at least one year under the control and supervision of a dentist or another dental therapist approved by the board" (**South Africa Department of Health, 2006b**).

The South Africa Dental Association opposes independent, unsupervised practice by dental therapists. According to the association, there is evidence of dental therapists providing treatment beyond the scope of their competency, such as permanent crowns, bridges and dentures. Dental therapists employed by unprincipled dentists have also directed them to perform services for which they are not qualified (**South Africa Health Professions Council, 2009; South African Dental Association, 2010**).

Trinidad and Tobago specifies that "a dental nurse is qualified to treat children only and such treatment shall be carried out in facilities or services operated by government or under the direct or indirect supervision of a dentist in a private clinic" (**Trinidad and Tobago Dental Profession Act of 1980**).

Jamaica allows dental nurses to work under indirect supervision of a clinical dentist. The dental nurse is technically not able to diagnose or to prescribe medications and works under a treatment plan approved by a supervising dentist (**Spohn, 1996**). There has not been any reported injury or damage as a result of the care provided by the dental nurses/dental therapists, and no dental nurse/dental therapist has ever had the certificate to practice removed or suspended (**McKenzie, 2007**).

QUALITY OF TECHNICAL CARE

In 1950, the American Dental Association sent Dr. Allen O. Gruebbel, Secretary of the Council on Dental Health, to New Zealand to conduct a comprehensive study of the New Zealand school dental nurse and the School Dental Service (**Gruebbel, 1950a**; **1950b**). This action was precipitated by Massachusetts' passing legislation for the Department of Public Health to train dental hygienists, in a two-year program, to prepare and fill cavities in children's teeth under the supervision of a dentist in a clinic approved by the Commissioner of Health (**Massachusetts Law, 1949**). Gruebbel graded the quality of care provided by the school dental nurses based on his "empirical judgment." He found the care "poor" with regard to examination and diagnosis, treatment planning, observation of growth and development, and preventive orthodontics. It was evaluated as "mediocre" with regard to amalgam fillings, extractions and dental health education. He considered child management and oral prophylaxis to be "good."

Also in 1950, John T. Fulton, the dental services advisor to the U.S. Children's Bureau, conducted a study of New Zealand's school dental nurse program through a fellowship from the World Health Organization (**Fulton, 1950**). As did Gruebbel, he acknowledged the hazards of assessing quality due to a lack of standard criteria. Nonetheless, he conducted a blinded assessment of 207 restorations placed by both dental nurses and dentists. He judged 82 percent of the restorations placed by dental nurses to be superior in quality. He concluded that the school dental nurse is capable of placing amalgam fillings of good quality. He made two further comments indirectly related to quality: 1) "Office hygiene is excellent… invariably being clean, neat and orderly"; and 2) "Patient management seems to present no problems. The dental nurses obviously have the respect and confidence of the children."

In 1966, the General Dental Council in the United Kingdom appointed 28 independent dentists to assess the quality of the restorations placed by the New Cross dental auxiliaries (dental therapists). The dentists inspected 13,303 restorations placed for 2,892 patients. Collectively, 91 percent of the restorations were rated as satisfactory (**GDC, 1966**).

James Dunning, public health dentist and dean of the Harvard Dental School, commented on the evaluations conducted by Fulton and Gruebbel regarding the care provided by school dental therapists in New Zealand. He said: "The question of quality of workmanship is an important one to consider … Fulton's opinion of it was generally favorable, Gruebbel's less so … Even if we assume that 28 percent of the fillings received by New Zealand's children are defective as Gruebbel does, and if none of the fillings placed by American dentists are considered defective (an almost impossibly optimistic assumption), the New Zealand children in both Fulton's and Gruebbel's survey still had more good fillings in their mouths than any known comparable group of children of ages 12 to 14" (**Dunning, 1970**).

As a result of the controversy that was being generated in California by a proposed dental therapist demonstration project (**Friedman, Ingle, 1973**), the California Dental Association and the Southern California Dental Association sent a team led by Dr. Dale Redig, then dean of the University of the Pacific School of Dentistry, to study the School Dental Service in New Zealand. Relative to quality of restorative care, the team found 87.3 percent of the 331 copper amalgam restorations and 97.1 percent of the 477 silver amalgam restorations were of satisfactory quality (**Redig et al., 1972**).

In 1970, the Forsyth Dental Center initiated "The Forsyth Experiment" (**Lobene, 1979**). The program was designed to train dental hygienists in basic restorative procedures. While it was forced to close the "experiment" in 1974 due to political pressure, it had demonstrated that hygienists could be trained in a relatively brief period of time to provide quality restorative procedures (**Lobene et al., 1974; Lobene, 1975a; Lobene, 1975b; Lobene, 1979**).

Another expanded functions project involving dental hygienists was implemented at the University of Kentucky between 1974 and 1976 (**Spohn, Chiswell, Davison, 1974**). Thirty-six students who were completing a four-year baccalaureate program in dental hygiene were taught to provide primary care for children, including the administration of local anesthesia, placement of rubber dams, restoration of teeth with amalgams and stainless steel crowns, and pulpal therapy. Toward the conclusion of the curriculum, a double-blind study comparing their restorative skills with those of graduating student dentists found no significant differences between the quality of their work and that of the student dentists (**Spohn, Chiswell, Davison, et al., 1975; Spohn, Chiswell, Davison, 1976**).

A five-year program between 1971 and 1976 at the College of Dentistry at the University of Iowa trained dental hygienists to perform expanded functions in restorative dentistry on both children and adults (**Sisty, 1973**). The results were the same as at Kentucky and Forsyth: Hygienists could be effectively trained, in a relatively brief period of time, to perform at a comparable quality, procedures that traditionally were reserved for dentists (**Sisty, 1976; Sisty, Henderson, Paule, Martin, 1978).** In 1979, the Iowa group published a review of the literature on expanded functions for dental auxiliaries and concluded that "the results of all studies indicate that dental auxiliaries can, with proper training, perform selected reversible and irreversible dental procedures at an acceptable level of quality" (**Sisty, Henderson, Paule, 1979**).

Roder reported on evaluations of restorations completed by school dental nurses and dentists in South Australia (**Roder, 1973, 1976**). Of the 8,734 teeth examined, only 1.8 percent of those restored by dental nurses were defective, compared with 2.6 percent of those placed by dentists.

David Barmes, chief of the Oral Health Unit of the World Health Organization, conducted a review of the South Australian School Dental Service (SDS) in 1983 (**Barmes, 1983**). Relative to quality of care, he concluded: "the quality of care that has been provided by the SDS can only be described as excellent, both clinically and in the social sense. The ability of dental therapists to play a vital role in maintaining that quality … is evident."

Several studies in Australia demonstrated that the retention rates of fissure sealants applied by dental therapists were equivalent to those applied by dentists (**Arrow, Riordan, 1995; Brearley Messer et al., 1997; Manton, 1992**).

A South Australian study conducted in 1996 comparing care provided by the private and public sectors found that children's oral health outcomes were better when they had received their dental care from the School Dental Service, where the majority of care is provided by dental therapists with off-site supervision. There were 1,521 children in three groups in the study who received clinical examinations; those who had dental care through:

- school dental services (SDS), that is, dental therapist-led care;
- private practices, that is, dentist-provided care;
- combination of SDS and private practices.

Analysis of data collected during this study showed that children treated by the SDS had better oral health than those seen by private dentists after controlling for sociodemographic characteristics; and that the social disadvantages of SDS children did not exert a negative effect on their oral health outcomes (**Gaughwin, Brennan, Spencer, Moss, 1996**).

The Saskatchewan government of Canada launched a two-year training program for dental nurses in Regina in 1972 to develop a children's dental health program. In 1976, Dr. E.R. Ambrose, dean and former chair of Operative Dentistry at McGill University;, Dr. A.B. Hord, chairman of Restorative Dentistry at the University of Toronto; and Dr. W.J. Simpson, chairman of Pediatric Dentistry at the University of Alberta; conducted a clinical examination of participants in the Saskatchewan Dental Plan (**Ambrose, Hord, Simpson, 1976**). Their blinded examinations of restorations placed by dental nurses and dentists used a criterion-based evaluation methodology. A total of 2,107 amalgams were assessed by the three examiners. The quality of amalgams placed by dental therapists in deciduous teeth was: 52 percent superior, 45 percent acceptable, with 4 percent unsatisfactory. The quality of amalgams placed in deciduous teeth by dentists was: 16 percent superior, 61 percent satisfactory, with 23 percent unsatisfactory. The same pattern was apparent when amalgams placed in permanent teeth were evaluated, with dental therapists having more fillings rated superior and fewer unsatisfactory than dentists. The

quality of multisurface amalgams placed in permanent teeth by dental therapists was: 47 percent superior, 53 percent satisfactory and 0 percent unsatisfactory. The quality of multisurface amalgams placed in permanent teeth by dentists was: 22 percent superior, 60 percent satisfactory and 19 percent unsatisfactory.

A total of 61 children with 97 stainless steel crowns were evaluated for margin extension, adaption, occlusion and tissue health. There were no significant differences between the quality of stainless steel crowns placed by dental therapists and those placed by dentists. Of the four criteria applied, the two different practitioners appeared to function at the same standard of quality.

Two hundred eighty-nine sets of bitewing radiographs by dental therapists were assessed, and 81 percent were evaluated as being of acceptable diagnostic quality. One hundred eighty-one periapical radiographs were evaluated and 95 percent were deemed of acceptable diagnostic quality.

In the discussion and conclusion section of their report, Ambrose, Hord and Simpson commented: "At the two-year point in the operation of the Saskatchewan Dental Plan, the quality of children's dental services assessed by an independent evaluating team must be considered very acceptable…. Aside from the high standard of the treatment services, there is little doubt that the personnel of the Saskatchewan Dental Plan place a good deal of emphasis on the preventive aspects of dental care.… There is no question that the children's dental program functioning in Saskatchewan is providing much needed dental care to large numbers of children who otherwise would not be receiving it."

Dr. Ralph Crawford and Bradley Holmes were requested by the Canadian government in 1989 to assess and evaluate dental treatment provided by Canadian trained dental therapists, as well as dentists, who were providing care for the aboriginal population (**Crawford, Holmes, 1989**). Both Crawford and Holmes were former presidents of the Canadian Dental Association. They rated the restorations placed as superior, satisfactory or failed, based on the criteria of surface and color, anatomic form and marginal integrity. They examined 323 patients and evaluated a total of 1,860 restorations. Of the restorations placed by dental therapists, 31.7 percent were excellent; 65.7 percent were satisfactory; and 2.5 percent were failures. Of the restorations placed by dentists, 8.1 percent were excellent; 80.5 percent were satisfactory; and 11.4 percent were failures.

Trueblood (**1993**) conducted an in-depth statistical analysis of the data that Crawford and Holmes had collected. He found that "from a statistical point of view, on the basis of six clinical restorative procedures encompassing 1,799 dental restorations, the quality of restorations placed by dental therapist was equal to, but more often than not better than, those placed by dentists."

Fiset (**2005**) examined the quality of care provided by the first cohort of dental therapists to practice in Alaska after having been trained in New Zealand. Criteria included record-keeping, cavity preparation and restoration, patient management, and patient safety. Friset concluded that the performance of the dental therapists met the standards of care he had established in every regard, and designated them "competent providers."

The treatment provided by dental health aide therapists in Alaska was assessed by Bolin (**2008a**) in a pilot study. Bolin audited the dental records of 406 patients that had 640 procedures completed by both dental therapists and dentists. He found no significant differences among the two groups in the consistency of diagnosis and treatment or postoperative complications as a result of the primary treatment.

An assessment by RTI International of the Alaska dental therapist program focused, among other issues, on clinical technical performance (**Wetterall et al., 2010**). The report stated: "The data indicate that the therapists who were observed are technically competent to perform those procedures within their scope of practice."

In an article published in the Journal of the American Dental Association, the RTI evaluators in Alaska reported: "Of 84 amalgams placed by therapists, ten (12 percent) had deficiencies … Of the 41 amalgams place by dentists, nine (22 percent) had deficiencies … Of 47 composite restorations placed by therapists, seven (15 percent) had deficiencies … Of 25 [composite] restorations placed by dentists, three (12 percent) had deficiencies" (**Bader et al., 2011**). In other words, 88 percent of amalgam restorations placed by dental therapists were satisfactory, compared with 78 percent of dentists; 88 percent of composite restorations placed by dentists were satisfactory, compared with 85 percent of dental therapists. Overall, the quality of care provided by dental therapists and dentists were of comparable quality.

Fernando (**2006**) evaluated the care provided by school dental therapists in **Sri Lanka**. She found that only 65 percent of the restorations placed by dental therapists were satisfactory, while 98 percent of the extractions performed were determined to be of acceptable quality.

A 2009 study in Australia evaluated the ability of dental therapists to place restorations in adults. Seven dental therapists placed 356 restorations in 115 patients. The restorations were evaluated six months later by dentists blinded to the intervention; 94.6 percent of the restorations were judged to be successful (**Calache et al., 2009**).

In a 2010 study of the quality of restorative care by dental therapists in a rural school in Malaysia, only 2.7 percent of 1,616 restorations placed in 404 children were of clinically unacceptable quality. The failures existed more in Class III

composite restorations than in amalgam (**Asegali, 2010**). A similar study by Makhir (**2011**) in Malaysia resulted in a similar finding. He found that 8.2 percent of the restorations placed in 332 primary schoolchildren required replacement. As in Asegali's study, those requiring replacement were primarily composite and glass ionomer restorations.

ACCESS TO CARE AND EFFECTIVENESS OF CARE

The impetus for adopting dental therapists as part of the oral health workforce has typically been the objective of improving both access to care and effectiveness of care for children.

In most countries, dental therapists are public health employees deployed in school dental programs. Studies from these countries demonstrate the positive impact of this delivery model upon the effectiveness of care for children, especially in reducing the amount of untreated decay. Global studies show high and steadily increasing enrollment in school dental programs over time, and reveal their positive influence in improving access to care for large numbers of children, often the entire population of elementary schoolchildren.

Evaluations of dental services based on the dental health of the population must be seen in the light of falling levels of dental caries due to other factors, such as fluoridation, and the many factors that mediate the relationship between service provision and population health.

However, the proportion of dental caries in children that has been effectively treated is a strong and reliable indicator of the accessibility and effectiveness of dental care. Studies demonstrate the positive impact of school-based delivery model upon the effectiveness of care for children, validated by data demonstrating improvement in DMFT/dmft related indices, as well as lower measurements of untreated decay.

New Zealand

New Zealand, the country where the dental therapist concept originated, has literature demonstrating the impact of dental therapists working in school-based programs dating to the 1950s.

DISEASE MEASUREMENT INDICES

The earliest studies show reductions in the levels of untreated dental disease, as demonstrated by improvements in the D/DF ratios. Fulton (**1951**), in his study of the School Dental Service in New Zealand, found the prevalence of dental caries to be high, but that much of it had been treated. At age 7, more than five of the deciduous molars had experienced decay, yet 95 percent of these had been restored. An average of two permanent teeth had been attacked by caries; 75 percent had been restored. By age 14 the number of carious permanent teeth had risen to 10, yet 86 percent of these had been filled. He found an average of "only 0.4 missing permanent teeth."

John Walsh, the dean of New Zealand's sole dental school at the University of Otago, presented longitudinal data that further established the reduction in untreated dental disease that occurred after the implementation of the School Dental Service. The ratio of extractions to fillings had fallen from 73 percent in 1925, to 7.5 percent in 1954, and to 3.6 percent in 1964. In 1960 there were 19 extractions per 100 children, versus 407 to 100 in 1925 (**Walsh, 1965; Walsh, 1968a, 1968b**).

Walsh suggested that a "Care Index" be used to determine the effectiveness of a country in treating dental caries in its children. The Care Index was calculated by developing a ratio of the filled teeth component (f/F) of the deft or the DMFT to the overall deft or DMFT. In 1968, the Care Index in New Zealand was 72 percent, meaning 72 percent of all the elementary schoolchildren's teeth that had been affected by dental caries had been restored. He cited data that indicated that the Care Index for the United States was 23 percent. Walsh claimed, "The worthiness of a society can be evaluated in terms of the care and concern for the health of its children."

The World Health Organization conducted an international collaborative study of dental manpower systems in 1976, comparing, among other things the DMFT of 13- and 14-year-olds in five countries. The Canterbury region of New Zealand had the second-highest DMFT. However, all but 0.6 of the caries had been treated; 94 percent of the DMFT score represented filled teeth, and less than 0.01 percent represented missing teeth (**Hunter, Davis, 1976**).

An editorial entitled "Signs of Improvement" in the New Zealand Dental Journal (**1978**) commented on some of the findings of the WHO International Collaborative Study (**Hunter, Watson, 1976**). The study found that the prevalence of edentulism was heavily related to socioeconomic variables. The editorial suggested that prior to this finding, "New Zealand dentistry had been rather smug … having boasted to the rest of the world that we possessed the greatest school dental service the world had ever seen. The alarming rate of edentulism in New Zealand shook us out of our smugness … We can take heart from the fact that every longitudinal indicator available suggests New Zealand's dental health

is improving and has been for years." In 1953, 22 percent of young adults were fully edentulous; in 1968 the figure was 13 percent, and in 1976, 7.5 percent. The mean DMFT improved from 16.7 in 15-to-19-year-olds in 1962-64 to 13.6 in 1976. The greatest decrease was in the D (decayed) component, which fell from 3.2 in 1962 to 1.3 in 1976. In 1940, when the 38-year-olds in the study were 5 years old, the dmft was 8.5; it had dropped to 3.8 in 1977. The editorial concluded that "it is entirely reasonable to predict that today's 5 year olds will be in much better shape when they are 38 in 2010! That is, if the dental profession makes prevention its primary goal."

Hunter reported on change in the prevalence of dental caries in both 5-year-old New Zealand children (**Hunter, 1984a)** and 12- and 13-year-old children (**Hunter, 1984b**) between 1977 and 1982. In 1982, the dmft for 5-year-old children was 2.6; with 44 percent of the children being caries free. The dmft had fallen from 3.6 in 1977, a 30 percent decrease. The dmft had been 11.2 in 1932, and 7.5 in 1950. It was reported that 47 percent of preschoolers were enrolled in the School Dental Service by age 3 and 87 percent by age 5. The mean DMFT for 12- and 13-year-olds in 1977 had been 7.0; in 1982 it was 3.7. Of the 3.7 DMFT, 3.6 represented filled teeth and only 0.1 decayed teeth. In the sample of 1,042 children, only three teeth were missing due to dental caries. Thirteen percent of the sample was caries-free. He attributed the decrease to an increased focus on prevention and dental health education in the School Dental Service, as well as increased fluoridation, topical fluoride application and fluoride dentifrices. In addition, the policy of the SDS of "when in doubt [about a potential carious lesion] observe and fluoride" also contributed to the decrease in the F component.

School Dental Service data indicated that 53 percent of 5-year-olds were caries-free in 2003, with a mean mft of 1.8 (**New Zealand National Health Committee, 2003**; **Thomson, Ayers, Broughton, 2003**). At age 12 and 13, 42 percent were caries-free, with a mean MFT of 1.6. Nash (**2004**) reported on asking one of the authors of paper (Thomson) where the d/D was in the dmft/DMFT. Thomson explained that at the end of an academic year there were essentially no decayed teeth, as they had been treated by the School Dental Service, either by restoration or removal.

A Portrait of Health was the title of the 2006-07 New Zealand Health Survey (**NZMH, 2002**). In the survey, parents reported that 50.9 percent of the children had never had a filling; 11.3 percent had one or more teeth removed due to decay, abscess, infection or gum, and 2 percent of 2-to-4-year-olds had a tooth removed for one or more of these reasons.

The New Zealand Ministry of Health conducted a national oral health survey in 2009 (**NZMH, 2010**). The report cited large improvements in the oral health of children since the 1980s. The number of caries free 12- and 13-year-olds had almost doubled between 1988 (28.5 percent) and 2009 (51.6 percent). The average

DMFT for the group had decreased significantly from 2.4 to 1.3. Four of five (79.9 percent) of 2-to-4-year-olds were caries-free; one in seven (14.9 percent) had untreated caries in one primary tooth; the average dmft was 0.8. One in two (50 percent) of 5-to-11-year-olds were caries-free in their primary dentitions; the majority (77.5 percent) were caries-free in their permanent dentitions; one in six (17.3 percent) had untreated coronal decay in at least one primary molar; and only a small proportion (2.7 percent) had untreated decay in one or more permanent teeth. This age group had a 1.9 dmft and 0.5 DMFT. Adolescents ages 12 to 17 had worse oral health than the younger group: two in five (44.7 percent) were caries-free; 12.7 percent had untreated coronal decay; the average DMFT was 1.9. The proportion of children who had visited a dental professional in the last year was highest among 5-to-11-year-olds (90.3 percent); the proportion was lower among adolescents (79 percent); and lowest for preschool children ages 2 to 4 (59.7 percent). Significant disparities existed in oral health status and access to care, particularly for those of Maori or Pacific ethnicity. Maori and Pacific children were less likely to have accessed oral health services in the previous year, less likely to have caries free primary teeth and less likely to meet brushing recommendations.

ACCESS

Studies from New Zealand demonstrate the improvement in access to care for children both by the number of dental clinics located in schools throughout the country as well as reporting the percentage of eligible children enrolled and seen in the School Dental Service.

Walsh reported that in 1956 there were 695 school-based treatment centers in the New Zealand School Dental Service, which meant that 98 percent of 2,424 primary and intermediate schools were being served by the service (**Walsh, 1965; Walsh, 1968a, 1968b**).

An evaluation of the dental care of children in both New Zealand and the United States was conducted by Beck (**1967**). He cited evidence to indicate that there was more access to dental care in New Zealand than in the United States. In the United States, half of children under 15 had never been to a dentist and 27 percent of children ages 5 to 14 had never been to a dentist. In New Zealand, 93 percent of children participated in the School Dental Service.

Davis (**1965**) visited New Zealand from Great Britain in the mid-1960s and wrote of his experience for the British Dental Journal. He reported that approximately 98 percent of children participated in the school-based program, being cared for by the dental nurses. He stated that approximately 59 percent of preschool children 2½ years and older are seen at the request of parents. He further commented that the criticism of the New Zealand scheme of being reparative and not preventive was "nonsense."

The Director General of Health of New Zealand, D.P. Kennedy, published a report of the school dental nurses in the New Zealand Medical Journal (**Kennedy, 1970**). He indicated that the public health dental program was extended past age 12 in 1946 to children from ages 13 through 16, with care provided by private dentists on a fee-for-service basis. The value of the change was noted in that in 1952, 29 percent of the 18-to-21-year-olds who were army recruits required dentures. By 1958, the effect of the benefit was reflected in the decrease to 11.4 percent; by 1963, it had dropped to 8 percent.

Richie (**1977**) reported that in 1977, 65 percent of preschoolers and 89 percent of primary and intermediate schoolchildren were enrolled in the School Dental Service in New Zealand.

In 1977, the Institute of Medicine in the United States sponsored a conference on international systems for delivering dental care. Richard Logan, assistant director of the New Zealand Health Department's Dental Division, reviewed the New Zealand School Dental Service (**Logan, 1978**). At that time, there were 1,373 school-based clinics. For schools with more than 450 students, permanent clinics existed, typically accommodating two dental nurses; schools with between 240 and 500 pupils had smaller on-site clinics for use by a part-time dental nurse. While the service was noncompulsory, 98 percent of the primary and intermediate school-age children participated, as did 64 percent of preschoolers, for a total coverage of 622,000 children.

In 2003, the utilization of the School Dental Service by schoolchildren was 97 percent of children 5 to 13 years of age, and 56 percent for preschool children (**New Zealand Health Strategy, 2004**). In the 2010 calendar year, 60 percent of preschool children and 98 percent of children 5 to 13 were enrolled in the School Dental Service. Sixty-eight percent of adolescents used publicly-funded dental services provided by private practitioners (**NZMH, 2012**).

COST-EFFECTIVENESS

Nash (**2004**) reported that New Zealand and Kentucky have approximately the same population, and roughly the same number of children. He reported that in 2002-03, Kentucky spent $40 million caring for the 43 percent of its children who were eligible for Medicaid/S-CHIP. (The utilization rate of the 43 percent eligible to receive care through public insurance benefits was not reported; nor were data for expenditures for dental care by private insurance or cash payments to dentists for the remainder of Kentucky's children that year.) New Zealand spent $34 million (U.S.) caring for all of its children enrolled in the School Dental Service, ages 6 months through age 17, reported to have been 97 percent of school-age children and 56 percent of preschoolers.

New Zealand Ministry of Health data indicated that $64 million (U.S.) was spent in fiscal year 2010-11 on providing comprehensive care by dental therapists in the School Dental Service for 624,700 children 0 to 12 years of age. This represented caring for 96 percent of New Zealand's 5-to-12-year-olds and 49 percent of 0-to-4-year-olds. The cost was $99.11 (U.S.) per child per year. The ministry cited three private-practice fees in New Zealand for that year to demonstrate the cost-effectiveness of care in the SDS. In the private sector, an examination, radiographs and a cleaning was $102 (U.S.); one surface amalgam restoration was $99 (U.S.); and a fissure sealant was $47 (U.S.) (**NZMH, 2012**).

Croucher (**2011**) reported that in New Zealand the average dental therapist earns $30,450 (U.S.). Community dentists earn $76,000 to $120,000 a year. Private-practice dentists earn $120,000 to $150,000 a year. He then stated, "With 90 percent of basic dental care being provided in New Zealand by dental therapists, it is clear that this workforce model is more cost-effective than a dentist-only workforce model."

Australia

The Australian literature on the influence of school-based dental therapy programs on DMFT/dmft indexes and improving access to care indicates they help to improve child oral health.

DISEASE MEASUREMENT INDICES

Roder (**1973**) found that secondary school students who had participated in the South Australian School Dental Service had lower decay rates (average of 3.56 carious teeth; 89.2 percent prevalence) versus those who had not participated in the program (6.33 carious teeth; prevalence of 96.4 percent). Walsh's Care Index (F/DF) indicated that the students who had been enrolled in the School Dental Service had a ratio of 0.51, compared with 0.26 for the children who had not been enrolled.

Roder (**1976**) again assessed the impact of the School Dental Service by evaluating 2,000 Australian secondary schoolchildren. He found that those who had received care in primary school through the School Dental Service had fewer carious teeth (2 to 3 percent) and more restored teeth than those who had not received care. This group also had better oral health knowledge and oral hygiene habits than those who had not received care through the School Dental Service. However, fewer of these children had visited a private practice dentist in adolescence. He suggested this could be due to a better self-perceived level of oral health, the cost of dental services in private practice, or reliance on the School Dental Service.

Roder (**1979**) noted that Australian school dental therapists were spending 25 percent to 30 percent of their time on oral health education. Additionally, he found that there had been improvements in untreated disease since 1969. In 1969, children averaged three untreated decayed teeth in nonfluoridated areas, and 2 untreated teeth in fluoridated areas. In 1979 the number was 0.8 in nonfluoridated areas and 0.5 in fluoridated areas. He also cited evidence to indicate that oral hygiene and gingival health had improved consistently with the number of years a child had received dental care via the School Dental Service.

L.M. Carr, a dental services advisor to the Australian Commonwealth Government, evaluated the impact of the Commonwealth-funded School Dental programs in 1981 (**Carr, 1982**). Data representing routinely provided dental care by 1,285 dental therapists were collected. Due to the similar conditions of training, equipment and supervision under which they worked, standardization was not undertaken, as the variation between examiners was considered minimal. The study used 245,144 examinations conducted in 1977; 415,803 examinations from 1978; 547,907 examinations from 1979; and 649,585 examinations from 1980. Data were weighted according to relative populations of children ages 4 to 13 to enable accurate comparisons between states and territories and from year to year (weightings are reported). From these data covering almost 2 million examinations, a fall in the DMFT index for children ages 6 to 13 was noted in the order of 26.9 percent. Considerable data were presented to support this finding: in 1977, the DMFT was 2.97; in 1980, it was 2.17. The DMFT indices for children ages 6 to 13 in Queensland (where only 6 percent of people use fluoridated water) were 3.09 in 1977 and 2.29 in 1980, representing an average reduction of 7.6 percent per year. This pattern held across the states and territories. Improvements in oral debris scores were also noted in the order of 21 percent. The authors considered that while it was impossible to determine and quantify the reasons for the improvements, clearly treatment provided by the school dental services would have reduced the number of decayed teeth and extractions required.

School dental services began in Western Australia in 1977 and in 1978. Baseline data were collected on dental caries, oral hygiene, gingivitis and calculus from 1,038 15-year-olds to enable future evaluation of the program. This data collection was repeated in 1981 with 1,093 15-year-old students, 79 percent of whom had received school dental care in their final year of primary school. The average DMF in 1979 was 9.64 and in 1981 it had decreased to 7.46. Reductions in untreated caries were shown to have occurred along with reductions in tooth loss, gingivitis and calculus scores. The authors concluded that school dental services had played a part in the improvements in oral health alongside water fluoridation and other services across the whole student population (**Medcalf, 1983**).

ACCESS

Riordan et al. (**1991**) reported that 93 percent of Western Australian children between the ages of 6 and 14 were treated by the School Dental Service in 1991. In Tasmania, 85 percent of primary schoolchildren, 30 percent of preschoolers and 50 percent of secondary schoolchildren had received care from 90 dental therapists by 1989 (**Merhuilik, Dever, 1997**).

In 2000, the Australian Institute of Health and Welfare (**AIHW, 2000**) reported on the use of dental services from 1994-1996 by 2,351 children ages 6 to 12 and 1,384 adolescents ages 13 to 16 via a national telephone survey of their parents. The study showed that Australia-wide, 62 percent of 6-to-12-year-old children visited the School Dental Service and 38 percent visited a private practitioner with variations across the states. In New South Wales and Victoria, the School Dental Service visit rates were 40 percent. Nationally, 33 percent of 13-to-16-year-olds had visited the School Dental Service, which illustrated the variation arising from eligibility criteria across different jurisdictions. Analysis of dental service program participation revealed that children from a lower socioeconomic stratum were more likely to utilize the School Dental Service program. Overall, 5.6 percent of 6-to-12-year olds had not participated in the School Dental Service program in the previous two years (percentages ranged from 2 to 10 percent by states); this figure was 9.6 percent for 13-to-16-year-olds (percentages ranged from 5 to 12 percent by state).

COST-EFFECTIVENESS

Excluding the cost of training for dentists and dental therapists, Blaikie and Weidenhofer (**1978**) showed that the school dental program in Australia was an economically acceptable method of delivering school dental care, with a fee-for-service alternative costing 20 percent more to deliver the same service.

Millsteed (**1996**) found that the 10 most-performed dental procedures provided for adults constituted 60.09 percent of all the dental procedures performed that year. They were procedures that dental therapists typically provided to primary and secondary school students in Australia. She made two estimates of the potential to make dental expenditure savings. The first was based on direct substitution of dental therapists for dentists in appropriate areas (public and private practices) showing a $238 million (Australian) savings representing 14.2 percent of recurrent national expenditure on dental services in 1992-93. The second model involved only the private sector and was calculated using Commonwealth Dental Health Program (CDHP) service data and showed that total CDHP service costs could be reduced by 19 percent or the equivalent of $223 million (Australian) nationally.

Millstead (**1996**) compared the cost of preschool services provided to children in Victoria in 1993-94, which had to be provided by dentists; with the cost of preschool services in South Australia, which were provided by dental therapists. The cost per child in Victoria was $265 a child, and in South Australia $52.49 a child.

Riordan's (**1997**) paper on the organization of dental care for children examined evidence to address the issue of cost-effectiveness of dental therapists and their substitution for dentists as primary providers of services. He stated that the needs of child populations for dental care were mostly low to medium technology and that dental therapists were better and more cost-effective providers of care.

Baltutis and Morgan (**1998**) endorsed this view in their paper published in the Australian Dental Journal, which reviewed dental disease patterns, service delivery, legislation and the productivity and quality assurance issues around the contemporary use of dental therapists and hygienists. They argued that dentists should be focused more on high technology and complex procedures and should allow dental therapists and hygienists to provide the low to medium technology services. They presented evidence to show that dental therapists could provide services at lower cost and equivalent quality to dentists, and in many cases higher quality in the lower technology services. Increases in productivity from 30 percent to 80 percent could be achieved with the addition of a dental therapist or hygienist.

At a similar time in Western Australia, an inquiry was underway to examine the adequacy and availability of dental services in regional, rural and remote Western Australia. The report noted the significant "striking cost effectiveness and ongoing success of the School Dental Service … " and attributed much of the decline in dental disease to the preventive activities of the SDS. In 1994, the state estimated the value of the services delivered per dollar expenditure in real terms was $1.47 (Australian), increasing to $2 in 2002 for every dollar spent. The cost of care per child in 2000-01 was $65.70, which was significantly less when compared with Scandinavia, where a dentist-based system existed, and the cost was estimated to be between $150 and $250 per child (**Martin, 2002**).

Canada

At one point, there were two dental therapist training programs in Canada. One school trained dental therapists to provide care in Saskatchewan's province-wide school-based program. The second dental therapy program was focused on training dental therapists to provide care for aboriginal children living in remote northern areas of Canada.

DISEASE MEASUREMENT INDEXES

A review of the Saskatchewan Plan was undertaken in 1981, after six years of operation of the provincial school-based dental therapist program for children (**Lewis, 1981**). The proportion of children who had all their treatment needs completed during the school year ranged from 76 percent to 90 percent. The average number of restorations dropped each year to about one half of the original

over six years; the average number of pulpal procedures also declined each year, as did the number of extractions, with one-third of the extractions being for orthodontic purposes.

The number of occlusal amalgam restorations placed on the first permanent molars of 6-8 year old Saskatchewan schoolchildren declined from 40/100 children in 1981-82, to 26/100 children in 1984-85. For adolescents, the decrease in the number of amalgams on first permanent molars declined from 45/100 in 1981-82 to 30/100 in 1984-85. After 10 years, the dental therapist-driven school-based program demonstrated a reduction in dmft for 6-year-olds from 6.5 to 3.4. The d/df ratio also declined, with the major category being filled teeth as opposed to decayed teeth. In 1987-88, the dmft of 6-year-olds had further declined to 1.1 (**Saskatchewan Health, 1988**).

Gordon Trueblood evaluated the impact of school-based dental therapy programs in Canadian aboriginal communities. He assessed the program using two indices: the ratio of restorations to extractions and the ratio of restorative to preventive work (**Trueblood, 1992**).

The ratio of restorations to extractions (R/E) demonstrates the commitment of dental therapists to render comprehensive care and also correlates with the quality of services provided to patients. A low R/E is suggestive of poorer overall dental health whereas a higher ratio indicates better dental health among the population served. Trueblood examined the ratio of restorations to extractions (R/E) in five different Canadian provinces and territories served by dental therapy programs. Over a 10-year period from 1978-88, there was a steadily increasing R/E ratio that revealed that dental therapists were having a beneficial effect upon the oral health of the communities they served.

The ratio of restorative to preventive work (R/P) is derived by dividing the total restoration RVUs by the total preventive dentistry RVUs. This ratio is an important measure from the viewpoint of public health dentistry and economics because it is affected by the natural shift from restorations to more preventive work. A low ratio indicates more preventive procedures than restorative procedures, suggesting overall improvements in the dental health of communities served by dental therapists. The ratio of restorative to preventive treatment (R/P) was calculated by the aforementioned geographical regions for all dental therapists from 1978 to 1987. During this period, "the data reveals a steadily declining ratio indicative of consistently improving levels of dental health in the communities served by dental therapists." The decline in the R/P ratio was an indicator that "the need for clinical dentistry may be decreasing in communities served by dental therapists. Therefore, the dental therapy program may be justified on the grounds of savings in future treatment expenditures alone."

Using Trueblood's approach of analyzing the ratios of restorations to extractions and restorative to preventive procedures, Tsuji and Katapatuk (**2007**) evaluated a native Canadian community in which dental care was provided by one dental professional over a 10-year time period. They found that "continuity of dental care has resulted in significant improvement in native health" compared with communities with a history of sporadic care by different providers. Their results promoted the "initiation of a community based dental therapy program in First Nations villages."

ACCESS

After the implementation of the Saskatchewan Dental Plan in Canada in 1974-75, Swanson evaluated survey data after the program's first year of operation to determine the effect of the school-based dental therapist delivery system on social class variations in the utilization of care (**Swanson, 1976**). Under the predominate system of delivery, which was that of private dentists being paid on a fee-for-service basis, only a small proportion of the population was receiving care, primarily those in higher socioeconomic status. Swanson found implementation of the school-based dental therapist delivery system altered utilization patterns and resulted in eliminating inequalities in the receipt of care by members of different socioeconomic groups: "Within one year of implementation of an alternative delivery system in Saskatchewan, it appears that virtually all of the first group of eligible children will be receiving care through either the provincial dental plan or private dental practice."

Clinics had been established in 215 schools across Saskatchewan by the end of the first year of the program, a further 60 clinics in the second year and 60 more were expected to be established by the end of year three. Three years after the province-wide school-based dental therapist delivery program was implemented, 58, 659 children (82 percent) were enrolled in the program (**Lewis, 1977**). By August, 1985, there were 565 dental clinics located in schools throughout Saskatchewan (**Saskatchewan Health, 1985**) and more than 80 percent of schoolchildren were receiving care from the program.

Hong Kong

A School Dental Care Service was established in Hong Kong in 1981. Literature indicates that over 20 years of using dental therapists to treat children has resulted in a decline in the dental caries of Hong Kong schoolchildren and improved access to care.

DISEASE MEASUREMENT INDICES

A study was conducted using a two-stage sampling method to select 300 children from four primary schools in Hong Kong (**Chan, Cheng, Fok et al., 1990**). The

age range of all the children was 9 to 11. The study group had participated in the School Dental Care Service continuously for the past four years and was matched with a control group of students who had not participated in the School Dental Service during that period. The overall dental caries experience of the two groups was comparable; however, School Dental Care Service participants on average had fewer decayed teeth (0.2 versus 0.6) and more filled teeth (0.6 versus 0.2). It was also found that School Dental Service children were more likely to brush their teeth two or more times a day (80 percent versus 64 percent) than children who were not enrolled in the program.

Three surveys evaluating the oral health of Hong Kong children have been completed since the School Dental Care Service was established in 1981. In a 1980 survey, of 1,140 schoolchildren age 11, more than half (57 percent) of the children had at least one permanent tooth with caries experience (**Law, 1981**). The mean DMFT was 1.5, and over 90 percent of carious teeth were untreated. Six years after the initiation of the School Dental Care Service, a second survey was conducted (**Evans, Lind et al., 1990**). Children ages 11 and 12 were included in the survey. The mean DMFT of the 11-year-olds was 1.3; the 12-year-olds, 1.5; with 56 percent and 60 percent, respectively, having at least one permanent tooth with caries experience. The main component of the DMFT was filled teeth, contributing 53 percent for 11-year-olds and 69 percent for 12-year-olds.

The most recent survey in Hong Kong was conducted in 2001. The DMFT of 12-year-old children was found to be 0.8 and 62 percent of the children had remained caries-free in their permanent dentition. The major component of the DMFT was the filled component at 0.6 (**HKDH, 2002**).

The results of these surveys indicate that with more than 20 years of dental therapists treating children in a school dental service, the dental caries experience of Hong Kong children declined. The mean DMFT score of the 11-to-12-year-olds decreased from 1.5 in 1980 to 0.8 in 2001, a 43 percent reduction. The number of 11-to-12-year-old children with no caries experience in their permanent dentition increased from 43 percent to 62 percent.

ACCESS

The surveys also demonstrated that the School Dental Care Service was successful at improving access to dental care for Hong Kong schoolchildren. Six years after the initiation of the School Dental Care Service, the participation rate in the program had increased from 29 percent to 65 percent (**Evans, Lind et al., 1990**). By 2001, the School Dental Service had been in operation for 20 years and the participation rate of primary schoolchildren was 88 percent.

Singapore

A Singapore Health Promotion Board report (**SHPB, 2009**) stated: "The DMFT index has been improving consistently since the institution of the Singapore Dental Service (SDS). Instrumental in this is the role of the DTs [dental therapists] in the SDS. The oral health status of children has improved most dramatically. Based on oral health surveys done in 1970, 1989, 1994, and 2003 the decayed, missing and filled teeth (DMFT) index of 12-year-old children has fallen from 3 in 1970 to 1.4 in 1989 to 1 in 1994 and to 0.54 in 2003. This has surpassed the goal set by the Ministry of Health of 1.2 by the year of 2000. Singapore has achieved one of the lowest DMFT in the world."

"In 2008, 238,157 primary school and 93,983 Secondary 1 and Secondary 3 pupils were screened, of which 226,382 (96 percent) and 90,010 (89 percent) respectively were rendered dentally fit. A decayed, missing and filled teeth (DMFT) index of 0.70 was achieved among the 12-year-olds, with the 15-year-olds obtaining a DMFT of 1.1" (**SHPB, 2009**).

Malaysia

DISEASE MEASUREMENT INDICES

Jafaar (**1995**) examined the impact of the School Dental Service upon dental disease in Malaysian schoolchildren. He found the prevalence of the df and DMF teeth in 6-year-olds had declined from 95.7 percent in 1971 to 89.3 percent in 1988. The mean df index declined only slightly from 6.3 to 6.2. In 12-year-olds, the prevalence of DMF teeth declined from 83 percent to 72.1 percent and the mean DMF index declined from 3.7 to 2.37, meeting the World Health Organization goal of a DMFT of 3 or less at age 12. There were essentially no changes among 16-year-olds. Of particular note was that the components of the DMF shifted from a largely decayed component of the DMFT in 1971 to a filled component in 1988, indicating that the capacity to repair teeth had increased but not the capacity to prevent new carious lesions.

Jafaar conducted further research to evaluate the outcomes of the School Dental Service on the oral health of 12-to-13-year-old children, using normative (objective) and subjective indices as complementary measures. Almost one-third of the sample (31.2 percent) was caries-free (DMFT=0). The overall prevalence of dental caries experience was 68.8 percent (DMFT equal to or greater than 1). The World Health Organization targets the DMFT for 12 years of age at no greater than 3. The majority in the sample had a DMFT ≤ 3. There were significant differences in those children who had been determined to be "orally fit" by the School Dental Service versus those who were not "orally fit" in all dependent variables. Two-thirds (66.4 percent) of the children determined to be orally fit had no decayed

teeth. Children considered to be orally fit had a DMFT of 1.70±1.84 versus a DMFT of 2.45±2.54. (p 0.01) for children not considered to be orally fit. The orally fit had a lower DT (0.19 versus 1.42) and higher FT (1.46 versus 0.87) than those not certified by the School Dental Service as orally fit (**Jafaar, 1999**).

The oral health status of 12-year-old children in the urban and rural areas constituting Kuala Lumpur was investigated by Zakaria **(2010).** In 2010, 94 percent of the 12-year-old children in urban schools were caries free, as were 87 percent of the children in "rural" Kuala Lumpur schools. In the urban area, 3 percent had a DMFT of 1 and 3 percent had a DMFT of 2; in the "rural" areas 7.5 percent had a DMFT of 1 and 5.5 percent had a DMFT of 2. The author concluded that the school program staffed by nurses was highly successful in a metropolitan area and resulted in a significant reduction in disparities in oral health between the economically advantaged and the disadvantaged. The School Dental Service reduced inequities that would otherwise have existed between these two groups due to the expense of obtaining dental care privately in dentists' offices, and the consequent inability of the economically disadvantaged to obtain care.

The impact of the School Dental Service has been significant. The caries experience of 12-year-olds in 1975 as measured by the DMFT Index was 3.8 teeth. By 1997, it had been reduced to 1.6 teeth. Data indicated that 10 percent of 12-year-old children had severe caries experience (**MMH, 2003**). Between 1998 and 2004, the percentage of caries-free 12-year-olds increased from 48.6 percent to 56.1 percent (**MMH, 2004**).

ACCESS

By 1995, dental care was provided to 100 percent of elementary and secondary schoolchildren by dental nurses in the two Malaysian states of Penang and Johor. Mean coverage for all states was 83 percent for primary schoolchildren and 43 percent for secondary students. Mean coverage for preschool children was 80 percent, with 14 percent coverage for expectant mothers (**Jafaar, 1995**).

Implementation of the systematic, incremental school-based dental care system, operated by dental nurses since 1985, has resulted in a sharp decline of decayed teeth and a corresponding increase in restored teeth in children (**MMH, 2005**). The program has been so successful that by 2003 the school dental program reached 96 percent of elementary and 67 percent of secondary schoolchildren. Only a few parents decline treatment by the dental nurses, primarily because they have a private dentist. Of those given care, 97 percent of elementary and 91 percent of secondary schoolchildren were rendered orally fit. The major contributing factor to this increase was in the coverage of elementary schools, which rose from 37 percent in 1984 to 90 percent in 2003 (**MMH, 2004**). This could not have been achieved except through the use of dental nurses. The services by dental nurses are provided in school dental clinics, mobile dental clinics and by dental teams

that use portable dental equipment. The goal is to render all schoolchildren orally healthy before they leave the school system. Recently, dental nurses have begun caring for preschool children as well.

PERSPECTIVES OF THE DENTAL PROFESSION TOWARD DENTAL THERAPISTS

The perspective of the dental profession is well represented in the literature on dental therapists. It speaks not only to the attitude of dentists on both sides of the issue; it also purports to represent the attitude of the public. Following are the attitudes expressed in those countries for which there is available information.

United States

Speaking at an American Public Health Association meeting in 1938, Guy S. Millbery, dean of the School of Dentistry at the University of California in San Francisco, drew an analogy between training persons to do small fillings and extract deciduous teeth and nurses with intensive training in perinatal care and delivery. He said, "I believe all of you will agree with me that such an operation is far more serious for the patient than cleaning teeth, filling small cavities, and extracting temporary teeth." He then raised the question, "Does it not seem possible to you that we should be able to train persons to do these simple operations for children in two years' time?" However, he concluded, "The dental profession probably will not accept this program" (**Millbery, 1938**).

In October of 1949 in a report to the House of Delegates, the Council on Dental Health stated: "Attempts are now being made to introduce into this country … the New Zealand style dental plan for children … There is a complete lack of reliable information on the soundness and effectiveness of this program as it operates in New Zealand." The House of Delegates passed four resolutions opposing the Massachusetts experimental program at its session in San Francisco, Oct. 17-20, 1949 (**ADA, 1949b**).

Dr. Vlado Getting, Commissioner of Health of Massachusetts, responded to Dr. Harold Hillenbrand, Secretary of the American Dental Association, "It is difficult at this time to understand the grounds on which it logically can object to research which evaluated new methods of meeting the problem of dental disease … the resolutions adopted by the House of Delegates of the American Dental Association … may perhaps have been hurried and therefore inconsistent with the declared objectives of the American Dental Association" (**ADA, 1950**).

In February 1950, the American Dental Association sent Allen O. Gruebbel, secretary of the ADA Council on Dental Health, to New Zealand to conduct an objective and comprehensive study of the New Zealand school dental nurse and School Dental Service. Gruebbel wrote that "under the dental nurse plan dental care for children has been relegated almost entirely to partly trained auxiliary personnel, the scheme has had a deleterious effect on the scientific development of pedodontics … Parents in New Zealand have a false sense of security regarding the dental health of their children because of the belief that their dental needs are being met" (**1950a**).

Alfred Asgis opposed the Massachusetts "Dental Nurse-Operator" Project at Forsyth because it was not a dental research, experimental or educational project, it would lower the quality of dental care for children, and "it will bring about sublevel dentistry and it is an attempt to admit unqualified persons to the practice of dentistry in the United States" (**Asgis, 1950**).

In a 1972 Journal of the American Dental Association article, Friedman concluded: "The immediate advantage of a school-based service, staffed by dental nurses, and the long-range benefit to adults has been well documented. Many New Zealand dentists were concerned initially with the effects of a school dental service on their economic and professional status. These same concerns are expressed in countries that are developing this type of program at present. The experience in New Zealand has demonstrated that the provision of dental care by nurses within the restricted environment of schools does not detract in any way from the dental profession. Quite the opposite—it results in greater awareness among the general population of the necessity for periodic dental care, thereby increasing the demand for treatments by private practitioners" (**Friedman, 1972**).

A committee of the Northern and Southern California dental associations was sent to study the New Zealand School Dental Service in 1972. Their report stated that "there is little doubt that dental treatment needs related to caries for most of the New Zealand children age 2½ to 15 have been met." Additionally, the committee was "impressed with the long standing commitment of the dental profession and people of New Zealand to the dental care of children." Nonetheless, it concluded, "Dental care provided by an independent dental nurse working alone would probably not be accepted by the public in California … Many persons of low income would resent the implication of a 'second class' service which they would be forced to accept because of their inability to pay for the customary services used by the more affluent members of society" (**Redig et al., 1973**).

Friedman and Ingle, in letters to the Journal of the American Dental Association and the California Dental Association Journal, expressed their "dismay by the conclusions of the committee, which consisted largely of unproven assertions about professional and public unacceptability of such a program in this country.

Most of the conclusions were merely restatements of objections previously voiced by the dental profession, and were scarcely related to the observations of the study committee in New Zealand" (**1973a, 1973b**).

James Dunning, then dean of the Harvard Dental School, in a letter to the Journal the American Dental Association, called the Redig committee study "the most amazing combination of careful investigation and irrelevant value judgment I have seen in a long time" (**Dunning, 1974**).

In a 1977 Institute of Medicine conference, International Dental Care Delivery Systems: Issues in Dental Health Policies, Harold Hillenbrand, Executive Director of the American Dental Association said, in summarizing the conference: "When the dental history of our time is eventually written, I believe the New Zealand Dental Nurse Program will be considered one of the landmark developments in the practice of dentistry and dental public health." He went on to say New Zealand has "pioneered a very effective method for delivering dental health services to children." Finally, he concluded, "the New Zealand experience proves that we can develop an auxiliary program—and a very advanced one—that is acceptable to and approved by the profession of the country involved" (**Hillenbrand, 1978**).

Responding to the introduction of Dental Health Aide Therapists in Alaska, the American Dental Association overwhelmingly passed a resolution "opposed to non-dentists making diagnoses or performing irreversible procedures" (**ADA, 2004**).

Three past presidents of the American Public Health Association wrote a letter to the American Journal of Public Health taking issue with the ADA. "[The ADA has] a long record of preventing anyone except dentists from providing treatment, even to the underserved … Because organized dentistry is lobbying state and federal decision makers to stop this pilot [DHAT] program … we cannot help but think that there was a hidden political agenda for their publication. In times of dwindling resources, complex access issues, and evidence-based medicine, dentistry and public health, now is not the time to block innovative programs trying to serve the underserved" (**Allukian et al.**).

Nash (**2005**) reiterated his advocacy for developing and deploying a pediatric oral health therapist in the Journal of Public Health Dentistry. He suggested four potential practice environments for pediatric oral health therapists: schools, Indian Health Service clinics, private dental offices and the offices of pediatricians.

The executive director of the American Dental Association, James Bramson, and the Chief Policy Advisor of the ADA, Albert Guay, commented on Nash's article in a subsequent issue of the Journal of Public Health Dentistry (**Bramson, Guay, 2005**): "The distribution of resources in our health care system, including our

dental workforce, is based on the demand for care.… A two- tiered oral health care system, where a group of people receive care from a lesser-trained provider, is anathema to the concept of equality for all of our citizens. The idea that 'something is better than nothing' for some people insidiously erodes the goal of the best health care possible for all and institutionalizes the acceptance by society of second level care for some."

Nash (**2005**) responded, "a dental delivery system for children based on demand rather than need is not a system that meets the demands of social justice."

In 2006, the American Public Health Association issued a policy statement in support of the Alaska program, "Given the evidence of safe and effective oral health care delivered by Dental Health Aide Therapists and the need for such services for populations in remote and under-served areas…." (**APHA, 2006**).

The Georgia Dental Association (**2010**) produced "A White Paper" opposing dental therapists. "It is impossible to alleviate distribution shortages by adding a new category of dental provider, such as the mid-level provider … There are distinct differences between the delivery of dental and medical services … medical model solutions should not be artificially imposed onto the dental model … The use of MLPs is not a solution. It is another problem and one that can compromise the health and safety of the patient."

The president of the American Academy of Pediatric Dentistry wrote an editorial in the journal, Pediatric Dentistry, declaring that "the United States has the best model for delivering dental care that exists … a dual standard of care, a new menu of mid-level providers, a 'fast-track education,' and a focus that is driven by cost savings are not in the best public interest" (**Hinson, 2009**).

A survey of board-certified pediatric dentists found that pediatric dentists were not supportive of adding a dental therapist to the oral health care workforce (**Toolo, Nash, Mathu-Muju, *et. al.* 2010**). Even though 75 percent of those responding to the survey had no knowledge of the concept of a dental therapist, 71 percent disagreed with adding such an individual to the dental team.

New Zealand

Although there was much controversy, at a special meeting of the New Zealand Dental Association in September, 1920, delegates voted 16 to 7 to support the adoption of the School Dental Nurse Scheme (**NZDA, 1920; Brooking, 1980**).

"The controversy surrounding the establishment of the scheme continued for some time … organized opposition was considerable on the grounds that the

employment of dental nurses posed … a menace to the public, a menace to the (dental) profession and an injustice to those seeking to enter the ranks of the (dental) profession by recognized avenues …" (**Leslie, 1971**).

Davis called the criticism of the New Zealand scheme of being reparative and not preventive "nonsense." He stated that when the children move on to secondary education they are turned over to local dentists with clean, well-cared for mouths (**Davis, 1965**).

"The school dental service has enjoyed the co-operation and goodwill of the New Zealand Dental Association. The idea of such a service arose not with government but within the New Zealand Dental Association—a professional and not a political decision … Those far-seeing and humanitarian members of the New Zealand Dental Association concerned solely with the well-being of children, who conceived this programme fifty years ago would also be proud to see today the excellent service that has evolved, a service that their critics of the 1920s described as 'foolhardy' and 'a menace to public health and the profession.' How wrong those critics were" (**NZDJ, 1971**).

The attitudes of New Zealand dentists, dental specialists, and dental students toward employing dual-trained "oral heath therapists" has been explored (**Moffat, Coates, 2011**). Fifty-nine percent of dentists and 53 percent of specialists would consider employing dually qualified dental therapists/dental hygienists in their practices. The main reason given for not employing a graduate was insufficient physical space in the practice. The authors concluded that "oral health therapists" had the potential to make a valuable addition to the dental team.

Australia

There was a culture of concern about dental workforce supply and demand expressed in the literature around 1980-81 that was neatly summed up in an Australian Dental Association (ADA) paper. There is "firm consensus … that there is an over-supply in the dental workforce…that there are too many persons providing dental services relative to both the demand expressed by the community for those services and the positions available for dentist employment" (**Wall, Hession, 1981**).

The Australian Dental Association, Victorian Branch, recommended that training of dental therapists should cease, that those still remaining be re-trained as dental hygienists, and that clinical treatment usually undertaken by dental therapists should henceforth be provided by dentists (**ADA VB 1992**).

The ADAVB declined to join a transition group on the basis that they "do not support a course that will produce an auxiliary with the combined skills of a dental therapist and dental hygienist…"

Atkinson's study showed that dentists' contact with dental therapists was poor and their knowledge of dental therapy practice was not comprehensive, but that there was support among practicing dentists in Victoria for wider utilization of their skills (**Atkinson 1993**).

In her president's column in the Australian Dental and Oral Health Therapists Association Journal, Lennon concluded by hoping "that the portion of ADA intent on denigrating the role of dental therapists looks beyond their own interests and takes into account the unmet need and ongoing suffering of that portion of the population who are unable to access dental care..."(**Lennon 2003**).

In a survey of knowledge and attitudes about Oral Health Therapists, dentists, in general, had positive attitudes, but many responses showed a lack of knowledge of their clinical skills and scopes of practice. The study provided evidence that dental professionals are not fully informed of the role of oral health therapists, which could be a major barrier to their employment (**Edmunds, Tane 2011**).

United Kingdom

Therapists were initially poorly received by the profession, but over the following decades a number of government and nongovernment reviews recommended the expanded training and roles for dental therapists (**HM Government, 1979; Nuffield Foundation, 1993**).

Grace (**1996**) welcomed the development of dental therapists, partly because of his experience working with a New Zealand dental nurse. There were advantages to employing dental therapists in terms of increasing the workforce, their better interactions with patients and indirectly as managing a team would allow the development and increased career satisfaction of dentists. Green and colleagues reported that NHS data indicated that at least 80 percent of clinical activity could be undertaken by a dental therapist and cited examples where delegation worked effectively (**Green, Galloway, Gorman, 1996**).

Dentists' knowledge of the clinical tasks of dental therapists was limited but most (64 percent) said they would consider employing one. Reasons for negative responses included lack of space, reservations on clinical skills, competence and responsibilities, and costs (**Ross et al., 2007**).

Canada

The relocation of the federally funded National School of Dental Therapy from the Canadian north to one of the provinces did not have the support of organized dentistry: "The CDA [Canadian Dental Association] was opposed to dental therapists and felt that by operating in the provinces, the dental therapists were practicing illegally because they were not licensed in the province. The CDA also felt that all irreversible therapeutic dental acts or services must be rendered only by a licensed dentist." (**Petrikowski, 1988**).

In the province of Saskatchewan, the College of Dental Surgeons of Saskatchewan was critical of the province's planned delivery system and introduction of unsupervised dental therapists to provide dental treatment for children. "To concentrate solely on methods of delivery and methods of financing treatment services would be to run the 'danger of pandering to the understandable urge to buy a quick solution for a difficult problem' … Any plan which merely results in millions of filled, patched-up teeth is, in our opinion, of questionable value, and when viewed in light of present day knowledge is ludicrous, to say the least …" (**Saskatchewan College of Dental Surgeons, 1973**).

In 1970 and 1972, surveys were sent to all practicing and licensed Saskatchewan dentists to assess their attitudes toward a prepaid dental care program for children in the province (dental therapists were introduced to the province in 1972). In both surveys, questions were asked about attitudes toward "British type auxiliaries" (dental therapists). Opposition to dental therapists fell from 58 percent in 1970 to 40 percent in 1972. The percentage favoring dental therapists rose from 29 percent in 1970 to 40 percent in 1972. Overall, 56 percent of dentists thought the public would support dental therapists and 37 percent of dentists thought the public would be indifferent toward dental therapists. Forty-five percent of respondents indicated they would hire a dental therapist to work in their practices to ease workload and free the dentist's time for more complex treatment (**Thomson, Mann, McPhail, 1973**).

Netherlands

Although the Dutch dental profession opposed the expanding role of the "new style dental hygienist," it was enabled by the support of other professional organizations, educational institutions, consumer organizations and the health insurance industry (**Friedman, 2011**). The government determines the legislation and regulates the capacity of dental and dental hygiene programs.

Malaysia

In Malaysia, which has one of the more extensive school-based dental nurse (therapist) programs, a survey of 66 dental officers attached to governmental dental clinics found that "95 percent agreed that dental nurses were an indispensable component of the dental team and that the utilization of this approach to oral health care delivery was appropriate for Malaysia"(**Dolah, Bar, Jafaar, 2006**).

Thailand

Public health dentists working with dental nurses at public hospitals and in the provincial heath offices of the Ministry of Public Health understand and appreciate the role of dental nurses as members of the oral health care team and acknowledge their value in both clinical dental care and in oral health promotion (**Khumeungsitti, 2009**).

There has been a recent proposal that would permit dental nurses to work in the private sector with dentists, assuming a role comparable to an oral health therapist (therapist/hygienist), and becoming affiliate members of the Thai Dental Council as well. However, the Dental Association of Thailand does not support such a proposal, wanting dental nurses to continue to be limited to working solely within the Ministry of Public Health (**Thai Dental Council, 2011**).

South Africa

In 1997, the South African Dental Association (SADA) asked Parliament to put a hold on the training of dental therapists and recommended conversion of existing dental therapists to dentists. In 2000, the SADA recommended the Health Professions Council of South Africa and the Minister of Health discontinue the training of dental therapists and do away with the profession based on their findings (**Naidoo, 2005**).

In 2010, SADA recommended against proposed increases in dental therapists' scope of treatment. "If all of the proposed changes were included, then the profession of dental therapy might as well be scrapped and those resources shifted to the training of dentists (**South African Dental Association, 2010**).

The South Africa Health Professions Council holds that "dental therapists are a hazard to public safety … [who have been] employed by unprincipled dentists [who] have also directed them to perform services for which they are not qualified" (**South Africa Health Professions Council, 2009**).

Jamaica

I.F. McKenzie, Director of the Dental Service, reported that on a scale of 1 to 5, with 1 being very dissatisfied and 5 being very satisfied, the public and the profession would rate their satisfaction with dental therapists at 4. There had not been any reported injury or damage as a result of the care provided by the dental nurses/dental therapists, and no dental nurse/dental therapist ever had their certificate to practice removed or suspended (**McKenzie, 2007**).

PERSPECTIVES OF THE PUBLIC TOWARD DENTAL THERAPISTS

In the **United States**, philanthropic foundations frequently provide leadership in identifying societal problems and funding pilot projects to stimulate both private and public sectors in resolving them. The problem of access to health care and its negative impact on health for the poor and underserved populations has been a focus of several U.S. foundations in recent years. With respect to oral health issues, these foundations have recognized that dental therapists can assist in addressing the problems of access and disparities. They have provided funds for research, advocacy and implementation of oral health care programs. Among them are the Josiah Macy Jr., Pew, Rasmuson, Robert Wood Johnson and W.K. Kellogg foundations.

In discussing problems related to access to care in the United States, C.N. Bertolami, dean of the New York University School of Dentistry, is confident that "patients—both adults and children—of every socioeconomic stratum will find care delivered by dental therapists to be entirely acceptable"(**Bertolami 2011**).

The W.K. Kellogg Foundation commissioned a national survey on the views of Americans on the issue of access to dental care. "More than three-quarters of respondents (78 percent) support a new effort to train a new dental provider—a licensed dental practitioner—to work under the supervision of a dentist to provide preventive, routine care to people without regular access to care" (**W.K. Kellogg, 2011**).

Fulton noted that in **New Zealand**, the dental nurses obviously have the respect of the children."They appear to stand in the same relation to the children as the school teacher" (**Fulton, 1950**).

Also in 1950, one member of the United Kingdom mission to New Zealand, who was delegated to talk to members of the public from all walks of life, found that those interviewed "were rather surprised that there should be any question of the value or usefulness of school dental nurses" (**Bradlaw et al., 1951).**

Davis remarked that in New Zealand that on "that almost intangible atmosphere of orderly calm in the clinics which never ceases to astonish the outside observer … the vast majority of the children attend state schools and there is an approximate 98 percent acceptance rate, the children being examined on entry at the age of 5. About 59 percent of preschool children are also seen at the request of parents from the age of 2½ upwards" (**Davis, 1965**).

Nash also reported on the view of the public relative to the utilization of dental therapists caring for children in New Zealand. He cited Stanley (**2000**), who referred to the School Dental Service in a New Zealand Dental Journal article as an "icon"; and quoted Thomson, a professor at the dental school as saying, "The School Dental Service has become an integral component of the New Zealand culture. To Kiwis it is like motherhood, apple pie and the flag" (**Nash, 2004**).

In 1983, David Barmes, then chief of the Oral Health Unit of the World Health Organization, undertook a review of the South **Australian** School Dental Service. He found widespread support for the service in its current form and the widely held view that it should continue to expand (**Barmes, 1983**).

In a **United Kingdom** survey of patients and dentists in eight dental offices, "Patients attending dental therapists were found to have a significantly higher level of overall satisfaction than those attending appointments with dentists…." (**Sun, Burns, Harris, 2010**).

A closely related series of studies by Dyer and Robinson (**2009**) explored these views and then measured them. No members of the public could describe the duties of a dental therapist. On having these duties explained to them, most (60 percent) would accept simple restorative treatment from a dental therapist. Men, younger people and those who thought they needed treatment were more likely to accept treatment. Fewer people would accept the same treatment for a child (55 percent) and, again, younger people found this more acceptable.

In **Canada**, P.R. Crawford and B.W. Holmes, both former presidents of the Canadian Dental Association, assessed the dental care provided by dental therapists on Baffin Island. Comments from local community members interviewed during the assessment process included opinions such as, "The need to retain and expand the dental therapist program, not curtail it in favor of contract dentists." Crawford and Holmes noted that "in all observations and conversations with residents and officials on Baffin Island it is recognized that the dental therapists play a very important role in maintaining dental health in the communities." They stated that "it is not recommended that dental therapists be replaced by contract dentists … their role be expanded … as much as one therapist in every community … and they become much more active in the provision

of oral hygiene instruction and restoration procedures for pre-school children" (**Crawford, Holmes, 1989**).

The majority of parents chose to enroll their children in the school-based Saskatchewan Health Dental Plan when it was put into operation during the 1974-75 school year. Parents of the 20 percent of nonenrolled children were interviewed by telephone. The most commonly cited reasons for failure to enroll in the Saskatchewan Dental Plan were lack of information about the program, parents had misplaced the enrollment forms, or the child was already being seen by the family dentist. Only 6 percent of nonenrolled children were being seen by a family dentist. "The results of this study suggest that no serious problems regarding enrollment now exist" (**Swanson, 1976**).

A review of the Saskatchewan Health Dental Plan by M.W. Lewis documented "the extent to which the parents of enrolled children are satisfied with it. The findings from a sample survey of 600 parents/guardians in 1978-79 indicated that, despite some minor concerns, there was overwhelming support for the plan, its organization and the dental nurse services. Parents were very much satisfied … 89.2 percent felt that dental nurses provide satisfactory services; respondents served in rural areas recorded the highest level of satisfaction with dental nurses in the province (94 percent)…."(**Lewis, 1981**).

In 1984, a new Conservative government came to power in Saskatchewan and in 1987 the school-based dental program was dismantled and transferred to the private sector. The cessation of the children's dental program met with "opposition in the legislative assembly, the employees of the plan and parents became outraged at the transfer of the school-based plan to the private sector" (**Niedermayer, 1973**).

In a 2010 study titled "The Saskatchewan Children's Dental Plan: Is it time for Renewal?" Ewart commented on the former school-based program: "It seems the majority of Saskatchewan citizens were very happy with this program, while a minority and the Progressive Conservative government was not. The minority decided what was best for the majority" (**Ewart, 2010**).

In the **Netherlands**, attitudinal as well as qualitative studies are conducted periodically of the dental hygienists' services, which includes dental therapists. In one such study, the parents were generally satisfied or very satisfied with the dental care provided. There were no demonstrable differences associated with SES (**Schuller 2010**).

Hong Kong parents also expressed satisfaction with the school dental therapist service. A 1984 survey found that most of the parents were satisfied with the quality of care provided to their child. Three-quarters (76 percent) of the parents

thought that the dental therapists treated their child well. Most of the parents (78 percent) reported that the dental therapists had given adequate oral health instructions and had taken necessary measures to minimize pain (64 percent) during treatment (**Chan, Chu, Lau et al., 1984**).

In another Hong Kong survey, the parents of participants were asked to complete a short questionnaire on their satisfaction with the school dental service. Results showed that 67 percent of the parents were either very satisfied or satisfied, and only 8 percent of the parents were dissatisfied (**Lo, 1987**).

Thailand reports indicate that the clinical dental treatment provided by dental nurses is well- accepted and is of good quality, primarily due to its limitation in scope (**Tawesak, 1988**).

In countries like **Tanzania**, with a developing economy, "patient satisfaction" can be attained even with therapy such as tooth extraction, and patients are very satisfied with the care they receive from dental therapists (N**tabaye, Scheutz, Poulsen, 1998**).

Eighty percent of the recipients surveyed in **Sri Lanka** were strongly appreciative of the care received. However, 20 percent indicated that the dental therapists could have been "kinder." An overwhelming majority of the recipients of the care provided by the School Dental Service, 90 percent, were satisfied with the quality of care provided by the school dental therapists, and 60 percent held the opinion that the service should remain as it was, without change (**Fernando, 2006**).

CONCLUSIONS

The global literature indicates:

1. Dental therapists practice in 54 countries and territories, including highly developed, industrialized ones as well as developing countries.
2. There are variable lengths of training for dental therapists, from two to four years, with two years being the tradition.
3. There is a movement in a few countries to integrate the training, and therefore scopes of practice, of the dental therapist and dental hygienist. Typically this is in a three academic year (27 months) program.
4. Dental therapists, in general, are not licensed professionals, but rather practice as registered auxiliaries.
5. Dental therapists practice primarily in public clinics, typically associated with caring for schoolchildren.
6. Dental therapists' scope of practice is primarily in caring for children, although several countries permit caring for adults.

7. Dental therapists typically practice with general supervision by dentists.
8. Dental therapists provide technically competent care.
9. Dental therapists improve access to care, specifically for children.
10. Dental therapists are effective in providing oral health care within their scope of practice.
11. Dental therapists have a record of providing oral health care safely.
12. The dental profession in a country accepts the care provided by dental therapists as valuable; however, there are some exceptions to this.
13. The public values the role of dental therapists in the oral health workforce.
14. Dental therapists included in the oral health workforce have the potential to decrease the cost of care, specifically for children.

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