

Role of telemedicine and mid-level dental providers in expanding dental-care access: potential application in rural Australia

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Despite great progress in oral health over the past three decades, the rates of caries remain high in Australia, particularly among underserved populations. The reasons for poor oral health amongst underserved populations are multiple, but rests with socio-economic determinants of health. The present review considers international workforce models that have been created to enhance the recruitment and retention of dental providers in rural areas. Several strategies have been developed to address care access problems in rural areas, including the use of telemedicine and mid-level dental providers (MLDPs). Despite ongoing opposition from dentistry organisations, the Alaska and Minnesota workforce models have proven that developing and deploying dental therapists from rural communities has the potential to address the unmet needs of underserved populations. It is more efficient and cost-effective for MLDPs to perform triage and treat simple cases and for dentists to treat complicated cases. The use of MLDPs is intended to increase the capacity of the dental workforce in areas that are too isolated to entice dentists. Telemedicine has emerged as one solution to address limited access to health care, particularly in locations where there is a lack of providers. Telemedicine not only provides access to care, but also offers support, consultations and access to continuing education for practicing dental providers in rural areas. This strategy has the potential to free up resources to increase care access and reduce oral health disparities, thereby contributing to closing the rural–urban oral health gap.

Key words: Telemedicine, dental therapist, workforce, rural, remote, oral health, disparity

INTRODUCTION

Dentistry in Australia, like in many countries, faces significant workforce issues, particularly an uneven distribution of the dental workforce¹. In 2013, a total of 20,000 dental practitioners were registered in Australia, with 65% of the total dental workforce being practicing dentists². However, the majority of practicing dentists work in the private sector, which is largely clustered in major cities³. There is also a marked variation in the average dentist-to-population ratio between urban and rural regions². The reluctance of dentists to practise in rural settings probably pertains to family reasons, low reimbursements and lack of continuing education opportunities⁴. As a result of this maldistribution in the dental workforce, many rural and remote communities in Australia are left underserved, leading to untreated oral disease. There are multiple reasons for this gap between rural and

urban oral health, one of which is lack of access to dental care⁵. Different strategies have been developed in many countries to address unmet oral health needs, including the use of telemedicine and the recruitment of mid-level dental providers (MLDPs)⁶.

Workforce shortages, sparsely populated regions, funding challenges and the decreasing cost of and advances in technology, have resulted in an increased interest in the adoption of telemedicine services⁷. Teledentistry is a domain of telemedicine that emerges from the combination of information communication technology (ICT) and dentistry. For several decades, telemedicine has played a role in bridging gaps and overcoming barriers related to distance through expanding care access to unreachable populations⁸. The use of role substitution in dentistry is not a new concept. The use of MLDPs, like dental therapists (DTs), to provide preventive and routine care is long established in many countries, including Canada, the

USA, the UK, the Netherlands and New Zealand⁶. The development and deployment of DTs has the aim of decreasing the costs and increasing the capacity of existing dental care⁶. Although the practices of DTs have been generally limited to children, their scope of practice has been extended, in some countries, also for the treatment of adults⁶. The present review draws on insights from international experiences and opportunities that address the shortcomings in the provision of dental care in rural settings, related to the shortage of dental providers, and to suggest solutions to reduce oral health disparities.

METHODS

The focus of this study was to identify and review the available literature related to the use of teledentistry and MLDPs in the dental workforce. With the very limited size of the literature base, no attempt was made to conduct a weighted meta-analysis/systematic review of the published literature. The review protocol included a wide-ranging search of multiple databases (PubMed, EMBASE, the Cochrane Library and CINAHL) using a combination of key words from the following list: ‘tele-dentistry’; ‘tele-health/tele-medicine and dentistry’; ‘dental therapist’, ‘mid-level dental providers’; ‘dental auxiliaries’; ‘allied oral health professionals’; ‘school dental service’; and ‘dental workforce’. All records electronically identified were scanned, by the authors, according to title and abstract, and the full text of all studies considered potentially relevant was obtained.

DENTAL THERAPIST PRACTICE IN AUSTRALIA

A DT is a member of the dental team who is registered with the Dental Board of Australia and has completed an accredited bachelor programme of study in the dual streams of dental therapy and dental hygiene. Before 2000, DTs were trained in non-university vocational schools in a 2-year diploma programme. The education of DTs is now university-based with 3-year curricula at the Universities of Melbourne, La Trobe, Griffith, Sydney, Newcastle, Charles Stuart, Queensland, Adelaide, Western Australia and Curtin. At the time of writing, many universities offer dual qualifications in dental hygiene and dental therapy, and the graduates of these programmes are called an oral health therapist (OHT). As in New Zealand, Australian DTs are responsible for examining, diagnosing, and developing and providing treatment plans for children, as well as referring those in need of oral treatment that is beyond their scope of practice⁹. A list of clinical services performed by DTs in Australia is summarised in *Table 1*.

Table 1 Scope of practice for dental therapists in Australia

Roles	Procedures
Oral diagnosis	Oral examination Intraoral dental radiography Extraoral dental radiography (on prescription) Impression taking (but not for prosthodontics treatment)
Prevention	Application of therapeutic solutions to teeth (excluding in-surgery bleaching) Fissure sealants Scaling Dental prophylaxis, including the removal of dental calculus
Operative care	Administration of local anaesthesia Restoration of coronal tooth structure (excluding indirect restorations) Pulpotomies
Orthodontics	Orthodontic procedures, under the supervision of a dentist (excluding diagnosis, treatment planning, initial fixation of brackets, design of orthodontic appliances, and activation and adjustment of orthodontic appliances)
Oral surgery	Extraction of deciduous teeth
Non-clinical	Oral health promotion and education

It is well documented that rural Australia experiences significant oral workforce recruitment and retention issues, particularly of DTs^{10,11}. With DTs only representing <7% of the Australian dental workforce², a significant shortfall in DTs is projected, particularly in rural and remote areas¹⁰. In 2013, there were an estimated 1117 registered DTs engaged in practice, with the vast majority (88%) employed by the School Dental Service (SDS)². Over the last decade, Australia’s SDS has suffered a reduction in workforce, and services remain largely concentrated in the highly populated regions; thus, it rarely provides a sustainable oral care service for all children¹².

Until the 2000s, employment of DTs was limited to the state-operated SDS that is responsible for providing most dental care for schoolchildren in Australia⁹. Since 2006, restrictions on the age of patients who can be treated by DTs have been extended to include adults in some Australian States^{13,14}. A recent study evaluated an educational bridging program to enable Australian DTs to treat patients 26+ years of age in Victoria¹³. Following completion of 203 hours of didactic and clinical observation, participating DTs indicated that the programme was successful in developing their clinical skills and poses an effective method for extending their existing scope of practice to adults¹³.

Employing DTs to provide primary care for children has been well received throughout the world because of the inability of the current dental workforce to address unmet dental-care needs¹⁵. Substantial evidence indicates that DTs can provide quality, safe and effective dental care at low cost^{6,16,17}.

Previous reports from Australia indicated that diagnosis and treatment-planning decisions are comparable between DTs and dentists^{18,19}. Developing and employing DTs to provide oral care services are considered rational and cost-effective approaches. In New Zealand, the annual earnings for DTs are \$30,000–\$45,000 compared with \$120,000–\$150,000 for practicing private dentists¹⁶. In addition, the average cost of New Zealand school-based dental care is \$99 per child, whereas in the private sector, an examination, radiographs and scaling collectively would cost \$99, and a simple restoration would cost an additional \$99²⁰.

TELEMEDICINE IN DENTAL PRACTICE

The rapid advances in ICT and availability of the Internet have increased the potential benefits of telemedicine to dentistry. Telemedicine has emerged as one solution to address limited access to health care, particularly in places far from care centres²¹. Teledentistry is a form of telemedicine that is specifically dedicated to dentistry and utilises ICT for delivery of oral care, teleconsultation, continuing education and public awareness²². Teledentistry application is of utmost importance in rural areas where shortages of the dental workforce are apparent. It has the potential to address various shortcomings that affect the health-care delivery system, such as poor infrastructure, shortage of practitioners and delay in the delivery of care as a result of long waiting lists or the long distance to travel to tertiary centers^{22,23}.

Despite the relatively slow integration of telemedicine into dentistry, the number of teledentistry programmes has rapidly increased, particularly in the USA and Europe²⁴. Although evaluation of different telemedicine applications has proven that this technology can be successfully integrated into different care settings^{24,25}, there is currently little active teledentistry practice in Australia. This could be pertained to practitioners' concerns with costs, surgery time and security threats of teledentistry, as well as the absence of clear guidelines and policy. With oral care services distributed very unevenly in Australia, particularly in rural areas, teledentistry poses an alternative approach for performing examinations, diagnosis and triage referrals, and supports locally based treatment^{26,27}.

Several areas in dentistry that are particularly appropriate for teledentistry are remote consultations for providing treatment plans or preventive care, supervising DTs practicing in remote areas and continuing education²⁸. Dental education^{29–33} and screening for oral disease^{26,34–38} are the most common types of teledentistry application in the literature. The teledentistry system offers efficient ways to deliver distance education and clinical training compared with face-to-face communication²⁸. For instance, Alaska's

dental health aide therapists (DHATs) and their supervisory dentists utilise telemedicine to exchange clinical data, to discuss the optimal way to perform a procedure and to consult on accurate diagnosis and making treatment plans³⁹. Evidence indicates that dental providers with minimal training can successfully perform complex dental procedures under the supervision of an off-site specialist^{29,40}. This approach would reduce the isolation of local providers and allow them to implement treatment plans under the guidance of a dentist at a distance.

EMERGING WORKFORCE MODELS

Several US states have developed programmes that utilise MLDPs and telemedicine to address barriers contributing to the poor oral health among the underserved population⁴¹. In early 2000, the Alaskan Native Tribal Health Consortium (ANTHC) developed a workforce model 'DHAT' that utilises telemedicine to address oral health disparities and lack of access to oral care in Alaska³⁹. Alaska's DHAT model was developed based on the New Zealand school-based program for DTs⁴². Before the development of the ANTHC, a total of 10 Alaskan students completed a 2-year dental therapy programme at the University of Otago in New Zealand⁴². In 2008, ANTHC partnered with the University of Washington to develop a 2-year training programme specifically designed for Alaska's DHATs. In the first year of the programme, students received basic training held at the University of Washington DENTEX centre in Anchorage, Alaska, and the second year of the programme consisted of intensive clinical training in Bethel, Alaska³⁹. Alaska now has 24 federally certified DHATs who provide preventive and therapeutic care for 40,000 Alaska Natives⁴³.

Following completion of 3,000 hours of training during a 2-year dental therapy programme, DHATs must undergo a mandatory preceptorship lasting 400 hours, under the direct supervision of licensed dentists, before they begin to work under general supervision³⁹. DHATs are closely connected with their supervisory dentists through telemedicine, with dentists providing direct, indirect and general supervision^{39,41}. To retain certification, DHATs continue to work in their villages under general supervision, provided that they demonstrate competency in their full scope of practice⁴². A recent study found that Alaskan DHATs provide high-quality and appropriate care that is within their scope of practice⁴². The DTs have the potential to take up more substitute-type roles and be more self-reliant in treatment planning.

In 2009, the state of Minnesota passed legislation to authorise a new non-dentist member, DTs, to practice⁴⁴. The aim of this legislation was to address oral

health disparities and to expand access to dental care in Minnesota⁴⁴. This resulted in the creation of two new categories of practitioners (a DT with a bachelor degree and a masters-level advanced DT), along with a framework that outlines the legal scope of practices and oversight by a licensed dentist. The advanced DTs have a broader scope of practice and can practice off-site without general supervision of a dentist, but they still need to get approval from the supervising dentist before performing restorative and surgical procedures⁴⁴. The funding of Alaska's DHAT model is based on billing Medicaid for dental services delivered to Medicaid recipients⁴⁵. Whilst in Minnesota, DTs are reimbursed for the services they deliver to Minnesota Health Care Plan recipients using a fee-for-service payment model⁴⁵.

Apple Tree Dental is a non-profit model dental practice and runs five dental-care access programs in urban and rural areas of Minnesota⁴⁶. The Apple Tree Dental model links mid-level providers, practicing under the supervision of off-site dentists, with Head Start Centers, schools and other community sites for people experiencing physical, financial and geographical barriers⁴⁶. The Pacific Center for Special Care at the University of the Pacific, Arthur Dugoni School of Dentistry, created a model 'Virtual Dental Home', in sites throughout California, which uses a Cloud-based software system that allows recording, management and retrieval of data from any location. The model is completed with a collapsible dental chair, a laptop computer, a digital camera, supplies to perform temporary fillings and a handheld X-ray machine⁴⁷. Similarly to Apple Tree Dental, Virtual Dental Home permits mid-level providers to provide preventive and simple therapeutic services to an underserved population in community settings under the supervision of a licensed dentist.

Despite the unwillingness, for years, of dentists to work in rural communities, with the majority preferring to work in major cities⁴⁸, the Alaska and Minnesota models have faced opposition by dentists who express concerns about the scope of practice of DTs and their ability to fix dental-care access problems^{49,50}. The American Dental Association also started unsuccessful legal action against the Alaska initiative⁵¹. Despite ongoing opposition, the DHAT model has been welcomed by many in the oral health workforce who consider DTs as a viable solution for expanding oral health services for underserved populations⁵².

DISCUSSION AND CONCLUSION

A key feature of the Minnesota model is the adoption of restrictions to ensure that DTs practice in settings that serve low-income and underserved individuals⁵³.

An essential aspect of Alaska's DHAT is that DTs are recruited from the rural communities where they serve. It is widely acknowledged that, after graduation, students with a rural background are more likely to return to the villages where they were raised⁵⁴. This implies that locally recruited students will be willing to work and live in rural areas on a long-term basis as opposed to most of the dentists who are recruited from and train outside rural areas. Because the shortfall in the number of DTs in rural Australia is projected to increase, recruitment of increased numbers of rural students should contribute to increasing the number of dental providers practicing in rural areas¹⁰.

The implications of telemedicine for dental-care services and oral health in rural areas are enormous⁷. A previous study addressed a number of reasons of why Australian DTs leave the profession in rural settings, including family reasons, career change, poor salaries, relocation and lack of continuing education opportunities¹⁰. Aside from expanding access to dental care, telemedicine can be used to provide support, consultation and access to continuing education for dental providers practicing in rural areas. The use of telemedicine to supervise rural MLDPs remotely also offers a reliable approach to ensure competency and safe practice³⁹. This would support locally based treatment and allow practicing MLDPs to manage simple cases independently of a dentist but permit collaboration for complicated cases. This approach would also encourage practicing dental providers to consider working in rural areas.

There is a need for dental therapy training programmes focused on providing services in rural settings with supervision of a licensed dentist through telemedicine. Particularly, more emphasis on examination, diagnosis and providing preventive and routine care, as well as public education, is required. Telemedicine consultations often need a role substitution to perform examinations and various diagnostic and treatment procedures, and a dental team member other than a dentist can be trained to take up this role. Training this type of dental provider would need significantly less time and fewer resources compared with training a dentist. Because most dental care does not need in-depth specialty consultation, MLDPs with additional training would be able to examine and provide care to simple cases, but to refer complicated cases to a dentist. Recruiting and developing MLDPs may offer a viable approach to solve shortages in the dental workforce, in addition to providing support and incentives to dentists to attract them away from major cities.

There is marked variability in how a telemedicine-based care programme can be funded. Although the implementation of telemedicine necessitates initial

investments in ICT and equipment, and in the costs of technical and administrative personnel, cost savings can be realised in the long term as telemedicine use increases⁵⁵. Savings can also be achieved through reduction in duplication of tests and examinations, and in an increased efficiency in referrals and in communications between peers⁵⁶. Additionally, use of the available ICT infrastructure in dental practices would save on the cost of teledental equipment and reduce practice expenses and consultation costs. The use of MLDPs has the potential to free up human and economic resources to increase care access and reduce disparities in oral health. It is more efficient and cost-effective for MLDPs to perform triage and treat simple cases and for dentists to focus on treatment of more complicated cases^{57,58}. Based on evidence from recent reports on programmes in Alaska and Minnesota, the use of DTs is cost-effective as their earnings account for less than 30% of the revenue generated^{43,59}. Given that the salaries of DTs are about half those of dentists, funding could be secured through the revenue generated by DTs.

As telecommunications technology becomes more widely available and the use of DTs gains acceptance, this is likely to impact care access, the quality of and continued education and the costs of care. This strategy can also serve as a beneficial tool to ensure equality in the provision of oral health-care services and in closing the rural–urban oral health gap.

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Conflicts of Interest

None declared.

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