Public dental waiting list in Australia: a detailed analysis and discussion of management options.

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BDSc Hons (UWA)

This thesis is presented for the degree of Doctor of Philosophy of The University of Western Australia

School of Anatomy, Physiology and Human Biology

2019
Abstract

Objective measures indicate that generally oral health of the Australian population has improved over the years. The gains, however, have not been equally shared among all socioeconomic groups of our communities. The universal health care cover known as Medicare does not include dental care. Around 80% of dental services are delivered through private dental clinics on fee-for-service basis, where the patient is responsible for the cost of treatment, with or without the assistance of private health insurance cover.

Eligible people have an additional option of seeking subsidised dental care through a network of government dental clinics. The demand for subsidised dental care far exceeds the capacity of the public dental system to provide non-emergency dental services, resulting in long waiting lists. Thus, inequality in oral health has a strong socioeconomic dimension, with people reliant on public dental care being less likely to benefit from early detection and preventive dental services.

This research examines the national dental waiting list, provides a detailed analysis of point-in-time access to subsidised dental care, looks at the distribution of the eligible population, and offers suggestions on making the system more effective and sustainable.

Inequality in access to subsidised dental care also has a strong urban-rural dimension, with rural residents being up to 40% less likely to receive treatment. The type of dental services commonly received by various socioeconomic groups also differs greatly. Private patients are more likely to receive preventive dental services, in contrast to public patients. Indigenous patients are at a greater risk of tooth loss when compared to other public patients.

A cost effective and sustainable public dental care system with waiting times that do not exceed recommendations is possible to achieve. The approach should be multifaceted. A systematic upregulation of the public dental sector and simultaneous ongoing arrangements with the private sector for provision of dental services in rural and remote areas should be considered. Inclusion of dental care under Medicare is not a viable option for Australia at this point in time.
Acknowledgements

I would like to thank my supervisors Winthrop Professor Marc Tennant, Associate Professor Estie Kruger and Emeritus Professor John McGeachie for all the advice, support, guidance and encouragement I’ve received over the years.

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I would like to express my gratitude to my lovely wife Elena for her support, understanding, encouragement throughout this journey, and for her patience while listening to my ideas for research.

This research was supported by an Australian Government Research Training Program (RTP) Scholarship.
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Appendix I

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Appendix B (publication – Australian Journal of Primary Health 2015): Geographic distribution of point-in-time access to subsidised dental services in Western Australia.

Appendix C (publication – Rural and Remote Health 2017): A national analysis of dental waiting lists and point-in-time geographic access to subsidised dental care: can geographic access be improved by offering public dental care through private dental clinics?

Appendix D (publication – Australian Journal of Primary Health 2017): Selecting a location for a primary healthcare facility: combining a mathematical approach with a Geographic Information System to rank areas of relative need.

Appendix F (publication – Australian Journal of Rural Health AJRH 2018): Shortage of dentists in Outer Regional and Remote areas and long public dental waiting lists: Changes over the past decade.


Appendix H (communication - https://croakey.org/talking-teeth-does-a-uk-study-point-the-way-to-more-cheaper-dental-checkups 2016): Talking teeth: does a UK study point the way to more, cheaper dental checkups?

Appendix I (previously published work)
Publications arising from thesis

In line with the regulation of The University of Western Australia this thesis is presented as a series of six papers which either “have been published in refereed journals, manuscripts that have been submitted for publication but not yet accepted, or manuscripts that could have been submitted” (UWA, 2016).


2. Dudko Y, Kruger E, Tennant M. Geographic distribution of point-in-time access to subsidised dental services in Western Australia. Aust J Prim Health 2016; Feb;22(6):569-575. doi: 10.1071/PY15163 (Appendix B)


4. Dudko Y, Robey DE, Kruger E, Tennant M. Selecting a location for a primary healthcare facility: combining a mathematical approach with a Geographic Information System to rank areas of relative need. Aust J Prim Health 2018; doi.org/10.1071/PY17093 (Appendix D)


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<tr>
<td>ACT</td>
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<td>ACHR</td>
<td>Australian Centre for Health Research</td>
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Chapter One

1. Introduction
1. Introduction

At the level of an individual, the concept of good health can mean different things and can often be very subjective. The social comparison theory as described by Leon Festinger in 1954 proposes that individuals are likely to “self-evaluate” their beliefs and views by comparing themselves to others (Festinger, 1954). The theory has since evolved to include self-enhancement and positive self-evaluation as direct goals of social comparison.

The “self-enhancement” addition to the theory proposes that individuals may distort information obtained from social comparison to help them arrive at a more positive self-assessment result. In 1981 Wills described the downward comparison principles in social psychology (Wills, 1981). In essence, a person may select an individual or a group for social comparison whom they consider to be worse off than them, to feel better about their situation (Wills, 1981). However, in an alternative scenario where an individual compares themselves to someone who is better off, the opposite is suggested to be true, and the effect on self-esteem is negative (Wills, 1981).

Humans are very sociable beings and much of such comparison takes place during daily interactions or virtual activities such as looking through Facebook. Whatever the mode of encounter, a smile is one of the first things one notices about a person, be it in real life or on a photograph. A smile can tell us a lot about a person; how happy they are, whether they like us, or how approachable the person is. A beautiful smile can also be uplifting and memorable.
People who feel self-conscious about their teeth may not smile as freely or as widely, possibly affecting how they are perceived by others. In more extreme cases poor oral health can negatively impact social contact, professional activities, or even intimacy (Griffin, et. al., 2012). Dental decay and loss of dentition can limit what a person can eat and diminish the sense of satisfaction from food (Griffin, et al., 2012). Poor oral health can affect speech (Smith and Sheiham, 1979), and negatively impact physical appearance of a person (Eli, et. al., 2001).

The majority of Australians have access to high-quality dental care services and generally have good oral health, largely as a result of improvements in personal oral hygiene at a population level. But there are also people in our society who are not benefiting and have missed out on the improvements.

Factors such as socioeconomic status, geographic isolation, fears and phobias, poor understanding of oral health, cultural and language barriers can play a role. Some people still consider that they only need to see a dentist when they are in pain. Financial barriers to preventive dental care tend to have a greater effect on people representing lower socioeconomic groups and those residing outside major cities (AIHW, 2013).

If not treated in a timely manner, dental decay can result in pain, abscesses and systemic infections, leaving individual little choice but to seek emergency treatment. Despite our much improved understanding of dental disease, and its consequences,
over the years, tooth decay continues to remain the most prevalent chronic disease in the world and indeed Australia (Lam et al., 2013)

A review of the literature by Cotti, with subsequent publication in the International Journal of Cardiology in 2011, suggested that chronic dental infection could also have links to a number of systemic conditions such as cardiovascular disease (CVD), chronic kidney disease (CKD), ischemic stroke and myocardial infarction (Cotti et al., 2011; Minassian et. al., 2010). There is also evidence to show that treatment of periodontal disease can have a positive impact on metabolic control in patients with insulin resistant type diabetes (Simpson et. al., 2010).

Dental decay is believed to be, largely, a preventable disease. Research shows that preventive measures and early detection is the key to good oral health (Griffin et. al., 2007; Tan et. al., 2010; Heitz-May et. al., 2002; Little et. al., 1997). Studies have found links between good oral health and good general health.

In Australia, medical treatment pertaining to general health is covered under Medicare, which provides access to either free or significantly reduced-cost medical care (including hospital care) and allows patients the option to choose, in most cases, which medical practitioner to visit. Dental treatment is not covered by Medicare and is largely paid for privately on the fee-for-service basis.
Dental care in Australian is largely privately funded. Private expenditure amounts to about 80% of the total annual expenditure on dental care as individual out of pocket expenses. The other 20% of the expenditure originates from a combination of State and Federal initiatives for the purpose of offering subsidised dental care to children and socioeconomically disadvantaged members of our communities.

Subsidized dental care is offered as a community safety-net to complement the private dental sector (McGuire et. al., 2011). Subsidised dental care is available to only eligible population and is provided through State government dental clinics. Eligibility for subsidised dental care is means tested. Thus, there is a direct relationship between eligibility and low socioeconomic status of a person. Further evidence exists to show a relationship between low socioeconomic status and poor oral health (Brennan, 2008); in essence defining all public dental patients as at greater risk of dental disease.

Demand for subsidised dental care by adults is triaged, following patient contact with trained receptionists at government dental clinics, and is applied across the States and Territories based on pre-determined clinical criteria. In essence, people with acute dental problems, usually involving pain or discomfort, are classed as an emergency and are seen on the day. For routine and non-emergency dental care people are placed on waiting list. The ability of a particular government dental clinic to offer routine care to patients on its waiting list depends on the demand for emergency care and available resources (Lalloo and Kroon, 2013).
The Australian Dental Association (ADA) in 2008 estimated that approximately 650,000 Australians are on public dental waiting lists, with an average waiting time of 27 months (Mattews, 2008). Government dental clinics do not openly advertise availability of subsidised dental care. Thus, the number of people that qualify, but are not aware of the service, could be much higher.

An often forgotten effect of having long waiting lists is that a person on the list may no longer qualify for subsidised dental care if they become gainfully employed by the time routine treatment is finally offered. The problem is further compounded in cases where employment is of relatively short duration and the person is once again placed on to the waiting list.

Most people initially present with relatively minor problems when they are placed on the waiting list. Due to the dynamic nature of dental disease, and such long waitlist time, disease can progress to a point where a more complex/expensive treatment is indicated, or indeed, an extraction is advised. Subsequently, in many cases eligible patients are only able to access dental care when an obvious emergency develops. Publically employed dentists spend a large portion of their time treating such emergencies, with less time being allocated to routine care such as check-ups and preventive treatment. The emergency treatment is more likely to result in extraction of the problem tooth rather than a more conservative treatment (NACOH, 2004).
Professor Richardson, director of the centre for health and economics at the Monash University, has estimated that untreated dental problems cost our economy up to $2 billion per year in hospitalisation, emergency management and lost productivity (Richardson and Richardson, 2011).

The number of people waiting for non-emergency subsidised dental care has been increasing over the years. The existing system seems unable to meet the demand as evident from the increasing waitlist times. A final report by the Australian Health Ministers’ Advisory Council identified a “need for a robust service system that supports access across the community to basic preventive and treatment services for population subgroups with particular needs.”

Recently (2012) Federal government had implemented a National Partnership Agreement (NPA) to help address the problem of growing dental waiting list. Initial reports suggest that program has had some success in reducing the waiting times for routine dental care by giving patients an authority to seek limited subsidised care through private dental clinics to a maximum value of $1 000. However, the program is widely seen as a short-term measure with no funding guarantee beyond the immediate financial year (2015 – 2016). The cost effectiveness of the initiative is also yet to be measured.
It is clear that our public dental care system needs to evolve in order to improve access for marginalised communities, address current unmet need for the services, and have a level of “built in redundancy” for the future.

This thesis conducts a detailed analysis of the public dental waiting lists and point-in-time access to subsidised dental care, and discusses various management options in search for a more permanent, cost effective and sustainable model service delivery into the future.
Chapter Two

2. Literature Review
2.1 Health Care in Australia

Health system in Australia consists of an intricate, multilevel network of services, health care providers and health care recipients (AIHW, 2014; OECD, 2015). The health system is controlled by numerous governance and support mechanisms that develop policy, legal framework, ensure coordination, regulate and fund various aspects of the system.

As can be expected, a health care system of this magnitude and complexity can be expensive to maintain. In fact, in 2011 – 2012 financial year the cost of the system was estimated at $140.2 billion, which is about 10% of Australia’s GDP (AIHW, 2014). Interestingly, this amount is almost twice as high as in 2001 – 2002 financial year; indicating that health care expenditure is outpacing Australia’s population growth (AIHW, 2014). The increase in expenditure has largely been attributed to our ageing population and prevalence of chronic conditions. Funding of the health care system also covers a range of additional services such as population health initiatives, community health programs, health research, and health services for Indigenous Australians, mental health and health care infrastructure.

The World Health Organization defines a health system as “activities whose primary purpose is to promote, restore and maintain health and to deliver quality services to all people, when and where they need them” (WHO 2013b).

Health care system in Australia consists of a network of public and private providers in various settings (Dwyer, 2008).
2.1.1 Types of Health Care

*Primary Care* providers are often the first point of contact for non-urgent health related assistance (Kelleher, 2001). This category includes services provided by general medical and dental practitioners, pharmacists, dietitians, physiotherapists, chiropractors and Indigenous health workers (Kelleher, 2001). Primary health care receives about 36% ($50 billion) of the total health care budget (AIHW, 2014).

*Secondary Care* providers usually operate on a referral system from the primary care service providers. This category includes specialist such as Gastroenterologists, Immunologists etc., and can include health related services provided by hospitals (Nicholson, 2012).

*Hospitals / Tertiary Care* providers cater to patients that require urgent or surgical care, but can also provide care to patients requiring a more detailed investigation (AIHW, 2014).

2.1.2 Medicare

Medicare was introduced 1984 (AIHW, 2014). The aim was to offer free or subsidised care to citizens and permanent residents of Australia. Medicare can be described as a safety-net that consists of three sections: hospital, medical and pharmaceutical. In essence, the safety-net offers free care in public hospitals, rebates when seeing a primary or secondary health care provider and a subsidised range of prescription medications. Dental treatment, however, in only covered by Medicare in specific and limited circumstances (AIHW, 2014; Australian Government, 2014).
Safety-net rebates and benefits are based on a set fee schedule which is determined by the Federal government. Private health care providers are not required to adhere to the schedule and set their own fee. However, in these circumstances the patient is required to meet the difference, referred to as a “gap”, between the set fee and the actual fee charged (AIHW, 2014).

In a public hospital environment, Medicare offers free health care and accommodation to public patients. In this setting patients do not have a choice of doctors; they are assigned by the hospital (AIWH, 2014).

In a private hospital environment, Medicare covers 75 per cent of the set fee schedule and does not include accommodation or pharmaceuticals (AIHW, 2014).

Medicare does not cover procedures that are not medically indicated (AIHW, 2014), such as cosmetic procedures, and the following areas:

- Ambulance
- Dental treatment (limited exceptions)
- Physiotherapy
- Occupational therapy
- Chiropractic services
- Podiatry
- Psychology
- Optometrist

Medicare offers subsidies for a broad spectrum of pharmaceuticals included in the Pharmaceutical Benefits Scheme (PBS) (Australian Government, 2016). Under this arrangement, Australian citizens and permanent residents receive a discount on
prescription medicines that are featured on the PBS list. If a particular drug is not featured on the PBS list, the patient pays the full cost (AIHW, 2014).

An additional scheme, the Repatriation Pharmaceutical Benefits Scheme (RPBS), is overseen by the Department of Veteran’s Affairs (DVA) and offers a wide spectrum of pharmaceuticals at subsidised rates to returned servicemen and war widows / widowers (Department of Human Services 2012).

2.2 Importance of Oral Health

2.2.1 Oral Health and Systemic Diseases

The World Oral Health Report 2003 outlined the evidence showing that a close relationship exists between oral health and general health. Today, it is generally accepted that poor oral health has strong links to systemic chronic diseases, which in some cases can cause disability (Petersen, 2003).

Cardiovascular disease (CVD) has been recognised as serious, and unfortunately very common, disease in Australia, with around 4 million people being affected. CVD is the leading cause of death in Australia with around 50 000 people having died from it in 2008. Multiple studies have found strong links between periodontal disease and CVD (Walls, 2001; Genco, 2001; Cohen, 2001).

In some cases, a person with fewer than 10 natural teeth remaining is up to 7 times more likely to die from CVD when compared to fully dentate individuals (Holmlund, 2010). The authors described a linear relationship between the number of the
remaining teeth and risk of death from CVD. These findings indicate that number of remaining natural teeth can be used to gauge the risk of CVD in adults (Holmlund, 2010).

A systematic review by Bahekar in 2007 found that the incidence of coronary heart disease is significantly higher in patients with periodontal disease (Bahekar, 2007). These finds were supported in a systematic review by Khader in 2004 (Khader, 2004).

In Australia, access to dental care is through a number of different clinical pathways, and is financed in a number of different ways.

**Diabetes** has been linked to advanced periodontal disease. Patients with diabetes, especially poorly controlled cases, are at a greater risk of periodontal disease (Jung, 2011; AAP, 2011). Latest research suggests that periodontal disease may complicate control of diabetes (Jansson et al, 2006).

**Respiratory disease**: A systematic literature review (2006) found strong evidence for an association between oral health and respiratory disease: good oral hygiene reduced the frequency of respiratory conditions in nursing home residents. In particular, there was an increased risk of pneumonia in patients with poor oral hygiene.

**Stroke** has also been linked to poor oral health; there being around a 17% increase in the risk for stroke among patients with severe periodontal disease, compared to healthy individuals (Wu et al, 2000; Joshipura et al, 2003).
**Chronic kidney disease** (CKD) could be another chronic systemic condition associated with chronic periodontitis. The link is tentative in the sense that periodontal disease was more common in patients with chronic kidney disease, not the other way around (Akar et al, 2011).

**Peripheral vascular disease** (PVD), or hardening of arteries, is greater in patients with periodontal disease (Meurman et al, 2004). However, further studies are needed to confirm the risk.

**Dementia** may be associated with tooth loss. A recent Japanese study of over 4 000 participants found that those with some tooth loss or no teeth were more likely to suffer from dementia when compared to fully dentate patients (Okamoto et al, 2010).

**Premature and birth-weight** may also be associated with periodontal disease in a mother’s mouth. It has been suggested that bacteraemia from periodontal disease in a mother may have an impact on the health of the developing foetus and lead to preterm birth (Cullinan et al, 2009). Preterm birth carries greater risk of early death or developing a chronic medical condition in those babies that survive (Offenbacher et al, 1996).

**Stomach ulcers** causing H. pylori were more prevalent in plaque of patients with poor oral hygiene (Al Asqah et al, 2009).
2.2.2 Mechanism of action

The mechanism of action is not fully understood. Some possible explanations include bacteraemia caused by the action of chewing in people with periodontal disease. Brushing of teeth may also cause bacteraemia in established periodontal infection cases. Bacteraemia, in turn, could cause problems in other parts of the body. In some cases bacteria that are commonly found in periodontal infection sites have been identified in arterial walls and even in amniotic fluid. It is also possible that bacteria in the blood may release toxins which may cause the immune system to respond. The response may harm blood vessel walls, making it possible for blood clots to form.

In addition, poor oral health may introduce the impact on the ability to chew food. This may, in turn, alter the diet and reduction in nutritional value (Locker, 1992).

2.3 Dental Care in Australia

2.3.1 Private Dental Care

The majority of dental care is provided in a private practice pathway though a distributed collection of settings (Lam, 2012), the majority of which are situated in densely populated capital cities (Tennant, 2013). Previous research points to the distribution of these clinical settings being driven by population affluence and not necessarily disease burden (Tennant, 2013).

In this private practice pathway the patient is responsible for the costs of any treatment, with or without the assistance of privately funded insurance. The level of health insurance in Australia fluctuates, but currently about 45% of the population is
covered (Kruger, 2011). Market forces set the costs of care in this pathway there is no
government interference in the market, although there is some effect of insurance
driven schemes on the fee for service arrangement within a minority of practices.

2.3.2 Public Dental Care

Consistent with a strong social policy position held by sequential Australian
governments since at least WWII, people in poverty have access to subsidised health
services inclusive of dental care. Dental care is provided through a series of public
dental clinics distributed across Australia (Tennant, 2013). The cost of care is
subsidised by State governments by between 25% and 100% of the benchmark Federal
Government Fee (DVA), based on the income level of the patient (Dental Health
Services, 2008). Variation on the level of subsidy is seen from jurisdiction to
jurisdiction, and in some cases differences exist between population groups. Although
the federal fee schedule is based loosely on private practice fees, it is estimated to
range from 20-40% less than a similar “basket” of care in the private sector (Australian
Dental Association, 2013).

Aboriginal and Torres Strait Islander people, in addition to the two pathways outlined
above, can also access dental care through a series of Aboriginal Medical Services
(AMS) clinics distributed across Australia. On the whole these clinics provide care at
no cost to the patient (Dyson, 2012).
2.4 Public Dental Care (Settings and Eligibility)

In Australia public dental services are available in a range of settings such as school dental clinics and community dental clinics. In some cases a voucher may be issued allowing for limited subsidised dental care to be provided in a private dental practice.

There are slight variations in eligibility criteria across States and Territories in Australia. Generally, however, an adult needs to possess either a Health Care Card or a Pension Concession Card to receive subsidised dental care (NSW Health Department, 2016).

Children are usually considered eligible for subsidised dental care if they are less than 18 years old and have a Medicare card (NSW Health Department, 2016).

2.5 Funding of Health Care

The Health Care system receives its funding from government and non-government (patient contributions and private health insurance) sources. In 2011 – 2012 financial year a total of $140 billion was spent on health care (AIHW, 2014).

In 2011 -2012 financial year hospitals received a total of $53.5 billion. State and Territory governments contributed $22.9 billion (43%) and the Federal government paid a further $19.5 billion (37%). The remaining $11 billion (20%) came from non-government sources (AIHW, 2014).

In the same year primary health care services received $51 billion in funding. Federal government contributed $23 billion (46%), non-government agencies contributed $20 billion (40%), and State and Territory governments funded the remaining $7 billion (14%) (AIHW, 2014).
The remaining $27.5 billion was spent on other recurrent components of the health
care system. Expenditure on infrastructure amounted to $8 billion of the total (AIHW,
2014).

2.4.1 Funding Trends

Over the 10 year period (2001-02 to 2011-12) expenditure on health care has
increased by about 1.7 times, when adjusted for inflation. State and Federal
governments have retained their position as the primary source of funds. However,
the contribution of the Federal government has declined (from 44% to 42.4%), as has
the contribution by non-government sources (from 32.8% to 30.3%). Contributions by
State and Territory governments have increased (from 23.2% to 27.3%), accordingly.

2.6 Funding of the Dental Care

Total expenditure on dental health was around $8 billion (AIHW, 2015) in 2013 – 2014
financial year; which is about 6% of the expenditure on the Health Care System. Of
that amount, about $5 billion was paid by individuals (AIHW, 2015). Private Health
Insurance providers contributed $1.5 billion to the total (AIHW, 2015). Federal
Government expenditure on dental care amounted to $0.5 billion in the last (2013 –
2014) financial year. State and Territory Governments paid approximately $0.7 billion
in the same financial year (AIHW, 2015). The Department of Veteran’s Affairs
contributed $0.1 billion to the total amount (AIHW, 2015).
2.6.1 Funding trends


From July 2016, the Federal Government will establish a new Child and Adult Public Dental Care agreement with States and Territories. The agreement is expected to be in place for 5 years. Around $415 million will be made available in the 2016 – 2017 financial year, with a total of $2.1 billion to be spent over the 5 year term of the agreement (Health Department, 2016).

2.7 Effectiveness of Private Dental Insurance

The Annual report (2015) on dental health of the Australian population stated that most (77%) of adults with private dental insurance cover reported that their insurance fund met some of the dental costs arising from their last dental visit (AIHW, 2015). A much smaller number of adults (8.5%) with private dental cover stated that their insurance fund paid all of the cost arising from their last dental visit. Ten per cent of adults with private dental cover indicated that they paid all of their own dental costs (AIHW, 2015).

Around 18% of those that met their own dental costs indicated that dental bilis caused financial stress. This is in contrast with 4% the sample population for whom insurance fund paid all of their dental costs and 10% of those people that had to make a partial payment (AIHW, 2015).
Individuals remain the largest source of funds for the Australia’s dental care system, contributing 59% of the total cost. Insurance funds contribute around 16% of the annual bill, with Federal and State governments making up the shortfall of around 25%.

### 2.8 Dental workforce

According to the Australian Institute of Health and Welfare, in 2013 there were 15 479 thousand dentists registered in Australia (AIHW, 2015). About 13 200 (88%) of those were working as dentists (AIHW, 2015). This, on average, translates to about 56 dentists per 100 000 of population. The distribution of dentists across Australia varies greatly with remote areas having as little as 25 dentists per 100 000 of population (AIHW, 2015).

Approximately 11 220 dentists were working in the private sector, with the remaining 1 980 being publically employed (AIHW, 2015). When differentiation between private and publically employed dentists was made, a significant contrast in distribution was observed. In particular there were 47 private dentists per 100 000 of population compared to 9 public dentists per 100 000 of population (AIHW, 20015). Considering the fact that approximately 47% of the Australian population is eligible for subsidised dental care (NSW Health Department, 2016), one can begin to appreciate the enormity of the problem our Public Dental Care system is facing.
2.9 Oral Health - Snapshot

Tooth decay has been described as the most common chronic disease in Australia (AIHW, 2014) and can occur at any stage in life. Good oral hygiene, low sugar diet and regular dental check-ups are effective in maintaining good oral health. Adopting these strategies early in life can significantly reduce the burden of poor oral health in later years. It is widely accepted that tooth decay is a preventable disease.

2.9.1 Children

Children are at risk of tooth decay as soon as deciduous teeth appear (Lonergan, 2014). However, only 12% of children up to 2 years of age have been seen by a dentist. Although caries experience in children of different ages differs, on average around 58% of children up to 12 years of age experienced tooth decay. The incidence of tooth decay in children has been identified as a good predictor of likely future dental problems (The Royal Australasian College of Physicians, 2013).

Poor dental health can have a negative impact on child’s performance at school and self-esteem. Up to 72% of Australian parents reported to be concerned about the appearance of their child’s teeth. Alarmingly, up to 48% of parents believe that decay is unavoidable in children (Lonergan, 2014).

Although, over the years, our understanding of dental disease has significantly improved, the incidence and severity of dental disease in children and adults increased since the late 1990s (AIHW, 2014).
2.9.2 Adults

Almost 60% of adults were unsure about the aetiology of tooth decay (Lonergan, 2014). Moreover, 49% of Australian adults indicated that they sometimes forget to brush their teeth before going to bed (Lonergan, 2014). Poor oral health has had a negative impact on quality of life on up to 28% of low income earning (up to $20,000) Australian adults. This figure is in contrast with the same experiences reported by 7.5% of higher income earning (more than $80,000) adults in Australia.

It has also been found that the adult Indigenous population is more than 2.3 times as likely have untreated tooth decay compared to non-Indigenous population.

Interestingly, around 37% of Australians believe that oral health of Australians needs to improve (Lonergan, 2014). And 75% of adult Australians think that they should have taken better care of their teeth when they were younger. But at the same time 58% think that everyone gets cavities (Lonergan, 2014). More than 25% of adults aged over 65 do not have any natural teeth. Around 20% of adults avoided having to alter their diet to compensate for problems with their teeth (Chrisopoulos and Harfoerd, 2013).

Periodontal infection is another common type of oral condition with up to 60% of the adult population being affected by mild to moderate form of the disease. A further 15% of adults are affected by the more advanced and destructive form of periodontitis (Eke et al, 2010).
2.10 Inequalities in Oral Health

Despite our better understanding of dental disease, and subsequent general improvement in oral health over the decades (AIHW, 2014; Slade et al, 2007), the gains have not been equally shared by all members of our communities and inequalities still exist. There are significant disparities in the dental service mixes between the private, public clinical pathways (Dudko et. al 2016). Research clearly show that private patients, irrespective of whether they attend a clinic in the capital or non-capital city, are much more likely to have their teeth restored rather than extracted. It is also apparent that edentulous spaces do not get filled as frequently by way of fixed or removable prosthesis in public clinics as they do in private clinics (Dudko et. al 2016).

When respect to the cost of treatment, it becomes evident that approximately threefold as much is spent on dental services through private clinical pathway when compared to public pathways (Dudko et. al 2016).

2.10.1 Age and Gender

The older population group (aged 65 and over) are 15 times more likely to suffer from gum disease compared to younger populations (15 to 25 years old). The incidence of edentulism among those aged over 65 is much higher (21%) by comparison to those aged between 45 and 64 (5.5%) (Chrisopoulos, 2013).

Men are 5% more likely to have untreated decay than women and on average likely to have more decayed teeth than women. Men are also 8% more likely to suffer gum
disease compared to women (Oral health and dental care in Australia, 2014). Females are more likely to feel uncomfortable about appearance of their teeth (28%) compared to males (22%).

2.10.2 Indigenous Australians

Indigenous Australians are at a greater risk of poor oral health compared to the non-Indigenous population (Slade et al, 2007). The risks include; a greater incidence of caries, periodontal disease and tooth loss. These oral conditions are also more likely to remain untreated, resulting in more extractions (Jamieson and Sayers, 2008). The contrast with non-Indigenous population is in part attributed to limited access to culturally aware preventive dental care, in particular in rural and remote locations where the Indigenous population is more commonly represented. Census 2011 estimates that there were 713 000 Indigenous people living in Australia, representing 3% of the total population (Australian Bureau of Statistics, 2014; Williams et al, 2011).

2.10.3 Socioeconomic determinants

Scientific evidence points to the vast differences in oral health that exist between groups of populations with different socioeconomic backgrounds in Australia. It has also been found that concession card holders are less likely to visit a dentist on a regular basis and have a higher rate of dental disease (McAuliffe, 2004). Adults with lower levels of education and household income are more likely to experience tooth loss and other oral disease which impact on their quality of life (Sanders, 2007; Spencer 2004; Slade et al, 2007). Adults in lower socioeconomic groups are twice as
likely to be missing up to 5 teeth by the age of 44 (Sanders, 2007), and this difference continues to increase with age.

There is a link between a person’s oral health status in adulthood and the socioeconomic position of that same person in childhood, and household income of the parents. Adults whose parents were involved in blue collar work (15%) were twice as likely to retain less than 20 teeth in later years, compared with people whose parents were considered to be white collar workers (7%) (Sanders, 2007).

By the age of retirement the contrast becomes stark with lower socioeconomic people, on average, having lost 15 teeth by comparison to 8 lost teeth by adults from the higher socioeconomic group (Sanders, 2007). This places the lower socioeconomic group below the critical 20 natural teeth threshold (shortened arch concept) described as an accepted prerequisite for adequate chewing function (Sanders, 2007).

Tooth loss is a slow and gradual process that is often accompanied by decay, bouts of toothache, chronic infection of the periodontium, reduced aesthetic value and lowered self-esteem.

The socioeconomic differences also extend to the prevalence of private health (including dental) insurance cover. People with lower socioeconomic backgrounds are
less likely to purchase private health insurance, and more likely to pay the full price of dental care, or being reliant on public dental care (Sanders, 2007).

2.10.4 Geographic barriers
Geographical remoteness has often been identified as one of the main barriers to obtaining health related services (ARCPOH, 2009). People living in non-capital city areas are more likely to have a problem-oriented pattern of dental attendance (ARCPH, 2009). Utilisation (as realized access) of dental services reduces (by as much as 40%) as the distance one has to travel to obtain the service increases (Dudko et al, 2016). People residing in regional areas have more missing teeth compared with city residents. The number of people with untreated decay was also higher in regional areas (37.6%) compared to capital cities (23.5%) (Chrisopoulos, 2013). Rural residents also had a greater risk of gum disease (36.3%) by comparison to their city counterparts (Chrisopoulos, 2013).

2.10.5 Impact of remuneration and private health cover on provision of dental care
The substantial difference in the mix of care provided in the different clinical pathways (private vs public) points to factors other than disease affecting the type of treatment provided. It would be easy to point to cost as an important factor; however, the cost to patients in the public sector are substantially subsidised by the taxpayer and thus the cost effect is ameliorated. More interestingly, the various remuneration patterns of operators in each sector may well play a role in the differences. In the private
sector, remuneration is based on fee-per-item, while the public sectors are salary-based models.

The mix of models of remuneration may be one reason for the substantial differences in the care provided in each pathway (Bloomfield, 1992). In the early 1990s Sir Kenneth Bloomfield conducted a review of the National Health Scheme (NHS) in the United Kingdom (Bloomfield, 1992). One of the common themes that emerged from the consultation with the dental professionals was that:

Some alleged that item of service payments encouraged dentists to work faster and faster, even to intervene unnecessarily.

The level of private health cover can influence the type of treatment a patient agrees to. A majority of adults with health insurance reported that their insurance paid some (in 78.7% of cases) or all (in 7.8% of cases) of the dental costs of their last visit. Only 9.4% of insured adults paid all their own dental expenses (Chrisopoulos, 2011). Some insurance funds have conditions attached to their policies that do not allow rollover of the allocated policy funds into the next calendar year, thus effectively encouraging the policy holder to ‘use’ the cover. This could result in more frequent dental check-ups and preventive care being delivered.
2.11 The Role of Public Dental Care

The public dental care system plays a vital role in meeting oral health needs of the very young, elderly and financially disadvantaged members of our community. The impact of oral disease on the general health and wellbeing of an individual, and indeed communities, has been well documented. However, there is another moral aspect of the public dental care system that can at times be overlooked but nevertheless needs to be mentioned. To this end I would like to share the following quotes:

"The measure of a society is found in how they treat their weakest and most helpless citizens." - Jimmy Carter.

"Our society must make it right and possible for old people not to fear the young or be deserted by them, for the test of a civilization is the way that it cares for its helpless members". - Pearl S. Buck (1892-1973), My Several Worlds [1954].

"A decent provision for the poor is the true test of civilization."
– Samuel Johnson, Boswell: Life of Johnson.

"...the moral test of government is how that government treats those who are in the dawn of life, the children; those who are in the twilight of life, the elderly; those who are in the shadows of life; the sick, the needy and the handicapped." - Last Speech of Hubert H. Humphrey.

"A nation's greatness is measured by how it treats its weakest members." - Mahatma Ghandi.
"Any society, any nation, is judged on the basis of how it treats its weakest members -- the last, the least, the littlest." - Cardinal Roger Mahony, In a 1998 letter, Creating a Culture of Life.

2.12 Challenges Facing Public Dental Care

Only a fraction of the eligible population (19% and 11% of the eligible metropolitan and rural residents, respectively) access subsidised dental care (Dudko et al., 2016). Even though this represents an underutilisation of care by the eligible population, the waiting times to see a dentist for non-urgent dental care can be up to 24 months (Dental Health Services 2014). With such long existing waiting lists, it is clear that public services and resources would not cope with increase in demand for services.

Changes in demography and the oral disease distribution as Australia’s population ages will need to be taken into account when planning future service delivery (National Strategy, 2001). Currently around 70% of those eligible for subsidised dental care are in possession of a Pension Concession Card (Dudko et al, 2016). Health Care Card holders make up around 30% of the eligible population (Dudko et al, 2016). Looking into the future, as our population continues to age, access to dental care may need to be given even higher consideration.

Data show that there is a gradual shift in dental care expenditure towards the individual-pays approach. This may result in access to oral health care becoming less equitable, as patient’s out-of-pocket expenses continue to increase. Equality in oral
health, especially for Indigenous Australians (Slade et al, 2007), might be more achievable if financial and educational barriers are eliminated and culturally sensitive services become more widely available.

Limited availability of public dentists (in terms of supply and distribution) is an ongoing problem. The demand for subsidised dental care is likely to continue to outstrip the ability of the existing oral health care system to provide the service.

Private dental clinics continue to be more concentrated in more affluent metropolitan areas (Tennant and Kruger, 2013). If serious consideration is to be given to the idea of contracting out public dental care, this maldistribution may reduce effectiveness of the initiative.

2.12.1 Waiting list

Public dental care waiting lists show that the demand for subsidised care exceeds the capacity of the system to provide services. Waiting time is the time between the dates a person in placed on a waiting list and the date they are offered routine dental care. Waiting times differ between States and Territories but are up to 24 months long (Dental Health Services, 2014).

Over the years, prolonged waiting times associated with public dental waiting lists have frequently featured in the national media and commonly perceived to be a major problem with the public dental care system (The Age Victoria, 2012; The West
Australian, 2012). This is one of the main reasons for patient dissatisfaction (Chu and Lo, 1999; Chu et al., 2001; Esa et al., 2006; Klingenberg et al., 2008). Patient dissatisfaction grows considerably when waiting times for routine dental care exceeds 46 days (Tuominen and Eriksson, 2012).

### 2.13 Measures to Reduce Waiting List


Following the report, a National Partnership Agreement (NPA) was introduced. Under the agreement the Federal Government allocated $515 million (for 2012 - 2013 financial year) to dental health to reduce the national dental waiting list. The NPA requires the States and Territories to provide regular updates on treatment rates and waiting lists in exchange for funds. A further $1.3 billion was pledged from 1 July 2014 to expand the services (Department of Health, 2012a).

Early reports suggest that the measure has been successful in reducing the national dental waiting list. However, as the measure was meant as a short-term solution, a more cost-effective and sustainable approach may be needed.
2.14 Conclusion

Federal government funded Medicare reduces the financial burden on Australians wishing to access medical or hospital care. Australian citizens and permanent residents can access free or reduced cost healthcare services. Dental care is not covered under Medicare and largely remains a privately funded expenditure.

A dental care "safety net" exists for financially disadvantaged individuals. Pension Concession Card and Health Care Card holders are able to access subsidised dental care through a network of public dental clinics. Indigenous Australians also have a choice of being seen at Aboriginal Medical Services clinics. In addition, all children under 18 are able to receive dental care through School Dental Services.

Currently, the demand for subsidised dental care for adults exceeds the ability of the public dental care system to provide these services, resulting in waiting lists, in some cases 24 months long. Long waiting lists exists despite the fact that only a fraction of the eligible population (18%) is making use of the services. When additional factors are considered, such as the ageing population and global economic slowdown, it becomes apparent that the system will struggle to meet any potential increase in demand for subsidised care.

Regular dental check-up is the key to early detection of dental problems. People with favourable visiting patterns (seeing their same dentist on a regular basis) are also more
likely to receive preventive dental services. In contrast, people who follow a problem oriented visiting pattern (seeing a dentist for a specific problem such as pain) are less likely to receive comprehensive treatment or preventive dental services. Poor dental health has been linked to systemic diseases resulting in an increased burden on our health care system, and our communities. Detection and treatment of dental problems at an early stage has the added benefit of eliminating the need for more involved (and expensive) treatment.

Despite overall improvements in oral health over the years, gains have not been equally shared by all members of our communities. People residing in rural areas and those representing lower socioeconomic groups are at greater risk of dental disease. Addressing these inequalities would require reduction or removal of fiscal and geographic barriers to accessing subsidised dental care. Our public dental care system needs to have the capacity to meet existing and future demographic challenges, while remaining cost effective.
Chapter Three

3. Aims and Hypotheses
3.1 Aims

The main aim of this thesis is to examine the composition and distribution of the national public dental waiting list and identify cost effective management options for future service delivery. The thesis offers a detailed analysis of the following aspects of dental care in Australia:

3.1.1 Examine the distribution of the National dental waiting list at the State level.

3.1.1.1 Account for the distribution of the population on the national waiting list across all States and Territories.

3.1.1.2 Consider the people on the national waiting list in terms of per capita of total population for each State and Territory.

3.1.1.3 Compare the cost of treating those people on the national dental waiting list in private clinics (subcontracting the work) vs public clinics.

3.1.2 Compare distribution of the eligible population and public clinic locations in Western Australia.

3.1.2.1 Identify if there is a relationship between distribution of the unemployed and not in the labour force population and those on the dental waiting list.

3.1.2.2 Consider to which eligibility criteria those on the waiting list belong (ie is it unemployed or the retirees that make up the bulk of the demand for subsidised dental care?)

3.1.2.3 Compare characteristics of metropolitan and rural eligible populations.

3.1.2.4 Calculate the percentage of those eligible for subsidised dental care who actually use the service.
3.1.3 Identify the distribution of those eligible for subsidised dental care at SA 1 level, define the catchment area of a public dental clinic, and gauge if any geographic advantage may be gained (in terms of eligible population coverage) by subcontracting the delivery to private clinics.

3.1.3.1 Calculate what percentage of the population resides within 5km, 10km and 50km radius of a public dental clinic.

3.1.3.2 Estimate what percentage of the eligible population resides outside metropolitan areas.

3.1.3.3 Gauge the impact, in terms of geographic reach, by offering subsidised dental care through private dental clinics in cases where distance to the neared public dental clinic is considered to be excessive.

3.1.3.4 Identify any expected benefits of this approach to rural residents and compare with those residing in metropolitan areas.

3.1.4 Describe a mathematical model for identifying and ranking potential locations for health infrastructure projects.

3.1.4.1 Gauge whether inclusion of publically available statistical data into weighed mathematic formula can help to improve both quantitative (sites with similar statistical characteristics) and qualitative (sensitive to a variable of choice) attributes of the results when selecting potential sites for health infrastructure projects.

3.1.4.2 To see if the results can be further improved by combining the mathematical model with a Geographic Information System.
3.1.5 Identify the most in need locations (at SA2 level) for future public dental clinics.

3.1.5.1 Apply mathematical modelling to identify and rank areas of relative need for new public dental clinics across Australia.

3.1.5.2 Cross reference the findings with a list of existing public medical hospitals with a view to, where possible, utilize existing infrastructure.

3.1.5.3 Gauge what improvement in geographic access can potentially be achieved in rural areas.

3.2 Hypothesis

This thesis explores the following hypothesis with respect to dental care in Australia:

**Hypothesis 1** - The cost of care per capita received by public patients in private clinical setting is similar to that received in public dental clinics.

**Hypothesis 2** – It is cheaper to subcontract the treatment of public patients to private dentists.

**Hypothesis 3** – The mix of care received by Indigenous public patients is similar to that received by non-Indigenous public patients.

**Hypothesis 4** - The national dental waiting list is long due to high percentage of those eligible for subsidised care seeking such treatment.

**Hypothesis 5** - Rural residents are not at a geographic disadvantage as far as access to dental care is concerned because even though the travel distance may be greater and total travel time should be similar to that in cities.
**Hypothesis 6** – The rate of utilisation of public dental care by rural residents is similar to that of metropolitan residents.

**Hypothesis 7** - Waiting lists are an unavoidable feature of the public dental care system.

**Hypothesis 8** – There is no association between socioeconomic status and access to dental care due to public dental clinics being available right across the country.

**Hypothesis 9** – The public dental care system is well positioned to meet current and future demand for services.

**Hypothesis 10** – Subsidised dental care is mainly used by unemployed people.

**Hypothesis 11** – Total federal and State expenditure on the public dental care makes up a large percentage of the expenditure on the health care system overall.

**Hypothesis 12** – There is no real benefit to subcontracting treatment of public patients to private clinics in rural areas.

**Hypothesis 13** – It is not possible to identify areas of relative need at SA2 level because the Department of Human Services only keeps statistics for those eligible for subsidised dental care at the level of electorate.

**Hypothesis 14** – There is no value in applying mathematical formulae to help identify and rank areas of relative need because health infrastructure expenditure is influenced by a large spectrum of factors.
Chapter Four

4. Materials and Methods
4.1 **Introduction**
This retrospective study collected and analysed statistical data from a series of publically available sources including Australian Bureau of Statistics, Public Dental Health departments in each State and Territory and previously published research to examine the composition and distribution of the national public dental waiting list to help identify cost effective management options.

4.2 **Ethics Approval**
All collected data was de-identified and grouped, rendering it impossible to identify individuals. Thus, no specific ethics approval was required. Nevertheless, this research has been carried out in line with the guidelines of the National Statement on Ethical Conduct in Human Research (NHMRC) and the policies and procedures of The University of Western Australia.

4.3 **Waiting List Data**
All waiting list data for each State and Territory for the 2012 – 2013 financial year was collected from official websites, or confirmed through direct communication with various jurisdictional bodies, and were analysed. The total number of patients listed for public dental care in Australian Capital Territory (ACT) 165, New South Wales (NSW) 42 000, Queensland (QLD) 62 513, South Australia (SA) 12 454, Tasmania (TAS) 17 225, Victoria (VIC) 116 864, and Western Australia (WA) 11 822. The Northern Territory (NT) did not report its data and offers of participation were declined. Notwithstanding this it is estimated that the data-size of the NT would be comparatively small.

4.4 **Eligible Population - WA**
Eligible population data (Pension Concession Card and Health Care Card holders) for Western Australia (n=426 955) were obtained from the Department of Human Services website.
4.5 Distribution of the Eligible Population - National

Initial research identified a close correlation between the distribution of the unemployed and not in the labour force population and those eligible for subsidised dental care (Dudko et. al., 2015). Thus Census 2011 statistical data were used to map the distribution of the eligible population across the nation as Statistical Area 2 level. The level of eligibility corresponded to about 75% of the total “unemployed” or “not in the labour force” population obtained from the Australian Bureau of Statistics (ABS) website.

4.6 Government and Private Practice Locations

Previously published research provided the physical address (as well as latitude and longitude) for each dental practice in Australia (collated from a number of open sources) as at August 2012; this formed the basis for these data (Tennant and Kruger, 2013).

4.7 Australian Statistical Geography Standard

The Australian Statistical Geography Standard (ASGS) was used for this thesis. This widely accepted framework for the geographic analysis of populations divides the country in to 4 levels of clusters. The levels are described as SA1, SA2, SA3 and SA4. The smallest clusters (SA1s) typically contain about 400 people per SA1 area. SA2s closely follow suburb gazetted suburb outlines with populations of about 10 000. Each
SA3 consists of SA2s and is likely to contain around 80 000 people. SA4s are State based (ABS, 2016a).

### 4.8 Usual Resident Population

Usual resident population data (Census 2011), covering the entire nation, were downloaded from the ABS website as Statistical Area 1 level.

### 4.9 Hospitals Data

Geographic locations for all public hospitals were obtained from the [www.myhospitals.gov.au](http://www.myhospitals.gov.au) website. Only general public hospitals with emergency department were selected.

### 4.10 Socio-Economic Indexes for Areas (SEIFA)

Socio-Economic Indexes for Areas (Census 2011), covering the entire nation, were downloaded from the ABS website at Statistical Area 1 level (ABS, 2016).

### 4.11 Geographic Analysis

The Quantum Geographic Information System (version 2.8.1) software was used to map population distribution, dental clinic and hospital locations, and SEIFA index.
4.12 Data Processing

In an effort to automate the process of analysing available data, a computer program was written. This was compiled using Python version 3.5.1 and makes use of hierarchal tree data structure in conjunction with a recursive algorithm to achieve the results. The program was instructed to read Comma-Separated Value data file containing statistical data to compile first data branch at SA1 level using a weighing formula. The first branch results were then used by the program to compile the next branch at SA2 level via recursive algorithm. This process continued until results as SA3 and SA4 levels were obtained. A report was generated upon completion of the branch building process, which allowed for the aggregate values to be calculated for each statistical area, and ranked from low to high.

4.13 Weighing Formula

The SEIFA index was weighted with two task specific factors; “usual resident population” and “unemployed or not in the labour force” population. The inclusion of “unemployed or not in the labour force” population allowed for comparison of concentrations of the eligible population between all statistical areas, and made it possible to consider those concentrations as a percentage of the total population of each statistical area. Thus making it possible ultimately to rank those areas once smoothing was applied.
Chapter Five

5 National dental waiting lists: what would it take to reset to zero?

This chapter was published in the Australian Health Review.

5.1 Abstract

Objective: Over the years, long public dental waiting lists across Australia have received much attention from the media.

The issue for eligible patients, namely a further deterioration of dental health because of not being able to address dental concerns relatively quickly, has been the subject of several State and Federal initiatives. The present study provides a cost model for eliminating public dental waiting lists across Australia and compares these results with the cost of contracting out public dental care to private clinics.

Methods: Waiting list data from across Australia were collected from publicly available sources and confirmed through direct communication with each individual State or Territory Dental Health body. Average costs associated with employing key dental personnel and performance figures were used from previously published data to estimate the potential financial commitment and probable public benefits.

Results: The cost model suggests that, on average, it would be more than twice as expensive to contract the work out to private dental clinics as to treat eligible patients within public dental clinics. It is estimated that the cost of eliminating the legacy dental waiting lists (over 12 months) would be between $50 and $100 million depending on the method adopted. The effort would require some 360 dental teams.

Conclusion: The design of the Australian public dental care system that is targeted at meeting the needs of eligible patients into the future, in addition to being effective
and sustainable, must also offer a level of protection to the taxpayer. The ability to address waiting list backlog identified in the present study clearly would require a mix of service models depending on service availability at different locations. Further research is needed to optimise the mix of service providers to address community needs.

5.2 What is known about the topic

Long public dental waiting lists across Australia have received much attention from the media. The topic has been the subject of debate at the government level and, over the years, has seen an increase in allocation of public funds in an effort to address the policy needs.

5.3 What this paper contributes

This study calculates the actual number of people on the public dental waiting list, provides a detailed analysis of the distribution of the demand for the services and offers a cost model for resetting public dental waiting lists across Australia.

5.4 Implications for practitioners

This study carries no implications for individual practitioners at the clinical level. However, at the state and national levels, this model offers direction to a more cost-effective allocation of public funds and human resources.
5.5 Introduction

Until 1946, the Commonwealth of Australia, with the exception of its responsibility for the health of war veterans, did not have the constitutional power to offer health, pharmaceutical or dental services and benefits. In 1946, constitutional amendment gave the Commonwealth the authority to provide and fund a wide range of health services and benefits (Biggs, 2009).

Today, the adult dental care system in Australia consists of an intricate combination of private and public service providers and funding, evolving from this original constitutional divide between State and Commonwealth. The majority of dental care is provided via the private practice pathway, through a distributed collection of settings (Lam, 2012). In this private practice pathway, the patient is responsible for all treatment costs, with or without the assistance of privately funded insurance. The level of health insurance in Australia fluctuates, but currently approximately 45% of the population is covered (Kruger, et. al., 2011). Market forces set the costs of care in this pathway (without any government interference), although there is some effect of insurance-driven schemes on the fee-for-service arrangement within a minority of practices.

Consistent with the 1946 amendment to the Australian Constitution, and strong social policy positions held by sequential Australian governments since World War II, people in poverty have access to subsidised health services, inclusive of dental care. Subsidised dental care is provided through a series of public (State and Territory run) dental clinics distributed across Australia (Tennant and Kruger, 2013). Public dental
clinics are usually located in major centres and provide access to a limited range of dental treatments (Biggs, 2008). Some locations also contract out services to private dentists.

The cost of dental care to eligible patients is subsidised by State governments, with various co-payment approaches taken by individual States and Territories, but universally based on the income level of the patient (DHS, 2008). The demand for dental services from eligible patients exceeds the capacity of State and Territory public dental services to provide treatment, resulting in waiting lists, with historical waiting times of 27 months reported (Lalloo and Kroon, 2015). Long waiting time for an appointment has been identified as one of the main reasons of patient dissatisfaction (Chu and Lo, 1999) and has frequently been the source of news stories in the national media.

More recently, the Commonwealth Government has committed $1.3 billion over several years to State and Territory governments to support additional dental services for adults. This funding is being provided through a National Partnership Agreement (NPA) for adult dental services. The measure is aimed at reducing long waiting times to see a public dentist by providing eligible public dental patients with an authority to seek limited treatment from a private dentist. The current NPA for public dental patients ended in March 2015 and a cut-down 12-month extension was put in place. The second NPA was originally scheduled to start on 1 July 2014, but the Budget proposed its deferral until 2015–16. Although early reports suggest that the NPA has had some success in reducing the national dental waitlist, the initiative is deemed too
new to determine with any degree of certainty whether the effect will be long lasting, cost effective and sustainable.

The public dental system in Australia is highly dynamic and the waiting lists tend to provide a buffer between the demand and available public resources. Therefore, waiting lists may not be inherently bad as long as the eligible patients are able to access the required care within the desirable time frames (Lalloo and Kroon, 2015). Patients with acute problems attending the Government Dental Clinics are prioritised and appointments are made immediately for the most urgent cases, whereas others are placed onto the waiting list (Lalloo and Kroon, 2015).

The present study examined, at the national level, dental waiting lists for routine dental care and modelled the total workforce and financial commitment that would be required to eliminate current waiting lists. Obviously, eliminating waiting lists is not a real outcome, but provides a solid basis for determining the magnitude of the national waiting lists and its effect on total system performance. Based on these findings, the paper attempts to identify a cost-effective and sustainable approach to addressing the demand for subsidised dental care into the future that would also allow the desirable time frames (Lalloo and Kroon, 2015) for routine dental care to be maintained.

5.6 Methods

All data used in the present study were grouped into total numbers for regions; therefore no ethics approval was required.
5.6.1 Waiting list size

All waiting lists data for each State and Territory were collected from websites or confirmed through direct communication with various jurisdictional bodies. The data were collected for a single time-point (mid-2013). This time point was chosen specifically because any large-scale effect from the NPA would be unlikely so early in the implementation process (within a couple of months) (Queensland implementation plan, 2013).

5.6.2 Value of care

Previously published data (Dudko, 2015) identifying the average mix of care via various clinical pathways in Western Australia (Dudko, 2015) were used to represent the monetary value of a typical low, middle and high cost dental treatment plan per 1000 patients.

5.6.3 Primary model approach:

5.6.3.1 Operator efficiency

Efficiency data (i.e. the time taken for an operator to complete care on patients) for public dental service dentists were collected from previously published work (Gutacker, 2015). In short, the average number of patient visits per treatment plan (mean (+/- s.d.) 3.0 +/- 1.8) (Dudko, 2015) and the average number of patients seen per day (10 patients) by a public dentist was used as the benchmark activity. Assuming a full-time equivalent (FTE) of a 7.6-h work day (38 h per week), the average number of patients a single public dentist would be able to treat per year was calculated. ‘Work year’ was defined as a calendar year minus weekends (104 days), public holidays (12 days), annual leave (20 days), Continued Professional Development leave (5 days) and
personal leave days (~4 days). The actual number of work days for a public dentist has been calculated to be 220 (365 – (104 + 12 + 20 + 5 + 4)).

5.6.4 Alternative model approach

An alternative approach would be to provide subsidised dental care through the existing network of private dental clinics around Australia to complement the effort of the government dental clinics. In this model, a private dentist would be reimbursed for service provision to eligible patients in line with the Department of Veteran’s Affairs (DVA) dental fee schedule. A previous study from our group identified the mix of care a patient is likely to receive via four different clinical pathways in Australia, including public, Chronic Disease Dental Scheme (CDDS), private and Aboriginal Medical Services (AMS)-based care (Dudko, 2015). In the present study we rested on the most commonly used dental treatment item numbers identified in each clinical pathway and monetary value assigned using the 2013 DVA dental fee schedule (ADA, 2013b) per 1 000 patients treated.

5.7 Results:

5.7.1 Waiting list size

The total number of patients currently listed for public dental care in the Australian Capital Territory (ACT; \( n = 165 \)), New South Wales (NSW; \( n = 42 \ 000 \)), Queensland (Qld; \( n = 62 \ 513 \)), South Australia (SA; \( n = 12 \ 454 \)), Tasmania (Tas.; \( n = 17 \ 225 \)), Victoria (Vic.; \( n = 116 \ 864 \)) and Western Australia (WA; \( n = 11 \ 822 \)) was obtained from State Dental Health Services websites or through written requests for data to the department (Table 5.1). The Northern Territory (NT) did not report its data and offers of participation were declined. Notwithstanding this, it is estimated that the number of
people on the NT public dental waiting list would be very small compared with other States and Territories.

Table 5.1: Average cost of treating public dental patients across each State and Territory

| ACT, Australian Capital Territory; NSW, New South Wales; Qld, Queensland; SA, South Australia; WA, Western Australia |
|---|---|---|---|---|---|---|---|
| Co-Payment value | ACT | NSW | QLD | SA | TAS | VIC | WA |
| ~20% | Nil | Nil | $155 max | $44 / app | $26.50/app | 25% |
| People on waitlist | 165 | 42 000 | 62 513 | 12 454 | 17 225 | 116 864 | 11 822 |
| State population Ppl on waitlist/1000 | 386 000 | 7 432 200 | 4 676 403 | 1 674 700 | 513 400 | 5 768 600 | 2 535 700 |
| Cost of labour | $38 115 | $9 707 334 | $14 440 503 | $2 876 874 | $3 978 975 | $26 995 584 | $2 730 882 |
| Less Pt Co-Payment | $6 913 | 0 | 0 | $1 930 370 | $2 273 700 | $9 290 688 | $618 094 |
| Net cost | $31 202 | $9 707 334 | $14 440 503 | $946 504 | $1 705 275 | $17 704 896 | $2 112 788 |
| Total cost | $46 648 502 |

5.7.2 Primary model approach

Operating teams required to eliminate the national waiting list:

The cost of providing a dental service in terms of subsidies, dentist and assistant wages per 1 000 patients can be calculated.

Applying the methodology, it was modelled that, on average, a public dentist is able to complete 2 200 patient visits (appointments) per work year (220 days per year x 10 patients per day). Extrapolating this, on average, a public dentist is able to complete the treatment for approximately 733 patients per work year (2 200 patient visits / 3 visits per patient to complete an average treatment).

Given that the waiting lists at the time of the present study was 263 043 people, it is estimated that 359 (263 043 / 733) dental teams will be able to completely eliminate
the waiting lists in 1 year assuming they undertake no other care than remove patients from the list. It is noted that many government clinics are also teaching facilities where students are also rostered to provide endpoint dental care under supervision, which may affect output calculations.

5.7.3 Cost model

The Australian Dental Association estimates the average salary for a dentist (in 2013) was $92 000 (Open Universities Australia, 2014). The average wage for a dental nurse for the same year was $49 000 (Open Universities Australia, 2014a). The addition of superannuation entitlements (and various other on-costs) adds approximately 20% to the dentist and nurse labour costs. This translates to $101 per hour for both the dentist and the nurse (((($92 000 + $49 000 + 20%) / 220 work days per year) / 7.6 h per day). This equates to $231 127 (in salary and wages per 1 000 patients treated). The study does not account for costs associated with administration, reception, materials or laboratory work because direct labour costs are the most substantial cost component (some > 65%) of the overall costs (ADA, 2009).

The total cost in terms of dentist and nurse wages can now also be calculated with regard to elimination of all the dental waiting lists right around Australia by multiplying the cost of treating 1 000 patients by the total number of patients listed in thousands ($231 127 x 263.043 = $60 786 401; excluding patient co-payments).
5.7.4 Sensitivity analysis

The estimated cost is based on an ‘average’ course of care that spans over three appointments. The dental team’s time is the main cost determinant in this equation; it would therefore follow that price would change depending on the number of appointments a patient requires to complete their course of care. Taking into account the standard deviation of the sample for the length of course of care (1.8 appointments), a cost spread was established (Table 5.2). The cost of providing dental care (Table 5.2) is very sensitive to the number of appointments required to complete patient course of care. The cost spectrum spans between $24 478 781 (1.2 appointments) and $97 024 988 (4.8 appointments), with an average of $60 786 401 (three appointments), excluding patient co-payments (Table 5.2).

<table>
<thead>
<tr>
<th>Teams Required</th>
<th>Team Labour cost</th>
<th>Approx. Co-Payment</th>
<th>Estimated net cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minus SD of 1.8 = 1.2 app</td>
<td>143</td>
<td>$24 478 781</td>
<td>$5 647 906</td>
</tr>
<tr>
<td>Average Number of app. 3</td>
<td>359</td>
<td>$60 768 267</td>
<td>$14 119 765</td>
</tr>
<tr>
<td>Plus SD of 1.8 = 4.8 app</td>
<td>574</td>
<td>$97 024 988</td>
<td>$22 591 624</td>
</tr>
</tbody>
</table>

5.7.5 Summary of the model outcome

In short, it is estimated that it will take 359 public dental teams 12 months with a cost estimated at $60 million to eliminate the waiting lists that remain in Australia. Most of the teams ($n = 169) would need to be based in Victoria, whereas 86 teams would be needed in Qld and the remaining 104 would be located throughout the other States and Territories.
5.7.6 Alternative model approach

It is recognised that even though Australia has a sizeable network of public dental clinics throughout the country, long waiting lists and geographic remoteness of towns and cities can make it difficult for eligible patients to access the services in a timely manner. The waiting times for eligible patients on the public dental waiting lists for routine dental care in Australia is beyond optimal (Lalloo and Kroon, 2015). Therefore, it would be reasonable to conclude that there is a shortage of government dentists doing the work. If this statement is correct, it would follow that in order to completely eliminate all the current waiting lists in Australia, either more funds need to be allocated to employ public dentists (and building new clinics) or consideration must be given to contracting the work out to private dentists. Previous work identified the average cost and compared the types of services a patient was likely to receive via four clinical pathways: public, CDDS, private and AMS (Dudko, 2015). A concise overview of the findings has been included below to help understand the composition of the cost associated with the alternative approach model.

Patients attending public dental clinics, on average, received treatment to the value of $209 523 per 1000 patients. In this pathway, 7% of the total value was attributed to extractions, 4.8% to crowns and bridges and 50% for the provision of simple fillings. In this setting, between 50% and 75% of the treatment cost is subsidised by the government, depending on patient eligibility (Dudko, 2015). The CDDS, which, until recently, provided eligible people (not based on economic eligibility but on health-based factors) the ability to claim rebates from the national government health financing system (Medicare) for dental treatment provided by private dentists. The
CDDS, introduced in 2007, entitled people with chronic medical conditions (directly related to their dental health) to be covered for dental treatment up to the value of $4 250 over a 2-year period (Armfield et. al., 1998). In the CDDS pathway, patients received approximately $470 062 worth of treatment per 1 000 patients. Extractions accounted for only 2% of the workload. Crowns and bridges made up 18% of the bill, whereas simple fillings contributed 27% to the overall total (Dudko, 2015).

The private care pathway showed similar financial results to the CDDS. On average, $477 790 worth of treatment per 1 000 patients was provided. Extractions made up 1.9% of the total cost, with crowns and bridges accounting for 15.9% and simple fillings for 47% of the total amount (Dudko, 2015).

In short, patients receiving treatment through both the CDDS and private pathways received fewer extractions and more than threefold as many complex (crown and bridge) restorations as those being treated through the public pathway. Because the now historic CDDS was paid for by Medicare and analysis of both CDDS and private clinical pathways offers an objective overview of the type and frequency of services delivered. These pathways can be viewed as an example of the kind of cost the taxpayer may be expected to meet should serious consideration be given for the work to be contracted out to the private sector and the spectrum of service delivery in terms of dental item numbers is not restricted. Projecting these findings over our national dental waitlists, the cost of eliminating current dental waitlists by contracting the work out to private clinics is likely to be $111 415 509 including patient co-payment. As a comparison, our previous calculation found that 359 strategically located government-employed dental teams, not undertaking any other activities
except treating patients on the waiting list, would have the capacity to eliminate
Australia’s entire dental waiting list for a total of $46 648 502 once patient co-payment
is taken into account (Table 5.1).

5.8 Discussion

A recent inquiry into Adult Dental Services in Australia by the ADA (March 2013) has
concluded that: “the NPA is unlikely to reach the level of funding that was expended
under the CDDS in any given year” (ADA, 2013a).

Therefore, experience with the CDDS can provide some insight into the costs
associated with ‘contracting out’ of public dental care. As both the CDDS and the
private pathway examples demonstrate, such care is more expensive compared with
the public pathway. However, it must be noted that, compared with the public
pathway, CDDS and private pathways have higher rates of provision of endodontic and
crown and bridge services. These services are generally more labour intensive and
thus more expensive. Conversely, the public pathway has a higher rate of extractions
and simple restorative services. These differences may reflect the predominance of
emergency or problem visiting for public dental care and the subsequent lack of
opportunity for more comprehensive and preventive dental care. Changes in patients’
personal circumstances may also create a situation whereby patients move in and out
of eligibility without ever reaching the top of the waiting list. The difference in cost
may also reflect the tighter rationing of services within a course of care in the public
dental services. The criteria for the provision of complex restorations, such as crowns
and bridges, are complex and may require ‘standardisation’ should serious
consideration be given to contracting out these types of dental services. In addition, it has been well documented that such complex restorations require ongoing maintenance and good oral hygiene. Therefore, by definition, patients with a history of generalised decay are not always optimal candidates for complex restorative procedures, because under such conditions these restorations are more likely to be a risky long-term clinical decision. Of course, the requirement and techniques for maintaining good oral hygiene can be explained to patients before such restorations are undertaken. However, patient compliance with such recommendations can only be accurately assessed over time. Thus, provision of subsidised complex restorative procedures through public dental clinics may provide a better safety net for the taxpayer because there are stricter controls for providing such high-maintenance and expensive restorations.

The subject of long dental waiting lists is not new and there are many opinions on what should be considered to reduce them. The true number of eligible patients who would like to access subsidised dental care could be even higher than reported because of the fact that prolonged waiting times may discourage people from applying.

Adding to the debate, several studies have linked poor oral health and systemic diseases (Cotti, 2011); highlighting the urgency of addressing dental problems early. In more recent years, it has been suggested (Biggs, 2008) that perhaps dental care should be included under the Medicare scheme, offering the Australian public universal access to dental services. Although such a move could potentially reduce the waiting lists by allowing unlimited access to dental care privately, the cost associated with such
an initiative is likely to be prohibitive and has been estimated to be up to $11 billion annually (Biggs, 2009). Arguably the most cost-effective approach would be to continue to deliver public dental services through the public dental clinics, where available, and employing more dental teams if demand for services and clinical facilities allow. Standardising the classification of the currently available dental services through the public dental clinics as either ‘essential or medically essential’ or ‘elective’ could also be an option. This classification effectively creates two waiting lists: ‘essential’ and ‘elective’, not too dissimilar from what public hospitals operate under. This clear distinction allows publicly employed dentists to work quicker through the ‘essential’ waiting lists by focusing initially on elements of dentistry that are fundamental to arresting progression of disease. This sort of triaging of patients in the public sector has been effective in several places previously (Ponnusamy, 2013) and is a common practice in NSW and Qld. Reducing progression of disease is likely to improve the overall health of the patient and may reduce the amount of dental work required during future ‘elective’ visits.

In areas that do not have a sufficient population to warrant building a public dental clinic, the level of subcontracting of public dental services to private clinics should be increased. This approach, although more expensive, could potentially have an added bonus of providing more favourable terms for private practitioners to set up practice in country towns; offering additional benefits for the rural and remote communities.
5.9 Conclusion

In addition to being effective and sustainable, the design of the Australian public dental care system that is targeted at meeting the needs of eligible patients into the future, must also offer a level of protection to the taxpayer. The ability to address waiting list backlog identified in the present study clearly would require a mix of service models depending on service availability at different locations. It is estimated that the cost of eliminating the legacy of dental waiting lists (over 12 months) would be between $50 and $100 million depending on the method adopted. The effort would require some 360 dental teams, with most based in Victoria. Different approaches to addressing this legacy were considered and variations in the cost and manpower issues presented. Further research is needed to optimise the mix of service providers to address community needs.

5.10 Acknowledgements

The authors thank the Government Dental Services of the Australian Capital Territory, New South Wales, Queensland, South Australia, Tasmania, Victoria and Western Australia for sharing their data and providing support for this research.
Chapter Six

6. Geographic distribution of point-in-time access to subsidised dental services in Western Australia.

This chapter has been published in the Australian Journal of Primary Health.

Dudko Y, Kruger E, Tennant M. Geographic distribution of point-in-time access to subsidised dental services in Western Australia. Aust J Prim Health 2016; Feb;22(6):569-575. doi: 10.1071/PY15163 (Appendix B)
6.1 Abstract

**Background:** Western Australia (WA) is a State within Australia which occupies over a third of the continent. With a total land area of 2 529 875 square kilometres WA is home to about 2.6 million people, 426 955 of whom are eligible for subsidised dental care. Dental Health Services (DHS) is the largest public primary oral health care provider in WA with a net cost of service of $64 379 000.

**Objective:** To calculate likely travel distance to the nearest clinic, gauge utilization rates and estimate the dynamics of future demand for subsidised dental care.

**Methods:** Eligible population data were collected from the Department of Human Services and the Australian Bureau of Statistics websites and integrated with the waiting list and the recall list data provided by the DHS. Quantum Geographic Information System (QGIS) software was used to map distribution of the eligible population across WA by Statistical Areas, and to plot the locations of the Government Dental Clinics.

**Results:** Sixty five per cent of the eligible population reside in the metropolitan area. However, only 22% are either on the waiting list or have already received subsidised care. Thirty five per cent of the eligible population reside in country areas. Thirty per cent of the eligible country patients are located within a 100km range of a government dental clinic; with only 11% of those either on the waiting list or having already received subsidised dental care. Almost 6% of the total eligible population (22 383 people) reside outside the 100km range of any of the government dental clinics.

**Conclusion:** Country WA residents are at a significant disadvantage by comparison to their metropolitan counterparts with respect to access to subsidised primary care, and
are up to 40% less likely to receive treatment. The findings also suggest that the
demand for subsidised dental care is unlikely to fall significantly with improvements in
economic climate, but in fact is likely to rise as more baby boomers reach their
retirement.

6.2 What is known about the topic

The lower socioeconomic groups of our community do not receive adequate, timely
access to primary care, with historic waiting times for adult general dental care of up
to 24 months in Western Australia.

6.3 What this paper contributes

This study looks at the level of service utilisation by the eligible population and
provides a detailed analysis of the geographic distribution of the demand for the
subsidised primary oral health care services across Western Australia.

6.4 Implications for practitioners

This study carries no implications for individual practitioners at clinical level. However,
at the State level these findings offer directions for future service delivery.

6.5 Introduction

Until 1946, the Commonwealth of Australia, with the exception of its responsibility for
the health of war veterans, did not have the constitutional power to offer health,
pharmaceutical or dental services and benefits. In 1946 constitutional amendments
gave the Commonwealth the authority to provide and fund a wide range of health services and benefits (Biggs, 2008).

Today the adult dental care system in WA consists of an intricate combination of private and public service providers. The majority of dental care is provided via the private practice pathway, through a distributed collection of settings (Lam, 2012). In this, the patient is responsible for the cost of any treatment, with or without the assistance of privately funded insurance. The level of health insurance in Australia fluctuates, but currently approximately 45% of the population is covered (Kruger et al., 2011). Market forces set the costs of care in this pathway; there is no government price-control in the market, although there is some effect of insurance driven schemes on the fee-for-service arrangement within a minority of practices.

Consistent with the 1946 amendment to the Australian Constitution, and strong social policy positions held by sequential Australian governments since the WWII, people in poverty have access to subsidised health services, inclusive of dental care. Subsidised dental care is provided through a series of public (State run) dental clinics distributed across WA (Tennant et al., 2013). Dental Health Services (DHS) is the largest public primary oral health care provider in WA.

DHS provides subsidised dental care to Western Australians aged 17 years and older that hold a current Health Care or Pension Concession card. The cost of dental care to
eligible patients is subsidised by State government, with three co-payment approaches (no co-payment, 25% co-payment, 50% co-payment) that are based on the income level of the patient (DHS, 2008). Public dental clinics provide access to a limited range of dental treatment (general and emergency) for eligible patients (Biggs, 2008). Some locations also contract out services to private dentists.

The demand for dental services from eligible patients exceeds the capacity of State public dental services to provide treatment, resulting in waiting lists, with historical waiting times of 24 months reported (DHS, 2014). Long waiting times for an appointment are one of the main reasons of patient dissatisfaction (Chu and Lo, 1999) and have frequently been the source of news stories in the national media.

The present study examined, at the State level, the point-in-time rate of utilisation of government dental clinics across the State. The analysis included: the geographic distribution of the population eligible for the subsidised dental care; and gauged the effectiveness and capacity of the existing system to continue to provide dental services into the future.

6.6 Methods

No individual level data were used and no-identification of patients was possible with the grouped data provided. Thus ethics approval was not required. We also de-identified the clinics.
6.6.1 Eligible population

This retrospective study collected Pension Concession Card and Health Care Card holder’s (eligible people, n=426 955) distribution data from the Department of Human Services website (distributed by electorate). These data were re-distributed to boundaries (Statistical Area level 2- SA2) that are consistent with the 2011 Census. Census data for “unemployed” and those “not in the labour force” (n=583 872) by SA2 (Census 2011) were used to provide the relative proportions of eligible people to each SA2 within a given electoral boundary. Where electoral boundaries split across an SA2 the SA2 was split proportionally (on area) and then when the distribution of eligible people based on different proportions, in a small number of cases, was completed the SA2 data was rebound (Figure 6.1).
Figure 6.1: Eligibility data were available at electoral boundary levels (red lines). Each SA2 (black lines) had the number of eligible people distributed to it based on the 2011 census distribution of unemployed and not in the labour force (green dots (x10)). When electoral boundaries cross through an SA2 the SA2 was divided on area and the relevant numbers applied in two parts before rebinding to form a single number of eligible people for each electoral division.

6.6.2 Recall and waiting list data
Recall and waiting list data (single point in time, October 2012) that were provided by the DHS. All data used in this study were grouped into total numbers for Statistical Areas Level 2 (SA2).

6.6.3 Geographic analysis
The Quantum Geographic Information System (version 2.8.1) software was used to map distribution of the eligible population across Western Australia by SA2, and to plot the locations of Government Dental Clinics.
The Statistical Area Level 2 (SA2) is an area defined in the Australian Statistical Geography Standard (ASGS), and consists of one or more whole Statistical Areas Level 1 (SA1s). Wherever possible, SA2s are based on officially gazetted State suburbs and localities. In urban areas SA2s largely conform to whole suburbs and combinations of whole suburbs, while in rural areas they define functional zones of social and economic links. Geography is also taken into account in SA2 design. SA2s cover, in aggregate, the whole of Australia without gaps or overlaps (ABS, 2006).

Table 6.1: Distribution and Utilization of the Western Australian Metropolitan Government Dental Clinics by Eligible Population

<table>
<thead>
<tr>
<th>Perth Metropolitan Government Dental Clinics by code</th>
<th>Eligible population within 5km range</th>
<th>Eligible population outside 5km radius but within 10km radius</th>
<th>Eligible population residing outside the 10km radius but within 100km radius (peripheral clinics only)</th>
<th>Total eligible population within catchment area</th>
<th>Actual number of people on the waiting list</th>
<th>Actual number of people on the recall list</th>
<th>Total number of people registered for subsidised care</th>
<th>Percentage of eligible population registered for subsidised dental care</th>
</tr>
</thead>
<tbody>
<tr>
<td>1011</td>
<td>124 74</td>
<td>1 464</td>
<td>13938</td>
<td>816</td>
<td>1 284</td>
<td>2 100</td>
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<td>16 224</td>
<td>6 676</td>
<td>22900</td>
<td>1 956</td>
<td>1 604</td>
<td>3 560</td>
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<tr>
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<td>21376</td>
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<td>1 5 280</td>
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<td>7 981</td>
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<tr>
<td>1121</td>
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<td>2 885</td>
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<td>Total</td>
<td>177 325</td>
<td>99 243</td>
<td>49 708</td>
<td>326 276</td>
<td>21 611</td>
<td>30 547</td>
<td>62 152</td>
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</tr>
</tbody>
</table>

Centroid was recorded for each of the SA2s and the numbers of eligible people within a 5km and 10km radius (excluding overlaps) for each of the metropolitan clinics (Table 6.1), and 5km, 10km and 100km radius (excluding overlaps) of each of the country
clinics (Table 6.2) was calculated. Essentially if a centroid fell within the predetermined radius then population of that SA2 would be counted as “residing within” that radius. One hundred kilometre radius buffers were also calculated for the most peripheral metropolitan clinics, to account for the eligible country population residing within the buffered zone.

These numbers were cross-referenced with the waiting lists and recall list data to estimate the percentage of eligible people that have registered, or were routinely receiving subsidised dental care.
Table 6.2: Distribution and Utilization of Western Australian Country Government Dental Clinics by the Eligible Population

<table>
<thead>
<tr>
<th>WA Country Government Dental Clinics</th>
<th>Total eligible people within 5km range</th>
<th>Eligible population outside the 5km radius but within 10km radius</th>
<th>Eligible population outside the 10km radius but within 100km radius</th>
<th>Total number of eligible people within 100km range</th>
<th>Actual number of people on the waiting list</th>
<th>Number of patients on the recall list</th>
<th>Total number of people registered for subsidised care</th>
<th>Percentage of eligible population registered</th>
</tr>
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<td>2 669</td>
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</tr>
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</tr>
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<td>76 296</td>
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<td>4 099</td>
<td>8 806</td>
<td>11.54</td>
</tr>
<tr>
<td>Total eligible population in Western Australia</td>
<td>426 955</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
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</table>

6.7 Results

When the estimated eligibility by SA2 is overlayed with the actual eligibility by electorate a close correlation is observed (Table 6.3). It is also apparent that not every person who is not in the labour force, or is unemployed, has a Pension Concession Card or a Health Care Card, possibly due to other variables in means testing. Less than 73% of those identified through Census data as either “unemployed” or “not in the...
labour force” were likely to be in possession of a Pension Concession Card or a Health Care Card.

There was a stark difference between the levels of Government Dental Clinic point-in-time utilisation (when individual clinics are considered) relative to the eligible population across the State (Table 6.1 & Table 6.2) with, on average, much higher rates among metropolitan residents.

There are 426 955 people in WA eligible for subsidised dental care (Department of Human Services, 2011). The majority of those reside in the Perth metropolitan area (276 568 or 65%) and are located within a 10km radius of a Government Dental Clinic (Figure 6.2). Sixty four per cent (177 325) of the eligible population residing within the metropolitan area is located within a 5km radius of a Government Dental Clinic. However, of those eligible and residing within the Perth metropolitan area, only 62,152 (or 19%) received non-emergency dental care (recall patients) or have been placed on the waiting list for subsidised dental care (Table 6.1).

Outside the metropolitan area, there were 126 004 eligible people residing within 100km of a Government Dental Clinic (Figure 6.3). However, only around 11% of those are registered to receive the service, a much lower rate (40% reduction) by comparison to the metropolitan population (Table 6.2). Even with a further increase in the “service area” radius of the outermost (peripheral) metropolitan clinics to 100km (to account for the people residing relatively close to the city), 24 383 (6%) eligible people have
been identified to be residing outside the 100km travel range of a Government Dental Clinic.

Eligible people residing in areas with higher rates of unemployment, within the metropolitan area, were more likely to use the service than eligible people residing in areas with lower rates of unemployment. Such a relationship could not be demonstrated for the country population. The weighted average for utilisation of Government Dental Clinics across the State was calculated to be 18%. This finding is in agreement with the DHS annual report that estimates access to dental services for eligible adults to be at 18%.
### Table 6.3: Actual versus Estimated distribution of the eligible population.

<table>
<thead>
<tr>
<th>Electorate by code</th>
<th>Health Care Card Holders</th>
<th>Pension Concession Card Holders</th>
<th>Total eligible population by electorate</th>
<th>Estimated eligible population by SA2</th>
<th>Percentage of actual eligible population</th>
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<td>8 903</td>
<td>23 624</td>
<td>32 527</td>
<td>29 419</td>
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</tr>
<tr>
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<td>6 131</td>
<td>13 713</td>
<td>19 844</td>
<td>19 025</td>
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<td>22 905</td>
<td>32 372</td>
<td>32 340</td>
<td>99.90</td>
</tr>
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<td>5061</td>
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<td>20 057</td>
<td>27 774</td>
<td>30 675</td>
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<tr>
<td>5062</td>
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<td>29 967</td>
<td>25 971</td>
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<tr>
<td>5063</td>
<td>8 551</td>
<td>23 011</td>
<td>31 562</td>
<td>38 896</td>
<td>123.24</td>
</tr>
<tr>
<td>5064</td>
<td>9 147</td>
<td>22 428</td>
<td>31 575</td>
<td>32 403</td>
<td>102.62</td>
</tr>
<tr>
<td>5065</td>
<td>5 344</td>
<td>14 036</td>
<td>19 380</td>
<td>20 773</td>
<td>107.19</td>
</tr>
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<td>Total</td>
<td>118 931</td>
<td>308 024</td>
<td>426 955</td>
<td>425 562</td>
<td>99.67</td>
</tr>
</tbody>
</table>

#### 6.8 Discussion

Good dental health is fundamental to a person’s overall health, wellbeing and quality of life. Thus, timely access to primary oral health care services is critical in reducing the burden of dental disease on individuals and communities. Preventive dental care reduces the incidence of disease, facilitates early detection of problems, and reduces the need for extensive restorative or emergency treatments at a later stage (Metropolitan Health Service, 2013).
The subject of timely access to dental care for the eligible population is not new and there are many opinions on what should be done to improve it. Over the years, long public dental waiting lists across Australia, including WA, have received much attention from the media. The issue for eligible patients, (a further deterioration of dental health through not being able to relatively quickly address dental concerns), has been the subject of a number of State and Federal initiatives (Dudko et al., 2015).

Figure 6.2: Distribution of the eligible population across the metropolitan area of Perth by SA2, and within 5km radius of each clinic.
More recently, the Commonwealth Government committed $1.3 billion over several years to State and Territory governments to support additional dental services for adults under the National Partnership Agreement (NPA). Of that, close to $30 million was allocated to treat more public dental patients in WA (Metropolitan Health Service, 2013). The measure is aimed at reducing long waiting times to see a public dentist by providing eligible public dental patients with an authority to seek limited treatment from a private dentist; thus also improving access to primary oral health care services, especially for the country residents (Dudko et al., 2015).

The current NPA for public dental patients ended in March 2015 and a reduced 12-month extension was put in place. The second NPA was originally scheduled to start on 1 July 2014, but the Budget proposed its deferral until 2015–16 (Dudko et al., 2015).

Although early reports suggest that the NPA has had some success in reducing the State’s dental waiting list and has improved access to primary oral health care services, the initiative is deemed too new to determine with any degree of certainty whether the effect will be long lasting, cost-effective or sustainable (Metropolitan Health Service, 2013).

The current study examined the socioeconomic composition of the West Australian population, and identified the number of people eligible for subsidised dental care, as well as their residential location within the State down to SA2 level.
Government Dental Clinics are used by only a fraction of the eligible population (19.1% in the metropolitan area and 11.5% in the rest of the WA). Even though this represents an underutilisation of care by the eligible population, the waiting times to see a dentist for non-urgent dental care can be up to 24 months (Dental Health Services, 2014). It is of concern to consider a scenario where all (or even increased proportions) of all those persons eligible for public care would demand and utilise subsidised care. With such long existing waiting lists, it is clear that public services and resources would not cope with increased service demands.

There could be a number of reasons why more eligible people don’t register for subsidised dental care. For example, changes in patients’ personal circumstances may create a situation whereby patients move in and out of eligibility and therefore don’t register with the service as they may feel that their eligibility may change before they get to the top of the waiting list. Since offers of subsidised dental care are generally not featured in the mass media, it is also possible that people are simply not aware that such a service exists.

It is also possible that the waiting lists are indeed self-limiting, meaning that people are deterred by the long waiting times. Some may see this as a good point as the cost of service delivery is also minimised.
In a vast and relatively scarcely populated State like WA, or indeed the entire country like Australia, it could be argued that travelling for a 100km to see a dentist should not be considered to be excessive. However, one must remember that in “round trip” terms a patient residing 100km away from a nearest clinic will still be travelling for 200km in total, and spending most probably over 2 hours in the car, as roads rarely follow a straight line.

Furthermore, the travel needs to be considered in the context of the everyday travel activities for a particular community. In these terms one can begin to understand how prioritisation of trips to see a dentist for routine care might occur.

Geographical remoteness has often been identified as one of the main barriers to obtaining health related services (ARCPH, 2009). In an emergency situation most people will consider travelling 100km, or even further if necessary, to see a dentist, provided they have access to transport, the same distance and time investment could be viewed from a completely different perspective by the eligible population when it comes to non-emergency dental care.

As this study found that large parts of the eligible population reside within a relatively close distance to a Government Dental Clinic, it must be assumed that geographical and/or physical distance alone are not the only barriers to obtain services.
6.9 Conclusion

There is a substantial underutilisation of subsidised dental care by the eligible population of WA. Furthermore, there is a high degree of variation between individual clinics ranging from 2% through to 30%.

It is not surprising to find that country residents travel further for dental care by comparison to the metropolitan residents. One of the key contributions of this
research is to quantify the impact of the remoteness on utilization of subsidised dental care. Utilisation (as realized access) of dental services reduces (by as much as 40%) as the distance one has to travel to obtain the service increases.

With an average waiting time for non-urgent dental care at around 24 months (DHS, 2014) any increase in the uptake of the service could result in substantially longer waiting times. When this is considered in the context of the current economic climate, namely the end of the mining boom, rising rate of unemployment and our ageing population, increase in demand for subsidised dental care is a real possibility.
Chapter Seven

7. A national analysis of dental waiting lists and point-in-time geographic access to subsidised dental care: Can geographic access be improved by offering public dental care through private dental clinics?

This chapter has been published in the journal of Rural and Remote Health.

7.1 Abstract

**Background:** Australia is one of the least densely populated countries in the world with an uneven distribution of the population that is concentrated on or around coastal areas. Historically, inadequate access to public dental care has resulted in long waiting lists, received much media coverage and has been the subject of a new Federal and State initiative.

**Objective:** To gauge the potential for reducing the national dental waiting list through geographical advantage that could arise from subcontracting the delivery of subsidised dental care out to the existing network of private dental clinics across Australia.

**Methods:** Eligible population data were collected from the Australian Bureau of Statistics website. Waiting list data from across Australia were collected from publicly available sources and confirmed through direct communication with each individual State or Territory Dental Health body. Quantum Geographic Information System software was used to map distribution of the eligible population across Australia by Statistical Areas, and to plot locations of the Government and Private Dental Clinics. The percentage to the eligible population and those of the waiting list that could benefit from the potential improvement in access has been calculated for metro and non-metro residents.

**Results:** Fifty three per cent of people on the waiting list resided within Metropolitan areas. Rural and remote residents made up 47% of the population waiting to receive
care. The utilisation of both government and private dental clinics for the delivery of subsidised dental care to the eligible population has the potential to improve access for up to 25% of those residing within Metropolitan areas and up to 59% for eligible country folks.

**Conclusion:** Utilisation of the existing network of private dental practices across Australia for delivery of subsidised dental care could dramatically increase geographic reach, reduce the waiting list, and possibly make good oral health a more realistic goal to achieve for the economically disadvantaged members of our community. In addition, this approach has the potential to increase service availability in rural and remote areas for entire communities where existing socioeconomic dynamics do not foster practice.

### 7.2 What is known about the topic

The lower socioeconomic groups in our communities do not receive adequate and timely access to dental care. The eligible population in outer urban, rural and remote areas are more likely to follow a problem-oriented pattern of dental attendance.

### 7.3 What this paper contributes

This study investigates the geographic service areas of the existing adult government dental clinics and estimates the percentage of the eligible population that could
potentially benefit from the increased access to subsidised dental care that would follow should the work be contracted out to the private sector.

7.4 Implications for practitioners

This study carries no implications for individual practitioners at the clinical level. However, at the Federal level these findings offer direction for future service delivery.

7.5 Introduction

Australia is the sixth largest nation in the world with a total area of more than 7 million square kilometres, and a very low population density of just 3 people per square kilometre (World Population Review, 2015). This makes Australia one of the least densely populated countries on earth. Some parts of Australia are even less densely populated. The Northern Territory for example holds 0.2 people per square kilometre (World Population Review, 2015).

The distribution of communities throughout Australia follows the same principles as in any other country in the sense that water is essential to sustainable development. Much of Australia is desert, and this is the main reason why most of the population is concentrated on or around the more hospitable coastal areas (World Population Review, 2015).

Australians have generally enjoyed good dental health. The overall toll of poor oral health has reduced sharply during the 20th century with the introduction of fluoridated water and better understanding of dental disease. But these health gains have not
been equally shared across all socioeconomic groups (AIHW, 2006). It has been acknowledged by Australia’s National Oral Health Plan that low income earners are at a greater risk of dental disease by comparison to their more affluent counterparts (ADA, 2006).

Aboriginal and Torres Strait Islander peoples experience significantly higher levels of dental disease by comparison to all the other groups (McAuliffe, 2004). Rural residents are less likely to follow a prevention-oriented pattern of dental attendance (ARCPOH, 2009). It has also been found that concession card holders are less likely to visit a dentist on a regular basis and have a higher rate of dental disease (McAuliffe, 2004).

Poor dental health is more prevalent among those without private health insurance (ADA, 2006).

Ryan and Whelan (2006) noted an increase in the disadvantaged population in outer urban areas of major capital cities. These areas are often characterised by low cost housing and poor provision of services such as public transport (Ryan, 2006). There is also evidence that mobility rates fall as area socio-economic disadvantage rises (Ryan, 2006).

Nationally, access to oral health care is available through several clinical pathways. The majority (about 85%) of dental care is provided in a private practice pathway. When seeing a dentist privately, a patient is responsible for meeting the cost of service. In some cases the cost of treatment in this pathway is partially paid for by private health insurance, when available. Prevalence of privately insured persons varies from year to year, but at the present time about 45% of the population is
covered (Lam, 2012). Market forces set the costs of care in this pathway; there is no
government interference in the market, although there is some effect of insurance
driven schemes on the fee-for-service model within some practices.

Low income earners are able to obtain subsidised dental care through a large network
of public dental clinics distributed across Australia (Tennant, 2013). In this pathway
the cost associated with provision of dental care is tax-payer subsidised by between
25% and 100% of the benchmark Department of Veteran’s Affairs fee (DVA),
depending on patient’s income (DHS, 2008). There are some variations in the level of
subsidy between States and Territories across Australia. In some cases levels of
subsidy can also differ between population groups (DHS, 2008). The Federal fee
schedule is between 20% to 40% lower than a similar mix of care in the private
pathway (ADA, 2013).

In addition to the above pathways, Aboriginal and Torres Strait Islander people are
able to access oral health care through a network of Aboriginal Medical Services (AMS)
clinics. Generally, services provided at these clinics are free of charge to the patient
(Dyson, 2012).

Caries and periodontitis are the two most common diseases that result in chronic
damage. If not identified early, these two diseases can have a cumulative cost to
individuals, and the tax payer. Easy and timely access to preventive dental care
therefore could help to identify problems early, thereby reducing the severity and the
cost of treatment (Chrisopoulos, 2011). Many Australians understand the importance
of seeing a dentist regularly but not all are able do so. Historically, demand for subsidised dental care has outstripped the ability of the public system to provide care, resulting in waiting lists in some cases 24 months long (ADA, 2013).

The aim of this study was to gauge the potential for reducing national dental waiting lists through geographical advantage that could arise from subcontracting the delivery of subsidised dental care to the existing network of private dental clinics across Australia.

7.6 Methods

No individual level data were used and no-identification of patients was possible with the grouped data provided. Thus ethics approval was not required.

7.6.1 Waitlist data

All waiting list data (number of people waiting to receive non-emergency dental care) for each State and Territory were collected from websites or confirmed through direct communication with various jurisdictional bodies (the Northern Territory declined to participate). The data were collected for a single time-point (mid-2012). This time-point was chosen specifically because of its proximity in time to the available Census 2011 data.
7.6.2 Eligible population

There is a close correlation between the “unemployed” and “not in the labour force”, as derived from Census 2011 data and the distribution of the eligible (for subsidised dental care) population, as provided by the Department of Human Services (Dudko, 2016). Eligibility for subsidised dental care was about 75% of the total “unemployed” or “not in the labour force” sample obtained from the Australian Bureau of Statistics (ABS). It is noted that eligibility criteria differ slightly between States.

This retrospective study collected the “unemployed” and “not in the labour force” Census 2011 data from the ABS website (Statistical Area Level 2 – SA2) to represent the eligible population (n = 4 746 422) for subsidised dental care across Australia.

7.6.3 Government and private practice locations

Previously published research provided the physical address (and the longitude and latitude) for each dental practice in Australia (collated from a number of open sources) as at August 2012; these data formed the basis of practice locations (Tennant, 2013).

7.6.4 Geographic analysis

The Statistical Area 2 (SA2) is a unit of statistical geography that contains one or more Statistical Areas 1 (SA1s). In urban settings SA2s mostly follow officially gazetted suburb dimensions. In rural areas SA2s can outline a functional zones with socioeconomic links. Geography is also a consideration in SA2 design. When
combined, SA2s cover the whole of the continent without gaps or overlaps (ABS, 2006).

Quantum Geographic Information System (version 2.8.1) software was used to map and analyse distribution of the eligible population and waiting lists for patients across Australia by SA2, and to correlate this with the locations of government and private dental clinics.

7.7 Results

There are 373,259 people on the national waiting list. The total number of patients currently listed for public dental care in the Australian Capital Territory (ACT; metro = 2129, rural = 181), New South Wales (NSW; metro = 39,183, rural = 28,935), Queensland (QLD; metro = 48,728, rural = 81,818), South Australia (SA; metro = 5,211, rural = 6665), Tasmania (Tas.; metro = 6,323, rural = 10,902), Victoria (Vic.; metro = 74,606, rural = 42,258) and Western Australia (WA; metro = 21,611, rural = 4,709). These data were obtained from State Dental Health Services websites or through written requests for data to the various State Departments (Table 7.1 and 7.2). The Northern Territory (NT) did not report its data and offers of participation were declined. Notwithstanding this, it is estimated that the number of people on the NT public dental waiting list would be very small compared with other States and Territories.
Table 7.1: Distribution of the eligible population within metropolitan areas

<table>
<thead>
<tr>
<th></th>
<th>n on the waitlist</th>
<th>n (%) within 5km range of a government clinic</th>
<th>n (%) within 5km range of a government or a private clinic</th>
<th>n (%) residing within metropolitan area</th>
<th>Total n for State or Territory</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACT</td>
<td>2 129</td>
<td>18 296 (29.8%)</td>
<td>61 435 (99.9%)</td>
<td>61 485 (99.7%)</td>
<td>61 666</td>
</tr>
<tr>
<td>NSW</td>
<td>39 183</td>
<td>709 194 (81.7%)</td>
<td>848 436 (97.7%)</td>
<td>867 976 (54.3%)</td>
<td>1 597 396</td>
</tr>
<tr>
<td>NT</td>
<td>N/A</td>
<td>3 099 (18.8%)</td>
<td>13 047 (79.4%)</td>
<td>16 442 (46.5%)</td>
<td>35 393</td>
</tr>
<tr>
<td>QLD</td>
<td>48 728</td>
<td>279 349 (69.8%)</td>
<td>387 654 (96.9%)</td>
<td>400 228 (44.1%)</td>
<td>908 456</td>
</tr>
<tr>
<td>SA</td>
<td>5 211</td>
<td>169 646 (57.3%)</td>
<td>285 582 (96.5%)</td>
<td>295 821 (77.1%)</td>
<td>383 593</td>
</tr>
<tr>
<td>TAS</td>
<td>6 323</td>
<td>10 090 (18.1%)</td>
<td>37 972 (67.9%)</td>
<td>55 889 (44.8%)</td>
<td>124 672</td>
</tr>
<tr>
<td>VIC</td>
<td>74 606</td>
<td>604 149 (73.6%)</td>
<td>796 941 (97.1%)</td>
<td>820 910 (68.6%)</td>
<td>1 197 339</td>
</tr>
<tr>
<td>WA</td>
<td>21 611</td>
<td>171 957 (54.2%)</td>
<td>305 799 (96.4%)</td>
<td>317 202 (72.4%)</td>
<td>437 907</td>
</tr>
<tr>
<td>Total</td>
<td>197 791</td>
<td>Weighted avg 72.1%</td>
<td>Weighted avg 96.7%</td>
<td>2 835 953 (59.7%)</td>
<td>4 746 422</td>
</tr>
</tbody>
</table>

There are 4.75 million people in Australia eligible for subsidised dental care. The eligible population is made up of those residing within Metropolitan areas (n=2.84 million) and those residing outside Metropolitan areas (n=1.90 million). A Metropolitan area was defined as a 50km radius from the General Post Office (GPO) in each of the capital cities. The centroid was calculated for each of the SA2s, and the numbers of eligible people within a 5km radius of a government, or private clinics in Metropolitan areas was calculated (Table 7.1). A similar calculation was performed for the eligible population residing outside Metropolitan areas (Table 7.2). For this second group an additional range to 50km was also recorded. Essentially if a centroid fell within the predetermined radius then the population of that SA2 would be counted as “residing within” that radius. The radius calculations were cumulative (ie. An eligible population residing within a 50km radius also includes those residing within a 5km radius).

Seventy two per cent (weighted average) of the eligible population and about 142 000 of those on the waiting list are residing in Metropolitan areas and are located within a 5km range of a government dental clinic. When both government and private clinics
are considered, 97% of the eligible population, and 191 000 of those on the waiting list residing in Metropolitan areas, are within a 5km range of a dental clinic, representing a 25% improvement in geographical accessibility (Table 7.1).

In contrast, only 38% (weighted average) of the eligible population, and 66 000 of those on the waiting list residing outside Metropolitan areas, are located within a 5km range of a government dental clinic. When availability of private dental clinics is also taken into account, 64% of the eligible population, and 112 000 of those on the waiting list, fall within a 5km range of a dental clinic, representing a potential 59% improvement in accessibility (Table 7.2).

Table 7.2: Distribution of the eligible population outside metropolitan areas.
The NT had the lowest percentage of population eligible for subsidised care at 15% (Table 7.3), and had the lowest accessibility with only 19% of the eligible city residents residing within a 5km radius and only 4% of the eligible rural residents located within 50km range of a government dental clinic. The NT figures are in vast contrast with the findings for NSW where 82% of the eligible metropolitan population reside within a 5km range of a government dental clinic. Country residents in NSW also enjoyed better access to subsidised dental care, by comparison to people in the NT (and all other States), with almost all (97%) residing within a 50km range of a government dental clinic. Twenty one percent of the total NSW population are eligible for subsidised dental care (Table 7.3). This figure is comparable with those of other States and Territories.

The results show that 96% (weighted average) coverage of the eligible population, and 168 000 people on the waiting list, for most States and Territories can be achieved when the service area radius of both government and private dental clinics located outside Metropolitan areas is increased to 50km (Figure 7.1).

Table 7.3: State population and eligibility statistics

<table>
<thead>
<tr>
<th>State</th>
<th>n eligible population</th>
<th>n on the waiting list</th>
<th>(% of eligible population on the waiting list)</th>
<th>Total population</th>
<th>(% eligible for subsidised care)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACT</td>
<td>61 666</td>
<td>2 310</td>
<td>3.7</td>
<td>386 000</td>
<td>16.0</td>
</tr>
<tr>
<td>NSW</td>
<td>1 597 396</td>
<td>68 118</td>
<td>4.3</td>
<td>7 432 200</td>
<td>21.5</td>
</tr>
<tr>
<td>NT</td>
<td>35 393</td>
<td>N/A</td>
<td>N/A</td>
<td>234 800</td>
<td>15.1</td>
</tr>
<tr>
<td>QLD</td>
<td>908 456</td>
<td>130 546</td>
<td>14.4</td>
<td>4 676 400</td>
<td>19.4</td>
</tr>
<tr>
<td>SA</td>
<td>383 593</td>
<td>11 876</td>
<td>3.1</td>
<td>1 674 700</td>
<td>22.9</td>
</tr>
<tr>
<td></td>
<td>Population</td>
<td>Waiting List</td>
<td>Percentage</td>
<td>Eligible Population</td>
<td>Waiting List</td>
</tr>
<tr>
<td>-----</td>
<td>------------</td>
<td>--------------</td>
<td>------------</td>
<td>---------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>TAS</td>
<td>124,672</td>
<td>17,225</td>
<td>13.8</td>
<td>513,400</td>
<td>24.3</td>
</tr>
<tr>
<td>VIC</td>
<td>1,197,339</td>
<td>116,864</td>
<td>9.8</td>
<td>5,768,600</td>
<td>20.8</td>
</tr>
<tr>
<td>WA</td>
<td>437,907</td>
<td>26,320</td>
<td>6.0</td>
<td>2,535,700</td>
<td>17.3</td>
</tr>
</tbody>
</table>

### 7.8 Discussion

Good dental health is fundamental to a person’s overall health, wellbeing and quality of life. Thus, timely access to primary oral health care services is critical in reducing the burden of dental disease on individuals and communities. Preventive dental care reduces the incidence of disease, facilitates early detection of problems, and reduces the need for extensive restorative or emergency treatments at a later stage (Metropolitan Health Service, 2013).

The current study examined a time-point distribution of the eligible (for subsidised dental care) population and those on the waiting list across Australia, and calculated the expected improvement in geographical accessibility to basic dental care and the potential impact on the national waiting list, should private dental clinics be considered for a more permanent role as a safety-net for those eligible for subsidised dental care.

#### 7.8.1 Interpretation of the results

Distance is one of the main barriers to obtaining health related services (Rural Dental Action Group, 2006). However, one should also remember that the distance a person is willing or even able to travel to obtain a health related service should not be viewed in absolute terms, and may differ depending on the setting. Distance needs to be
considered in the context of everyday travel activities for a particular community. For example, 5km travel for a city resident on low income without access to private transport often means making use of several modes of public transportation and thus can be considered to be a long way to travel.

The same distance in a country setting may not be seen as excessive possibly due to the fact that town centres are generally smaller with the majority of services often being available within a short walk from the town centre. The use of public transportation is more likely to involve a single mode of transport. When sought of in these terms one can begin to understand how prioritisation of trips to see a dentist for routine care might occur for people residing in different parts of Australia.

This reasoning formed the basis for nominating a 5km travel distance to attend a dental clinic for the city residents, and a 5km (to allow for comparison) and 50km range for those residing outside the metropolitan area.

Our model found that people on the waiting lists in all States and Territories across Australia could potentially benefit from the reduction in the travel distance, should they have the option of choosing to obtain subsidised dental care through either a government or private dental clinic. The highest increase in the availability and/or spatial accessibility of dental care (up by 59%) was noted for those residing outside Metropolitan areas. This is a significant finding considering that rural and remote
residents are consistently at a disadvantage compared to their metropolitan counterparts when it comes to accessing health related services (ARCPOH, 2009).

7.8.2 Impact of distance on dental health

A person’s place of residence, and more precisely travel distance to dental services, has a significant impact on the rate of hospitalisation for potentially preventable dental conditions. The rate of hospitalisation increased markedly with the increase in distance to dental services (Chrisopoulos, 2011).

Figure 7.1: Geographic coverage: 50km radius from government and private clinics.
7.8.3 Key figures and issues

Results indicate that the number of people eligible for subsidised dental care (4.7 million) represents 20% of the total population of Australia (24 million). Those on the waiting list (Table 7.3) represent 10% of the total population eligible (or 1.6% of the total population of Australia) for subsidised dental care. An annual report published by the Dental Health Services of Western Australia states that in 2012 - 2013, 18% of the eligible population actually received subsidised dental care (DHS, 2014). Although the figures for other States and Territories are unknown they are expected to be similar.

Even though this represents an underutilisation of care by the eligible population, the waiting times to see a dentist for non-urgent dental care can be up to 24 months (DHS, 2014). It is of concern to consider a scenario where all (or even increased proportions) of all those persons eligible for public care would demand and utilise subsidised care. With such long existing waiting lists, it is clear that public services and resources alone would not cope with increased service demands.

When this is considered in the context of the current economic climate, namely the end of the mining boom, the rising rate of unemployment and our ageing population, future increase in demand for subsidised dental care is a real possibility. Thus a more permanent arrangement utilizing existing networks of private dental clinics may need to be considered, especially for those residing in rural and remote areas of the country.
7.8.4 National Partnership Agreement

In 2012 the Commonwealth Government committed $1.3 billion over several years to State and Territory governments to support additional dental services for adults under the National Partnership Agreement (NPA). This measure is aimed at reducing long waiting times to see a public dentist by providing eligible public dental patients with an authority to seek limited treatment from a private dentist; thus also improving access to dental care services, especially for the country residents (Dudko, 2015).

The current NPA for public dental patients ended in March 2015 and a reduced 12-month extension was put in place. The second NPA was originally scheduled to start on 1 July 2014, but the Budget proposed its deferral until 2015–16 (Dudko, 2015).

Although early reports suggest that the NPA has had some success in reducing the State’s dental waiting list and has improved access to primary oral health care services. The initiative is deemed too new to determine with any degree of certainty whether the effect will be long lasting, cost-effective or sustainable (Metropolitan Health Service, 2013).

7.8.5 Economic considerations

Rolling out tax payer subsidised government dental clinics and supporting infrastructure in regional areas is expensive, requires extensive consultation, may not be viable, and may not reach many eligible people due to the relatively low population
density of most regional centres in Australia. The solution needs to be effective and sustainable, and preferably benefit other layers of our communities.

Locations of private dental clinics are driven by market forces and economy (Tennant, 2013). In many cases private dental services cannot be sustained in rural and remote areas in part due to lack of dentists, high costs and low population density (Willie-Stephens, 2014).

It seems that an ongoing arrangement with the private sector in rural and remote areas could be the answer to the current and expected future growth in demand for subsidised dental care. If appropriate safeguards are implemented, it might be possible for all: the regional private patients, public patients and the taxpayer to benefit from such an arrangement. A long-term agreement to provide a predetermined set of dental services to the public patients may provide the extra financial incentive needed for private clinics to remain open (or for new clinics to open) in rural and remote centres. This approach may improve primary health services availability for the general population, offer a much needed safety net for the geographically disadvantaged low income earners. It will also provide a welcome reprieve for the taxpayer with respect to capital expenditure and the cost of subsidising more expensive emergency dental care.
7.9 Conclusion

Dental health plays an integral part in the overall health of an individual and by extension in our communities. Prevention and early detection of dental problems can minimize the need for complex and often expensive restorative work, and therefore reduce the demand on the public health care system.

Utilisation of the existing network of private dental clinics across Australia to deliver subsidised dental care could dramatically reduce national dental waiting list, increase geographic reach and possibly make good oral health a more realistic goal to achieve for the economically disadvantaged members of our community.

Previous experience with the Chronic Disease Dental Scheme (CDDS) shows that writing an “open cheque” in terms of the types of services that can be provided to treat public patients in a private setting can be very expensive (Dudko, 2015) and may not necessarily yield the much desired results. A framework with appropriate safeguards in place that would allow for subsidised dental services delivery at private clinics has the potential to reduce waiting lists, improve access for greater eligible population. This framework would also increase service availability in rural and remote areas for entire communities where existing socioeconomic dynamics do not otherwise foster private practice. Improvement in access to primary dental care could help promote preventive treatment by simplifying the process to obtaining such care and making it more affordable.
Chapter Eight

8. Selecting a location for a primary healthcare facility: combining a mathematical approach with a Geographic Information System to rank areas of relative need.

This chapter has accepted for publication to the Australian Journal of Primary Health. Decision on Manuscript PY17093.R1:

Dudko Y, Robey DE, Kruger E, Tennant M. Selecting a location for a primary healthcare facility: combining a mathematical approach with a Geographic Information System to rank areas of relative need. (Appendix D).
8.1 Abstract

Geographic Information Systems have become an invaluable tool in many industries as it can help to conceptualise available data and answer questions visually. The software allows for integration of key statistics and geographic data for a more detailed analysis. The objective of this study was to show how mathematically weighted, publicly available, relevant demographics data can be integrated with Geographic Information Systems to identify and rank potential locations for new primary healthcare facilities. Index of Relative Socio-economic Advantage and Disadvantage was mathematically weighted with respect to the usual resident population and the number of people not in the labour force data, at Statistical Area level 1 (SA1). Smoothing was applied by repeating the process at Statistical Area level 2, 3 and 4 to produce a quasi-index of priority. A total of 229 SA1 areas were identified and preselected as potential primary healthcare facility infrastructure sites across Australia. The quasi-index was incorporated into a Geographic Information System to produce a map identifying and ranking areas of relative need. Combining a mathematical approach with Geographic Information Systems can yield significant qualitative and quantitative advantages over conventional methods of site selection.

8.2 What is known about the topic

- Primary healthcare providers are usually the first point of contact for most people seeking health-related services.

- Lower socioeconomic status is associated with higher burden of disease and mortality rates.
8.3 What this paper contributes

This paper proposes a method of combining statistical data with a Geographic Information System to help identify and rank areas of relative need for new primary healthcare facilities.

8.4 Implications for practitioners

This study carries no implications for individual practitioners at clinical level. However, at the State and federal level these findings offer directions for future service delivery.

8.5 Introduction

Primary health care plays a major role in Australia’s healthcare system and includes health care provided in dental clinics, medical practices, nursing homes, Aboriginal Medical Services, hospices, old age homes and other allied health facilities (Department of Health, 2013). Primary healthcare facilities are commonly considered to be an important part of a community infrastructure (Finkler and Ward, 1999). Prior to choosing a location for a primary healthcare facility, the proposal usually undergoes a rigorous decision-making process, where potential sites, cost and benefits to communities are considered (Finkler and Ward, 1999).

Over the years, advances in technology in Australia and changing patient expectations have paved the way for the shift away from the traditional centralised healthcare delivery model to a ‘hub and spoke’ model (Govindarajan and Ramanurti, 2013).
Improvements in medical knowledge and technology make it possible to complete many procedures in a single day in ambulatory care or outpatient clinics (Govindarajan and Ramanurti, 2013). Named after a bicycle wheel, where the spokes are centrally connected at the hub, the model allows for multiple practising sites to act in a supporting role (spokes) to the secondary site (hub) such as a hospital. The model allows for provision of services to patients at more accessible locations and closer to areas of greater relative need (Govindarajan and Ramanurti, 2013).

Australia’s healthcare system is a multilevel network of public, private and non-government providers (AIHW, 2014). The Australian Government’s contributions to funding the healthcare system includes Medicare, which offers free or subsidised treatment by healthcare professionals such as general practitioners, specialists and optometrists (but does not cover dental) (AIHW, 2014).

Identifying areas of greater relative need for a new primary healthcare facility plays a critical role in improving accessibility for those members of the community who are more likely to use it (Dunn, 2013). Site selection for new primary healthcare facilities is a multilevel process, which consists of both objective and subjective considerations (Richards el al., 1999). An example of an objective consideration may include demographics of the population and any other statistics data relevant to the target population (Richards el al., 1999). Subjective considerations may consist of public opinion, which can often be gauged by holding consultations with the communities concerned, and may consider variables such as perceived need, environmental factors, transportation and streetscape to name a few (Richards el al., 1999). Both objective
and subjective factors are important contributors to the decision-making process, however, and in some cases, trade-off may need to be considered to accommodate one or the other (Vickery, 2011).

With the advent of computer-based Geographic Information Systems (GIS), decision-makers are able to integrate and visualise statistics and geographic data to assist in their decision-making process (Perera et al., 2010; Turk et al., 2014). GIS allows users to map and conduct spatial analysis for both spatial and attribute data, such as socioeconomic indexes (Perera et al., 2010; Turk et al., 2014). Visual presentation of the attribute data can help us to better understand relationships between objective and subjective variables, thereby further improving the objectivity of the decision-making process (Boulos, 2005). Examples of such information may include target population statistics data (such as number of people not in the labour force) and its relationship to the natural geographic boundaries, transport routes and proximity to other healthcare facilities.

Previous studies have found that lower socioeconomic status is associated with higher burden of disease and mortality rates (Glover et al., 2004; Rocha et al., 2013; Hoebel et al., 2016). The aim of this study therefore was to develop an approach to combine publically available population statistics data with GIS software to help identify and prioritise potential sites for primary healthcare facility infrastructure based on the location of the chosen target population.
8.6 Methods

Only publically available, de-identified population statistics data from the Australian Bureau of Statistics (ABS) was used in this study. Thus, ethics approval was not required.

8.6.1 Australian Statistical Geography Standard

Australian Statistical Geography Standard (ASGS) consists of:

SA1s – Generally have a population of between 200 to 800 people, with an average of 400 people (Australian Bureau of Statistics, 2017a).

SA2s – Are medium-sized areas and consist of whole SA1s. SA2s largely follow official suburb outlines and generally have a population range of between 3,000 to 25,000 people, with an average of 10,000 people (Australian Bureau of Statistics, 2017a).

SA3s – Consist of whole SA2s and generally have populations between 30,000 to 130,000 people (Australian Bureau of Statistics, 2017a). Typically these are functional areas of regional cities and/or large urban transport and service hubs (Australian Bureau of Statistics, 2017a).

SA4s – These are the largest sub-state areas of all (Australian Bureau of Statistics, 2017a). According to the Australian Bureau of Statistics, SA4s provide the best sub-state socio-economic breakdown in the ASGS. SA4s consist of whole SA3s and cover the whole of Australia (Australian Bureau of Statistics, 2017a).
8.6.2 Index of Relative Socio-Economic Advantage and Disadvantage data

Index of Relative Socio-Economic Advantage and Disadvantage (IRSAD) (Australian Bureau of Statistics, 2016), covering all of Australia, was obtained from the ABS website at Statistical Area Level 1 (SA1) (Australian Bureau of Statistics, 2017b). The IRSAD has been developed by the ABS to rank areas in Australia according to relative socioeconomic advantage and disadvantage (Australian Bureau of Statistics, 2017b).

8.6.3 Resident population data

Usual resident population data (Australian Bureau of Statistics, 2016), covering all of Australia, were also obtained from the ABS website at SA1 level. The SA1 has been designed for use in the Census of Population and Housing as the smallest unit for the processing and release of Census data (Australian Bureau of Statistics 2017a). Approximately 55 000 SA1s cover the whole of Australia without gaps or overlaps (Australian Bureau of Statistics 2017a). SA1s are considered to be the basic building blocks of the Australian Statistical Geography Standard (ASGS), and are used for the aggregation of statistics to larger Census geographic areas (Australian Bureau of Statistics 2017a).

8.6.4 Hospital data

Existing public hospitals location data (latitude and longitude) was collected from the www.myhospitals.gov.au website. The location data covers all general public hospitals with emergency departments across Australia. The location data was integrated into
the GIS software to allow for visual assessment of proximity to the identified areas of relative need.

8.6.5 Geographic analysis

Quantum Geographic Information System (version 2.8.1) free and open source (see www.qgis.org) software was used to map IRSAD index and results of statistical analysis.

8.6.6 Processing of SEIFA and resident population data

IRSAD data was weighted with respect to two factors to provide specificity for lower socioeconomic areas; “usual resident population” and the number of those “not in the labour force”.

\[ S_{\text{area}} = \frac{I_{\text{IRSAD}}}{N_{\text{pop}} + N_{\text{notlab}}} \]

[Ranking of Statistical Areas relative to each other]

Where:

\( S_{\text{area}} \) is the score assigned to an SA1

\( I_{\text{IRSAD}} \) is the Socio-Economic Index of an SA1

\( N_{\text{pop}} \) is the usual resident population of an SA1

\( N_{\text{notlab}} \) is the number of unemployed and not in the labour force of an SA1

The process was repeated at SA2, SA3 and SA4 levels to allow for ‘smoothing’ of the results. In this way, the variables pertaining to SA2, SA3 and SA4 areas have an equal
opportunity to influence the ranking of the lower level SA's. The results were added to produce an aggregate value. An extract from the table is show in Table 8.1. Each number was multiplied by 10 000 to simplify the process, as resulting raw numbers were at the third decimal point. Approximately 55 000 results were produced (equating to the number of SA1s in Australia). The resulting values were ranked from lowest to highest. The lowest 10% of all SA1s were identified and preselected. Finally, one SA1 (lowest ranking) was selected from each of its superior SA3s.

8.6.7 Computing available data

In order to automate the mathematical process, a computer program was written. The program was built with python, ver. 3.5.1 free and open source programming software (see www.python.org), and utilises a hierarchal tree data structure in conjunction with a recursive algorithm to achieve the results.

In short, the program reads the Comma-Separated Value data file available from the ABS to build a first data branch at SA1 level using the described weighting formula. With the first branch built, the program then used the SA1 results to build the next branch at SA2 level via a recursive algorithm. The process was then repeated to calculate results at SA3 and SA4 levels. Finally, a report was generated in the form of a Comma-Separated Value data file that allows for the aggregate values to be calculated for each statistical area, and ranked from lowest to highest.
Table 8.1: An extract from the calculations table.

<table>
<thead>
<tr>
<th>SA4 ID</th>
<th>SA3 ID</th>
<th>SA2 ID</th>
<th>SA1 ID</th>
<th>Weighed SA4</th>
<th>Weighed SA3</th>
<th>Weighed SA2</th>
<th>Weighed SA1</th>
<th>Sum of weighed SA1, 2, 3 and 4</th>
<th>Sum X 10,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>311</td>
<td>31103</td>
<td>311031314</td>
<td>3131423</td>
<td>0.000023</td>
<td>0.000002</td>
<td>0.000007</td>
<td>0.000001</td>
<td>0.000051</td>
<td>0.51</td>
</tr>
<tr>
<td>311</td>
<td>31104</td>
<td>311041321</td>
<td>3132114</td>
<td>0.000023</td>
<td>0.0000035</td>
<td>0.000025</td>
<td>0.000005</td>
<td>0.000088</td>
<td>0.88</td>
</tr>
<tr>
<td>311</td>
<td>31105</td>
<td>311051328</td>
<td>3132806</td>
<td>0.000023</td>
<td>0.000027</td>
<td>0.000008</td>
<td>0.000001</td>
<td>0.000059</td>
<td>0.59</td>
</tr>
<tr>
<td>311</td>
<td>31106</td>
<td>311061336</td>
<td>3133601</td>
<td>0.000023</td>
<td>0.000002</td>
<td>0.000002</td>
<td>0.0</td>
<td>0.000045</td>
<td>0.45</td>
</tr>
<tr>
<td>312</td>
<td>31202</td>
<td>312021356</td>
<td>3135607</td>
<td>0.000041</td>
<td>0.000033</td>
<td>0.000013</td>
<td>0.000003</td>
<td>0.00009</td>
<td>0.9</td>
</tr>
<tr>
<td>312</td>
<td>31203</td>
<td>312031361</td>
<td>3136110</td>
<td>0.000041</td>
<td>0.0000036</td>
<td>0.000002</td>
<td>0.000003</td>
<td>0.00009</td>
<td>0.9</td>
</tr>
<tr>
<td>313</td>
<td>31301</td>
<td>313011362</td>
<td>3136203</td>
<td>0.000021</td>
<td>0.000011</td>
<td>0.000008</td>
<td>0.000001</td>
<td>0.000041</td>
<td>0.41</td>
</tr>
<tr>
<td>313</td>
<td>31302</td>
<td>313021366</td>
<td>3136605</td>
<td>0.000021</td>
<td>0.000018</td>
<td>0.000005</td>
<td>0.000001</td>
<td>0.000045</td>
<td>0.45</td>
</tr>
<tr>
<td>313</td>
<td>31303</td>
<td>313031370</td>
<td>3137001</td>
<td>0.000021</td>
<td>0.000031</td>
<td>0.000009</td>
<td>0.000002</td>
<td>0.000063</td>
<td>0.63</td>
</tr>
</tbody>
</table>

SA = Statistical Area. See section 8.6.1 for detailed description of each.

8.7 Results

Using the above method, 229 SA1 areas (0.4% of all SA1s) have been identified and preselected as potential public health infrastructure sites across Australia. By incorporating this processed data into QGIS free and open source software ver. 2.8.1 (see www.qgis.org), a layered map was produced (Fig 8.1), highlighting the relationship between preselected SA1s and IRSAD and the existing public hospital network. The resultant values for the preselected SA1s are projected over the map and range from 0 to 1 whereby a lower number represents an area of relatively greater need, thus allowing us to rank and prioritise these areas for services delivery.

Fig. 8.1 depicts an extract from the map of Australia as an example of identified and ranked areas of relative need. Darker shaded areas correspond to low socioeconomic status, as identified by the IRSAD. Readers will notice that similarly shaded areas exist, yet only some display numeric values. The superimposed values identify areas of relative need. The identified areas of relative need can now be considered in terms of
distance to existing community health infrastructure, such as hospitals (green dots), and ultimately be included in the overall decision-making process.
Figure 8.1: Extract from the map of Australia. Areas of relative need identified by numbers ranging from 0 to 1: Lower numbers (and darker shade) represent lower socio-economic status, greater total population and higher unemployment rates. Dots indicate the locations of existing public hospital networks. Numeric value 0.68 (centre right) identifies Sussex Inlet, NSW as the priority area.

8.8 Discussion

Medicare aims to make healthcare services accessible to all Australians, irrespective of their socioeconomic status or other circumstances (Australian Institute of Health and Welfare, 2014). However, research by National Health Performance Authority 2013) indicates that this may not always be the case. Analysis of GP visits found that in some metropolitan areas, relatively healthier populations (as identified by the proportion of people with chronic medical conditions) receive higher than average number of GP
services (National Health Performance Authority, 2013), whereas in some regional areas less healthy populations receive lower than average number of GP services (National Health Performance Authority, 2013).

The Australian Primary Health Care Research Institute identified location and distance to primary healthcare services as one of the most important barriers in achieving equity in health care (Wakerman et al., 2015).

It is not uncommon for the IRSAD index to be used in conjunction with GIS software to create a map of socioeconomic distribution. However, the method described in this paper allows for further ranking of identical (with respect to the IRSAD) SA1s across the country, based on additional attribute data such as the size of the population and the level of population not in the labour force. This approach effectively weighs IRSAD with respect to additional attribute data, thereby improving relevance, by further qualifying the result.

Furthermore, the method allows for ‘smoothing’ of chosen statistics data by repeating the calculation at SA2, SA3 and SA4 level and then adding the results to produce an aggregate value at SA1 level. In this way, socioeconomic index and population data of SA2, SA3 and SA4 have an equal opportunity to influence the ranking of its subordinate, SA1. The method effectively identifies SA1s that meet the predetermined criteria, but also confirms that the IRSAD and population data of the surrounding SA1s, SA2 and SA3s supports the selection of that particular SA1. Thus, we can be sure that
the selected SA1 is not an ‘outlier’ (i.e. not surrounded by high socioeconomic areas) but in fact is a centre of a cluster of low socioeconomic areas and thus should be a focus of attention.

According to the ABS, ~4% of all SA1s in Australia do not have a listed IRSAD. However, the effect of this limitation is mitigated through the mathematical process, as each SA1 has its superior level (SA2), which does have an IRSAD listed and therefore an average for the area can be calculated.

8.9 Conclusion

Planning for primary healthcare infrastructure requires consideration of a unique set of circumstances in each individual case. Although circumstances surrounding each project can be expected to differ, such projects are almost universally aimed at addressing the long-term needs of the target community. Thus, a thorough understanding of the community’s health needs is required. A systematic approach, therefore, can help to identify priority areas for primary healthcare facility projects and avoid costly mistakes.

Combining a mathematical approach with Geographic Information Systems can yield significant advantages over conventional methods of site selection. These advantages are both qualitative and quantitative. Quality of the information is significantly improved because of an increase in specificity of data used through inclusion of statistical variables that more precisely characterise the target population and the
weighting and smoothing process. Quantitative improvement is achieved via a more obvious choice of sites with similar qualitative characteristics from which a selection can be made. The described method is based on statistical data from the ABS. Thus, application of the method produces precise and consistent results.

An example of an application of this method can be seen where it was applied to identify and rank areas of need for new public dental clinics (Dudko et al., 2017).
Chapter Nine

9. Identifying and ranking areas of relative need for new public dental clinics using a state-of-the-art data simulation approach.

This chapter has been published in the Asia Pacific Journal of Health Management.


9.1 Abstract

**Background:** Lower socioeconomic groups and country residents are more likely to experience dental disease. It is more cost effective to provide subsidised dental care through publically employed dentists when compared to subcontracting the work out to the private sector.

**Objective:** To identify and rank areas of relative need for new public dental care facilities across Australia. The secondary objective was to gauge how many of these areas are located in the vicinity of an existing public hospital (medical) with a view to utilise existing infrastructure for future service rollout.

**Methods:** Usual resident population, employment status and socioeconomic distribution data were downloaded from the ABS website at Statistical Area 1 level. A mathematical weighing formula was applied to those variables, which subsequently allowed for ranking of the results based on magnitude of the product values. The findings were considered in terms of proximity to existing public health infrastructure.

**Results:** A total of 49 SA1 areas were identified and preselected as potential sites for new public dental clinics across Australia. Eighty per cent of the identified areas of relative need were located outside metropolitan areas. Fifty per cent of those were in close proximity to an existing public hospital (medical).

**Conclusion:** Offering subsidised dental care through existing public hospitals may be an option. Such an approach has a potential to improve access to subsidised dental care in regional centres while minimising capital expenditure on infrastructure.
9.2 Introduction

The majority of Australians have access to high quality dental care services, and generally have good oral health largely due to the availability of fluoridated water and our much improved understanding of dental disease. Although the overall incidence of dental disease has reduced significantly by the end of the 20th century, the improvements in oral health have not been equally shared across all socioeconomic groups (AIHW, 2006). It has been acknowledged by Australia’s National Oral Health Plan that people representing low socioeconomic groups continue to experience greater levels of dental disease by comparison to their more affluent counterparts (ADA, 2006).

A report titled “Oral health and access to dental care – rural and remote dwellers” published by the Australian Institute of Health and Welfare noted that country residents are more likely to display symptomatic patterns of dental attendance when compared with metropolitan residents. Country residents are also more likely to experience complete tooth loss, and to not have seen a dentist in a couple of years for routine dental care. In short, statistically, country residents experience higher rates of dental disease and are less likely to receive preventive care (AIHW, 2005).

The demand for subsidised dental care across the country has remained consistently high over the years and often exceeds the capacity of State public dental services to provide treatment, resulting in waiting lists, with historical wait times of 2 years reported (DHS, 2014). Prolonged waiting times for an appointment is one of the main
factors resulting in patient dissatisfaction (Chu, 1999) and has frequently been the source of news stories in the national media (ABC, 2015)

Over the years, a number of State and federal initiatives were undertaken in an effort to meet the demand for subsidised dental care. Most recently the Commonwealth Government committed $1.3 billion over several years to State and Territory governments to support additional dental services for adults under the National Partnership Agreement (NPA). The measure is aimed at reducing long waiting times to see a public dentist by providing eligible public dental patients with an authority to seek limited treatment from a private dentist (Dudko, 2015).

It is generally more cost effective to provide subsidised dental care through public dental clinics when compared to contracting the work out to private sector (Dudko, 2015). Thus further investment in public dental health infrastructure may need to be considered in order for us to continue cost effectively meet the demand of our growing eligible population.

The objective of this study was to identify and rank areas of relative need for new public dental clinics, and to gauge what percentage of the areas identified were located in the vicinity of an existing public hospital network (with a view to strategically place dental chairs in some of the existing public hospitals rather than build new dedicated public dental clinics).
9.3 Methods

Only open access, non-identifying data were used in this research. Thus ethics approval was not required.

9.3.1 Australian Statistical Geography Standard

Australian Statistical Geography Standard (ASGS) was used throughout this study. This nationally agreed approach to geographic analysis of population divides the country into 4 levels of clustering based around size. These are described as SA1 to SA4. SA1 being the smallest with about 400 people per area, SA2 closely reflects suburbs with about 10 000 people per area, SA3 areas have about 80 000 people each while SA4 are state based (ABS, 2016).

9.3.2 Socio-Economic Indexes for Areas data

The data outlining the socioeconomic index (SEIFA) distribution across Australia were obtained from the Australian Bureau of Statistics (ABS) website at SA1 level (ABS, 2016a). SEIFA index has been designed by the ABS to arrange SA1s across Australia by their relative socioeconomic advantage and disadvantage (ABS, 2016a). The SEIFA data at SA1 level were used to calculate SEIFA index at SA2, SA3 and SA4 levels.
9.3.3 Resident population data

The population data spanning all of Australia were collected from the ABS website at SA1 level. There are approximately 55,000 SA1s in Australia, together covering the whole country without gaps or overlays (ABS, 2016). SA1s are commonly acknowledged to be the fundamental building blocks of the Australian Statistical Geography Standard (ASGS). When used in aggregate, SA1s contribute to statistics at SA2, SA3 and SA4 levels.

9.3.4 Eligible population data

Distribution data for the “unemployed” and “not in the labour force” were obtained from the ABS website at SA1 level and subsequently used to represent the distribution of the population eligible for subsidised dental care. Previous research identified a close correlation between the distribution of the “unemployed” and “not in the labour force” Census 2011 data and the actual distribution of the population eligible for subsidised dental care across Australia (Dudko, 2015a).

9.3.5 Public hospital location data

Geographic location data for existing public hospital network were obtained from the www.myhospitals.gov.au website. Only publically owned hospitals with emergency departments were selected.
9.3.6 Public dental clinic location data

Previously published research provided the physical address (and geographic coordinates) for each public dental clinic in Australia (collated from a number of open sources) as at August 2012 (Tennant, 2013).

9.3.7 Geographic analysis

Quantum Geographic Information System (version 2.8.1) software was used to map statistical data and quasi-index of relative need.

9.3.8 Processing of SEIFA, resident population and eligible population data

A previously developed mathematical approach to determination of areas of health care need, based on various smoothing functions of population disparities, was applied to the baseline data in this study (Submitted to Asia Pacific Journal of Health Management). In summary the method takes the SEIFA index for each SA1 and divides it by the usual resident and eligible population data to produce a weighted number. The process is repeated at SA2, SA3 and SA4 levels. The SA1 results were added to the SA2, SA3 and SA4 area results to which each SA1 in question belonged. Thus an aggregate value for each SA1 is produced. This fundamental mathematical approach provides a smoothing of the “wrinkles” in the SEIFA index between nearby SA1s and thus brings to the foreground areas that are substantive in size and population. These smoothed aggregate values for each SA1 level were arranged in an ascending order, forming a quasi-index of relative need. The most “in need” 10% per cent of the aggregate values (ie SA1’s) were selected for further analysis in this study.
9.3.9 Geographic disqualification

Geographic filtering was applied disqualifying SA1s that were located in the vicinity (within 10km radius for metropolitan and 20km radius for country areas) of an existing public dental clinic.

9.4 Results

A total of 49 SA1 areas (0.1% of all SA1s) has been identified and preselected as potential public dental clinic sites across Australia. The preselection data were uploaded into QGiS software and formed a part of a layered map (Fig 9.1). The map allows for visual assessment of the spatial relationship between preselected sites, existing public dental clinics and the public hospital network.
**Figure 9.1: Extract from the map of Australia.** Quasi index of relative need represented by numbers ranging from 0 to 1: Lower numbers (and darker shade) represent lower socio-economic status, greater total population and relatively higher percentage of eligible population. Dots indicate the location of existing public dental clinics. Numeric value 0.74 identifies Manjimup, WA as the priority area for a public dental clinic.

The numeric values for the identified SA1s project over the map and range from 0 to 1. Lower numbers identify areas of comparatively greater need, thus allowing the ranking and prioritisation of these areas for future service.

An extract from the map of Australia (South West of WA) is an example of identified and ranked areas of relative need (Fig 9.1). Various shadings indicate fluctuations in socioeconomic status of the population. Deeper shades indicate areas of low socioeconomic status, while lighter shades correspond to areas of higher
socioeconomic status. While similarly shagged areas can be seen, only few display numeric values. Only areas with displayed values meet the weighting criteria of relatively higher population and eligibility levels.

Tables 9.1 and 9.2 (country and metropolitan areas, respectively) list identified areas or relative need for a public dental clinic. The majority (80%) of the identified areas of relative need are located outside metropolitan areas. Over a quarter (27%) of all the identified areas were located in Victoria. Queensland accounted for 24% of all the areas of relative need across the country. Tasmania has more areas of relative need (14%) than New South Wales (12%). Northern Territory and Western Australia contributed 8% each to the total count of identified locations. South Australia made up 6% of the total, while no areas of relative need were identified in the Australian Capital Territory. Significantly, 50% of the identified areas of relative need outside metropolitan areas are located in the vicinity of an existing public hospital.
Table 9.1: Country locations: Identified areas of relative need for public dental clinic.

<table>
<thead>
<tr>
<th>State</th>
<th>Suburb</th>
<th>Nearest public dental clinic</th>
<th>Public Hospital in the immediate vicinity</th>
<th>State</th>
<th>Suburb</th>
<th>Nearest public dental clinic</th>
<th>Public Hospital in the immediate vicinity</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSW</td>
<td>Sussex Inlet</td>
<td>32km</td>
<td>No</td>
<td>TAS</td>
<td>Smithton</td>
<td>92km</td>
<td>Yes</td>
</tr>
<tr>
<td>NSW</td>
<td>Katoomba</td>
<td>26km</td>
<td>Yes</td>
<td>TAS</td>
<td>George Town</td>
<td>52km</td>
<td>Yes</td>
</tr>
<tr>
<td>NSW</td>
<td>Mudgee West</td>
<td>35km</td>
<td>Yes</td>
<td>TAS</td>
<td>Central Highlands</td>
<td>62km</td>
<td>No</td>
</tr>
<tr>
<td>NSW</td>
<td>Tuncurry</td>
<td>26km</td>
<td>No</td>
<td>TAS</td>
<td>Geeveston</td>
<td>55km</td>
<td>No</td>
</tr>
<tr>
<td>NSW</td>
<td>Nambucca Heads</td>
<td>46km</td>
<td>Yes</td>
<td>TAS</td>
<td>Forestier</td>
<td>56km</td>
<td>No</td>
</tr>
<tr>
<td>NSW</td>
<td>Evans Head</td>
<td>32km</td>
<td>No</td>
<td>VIC</td>
<td>Camperdown</td>
<td>50km</td>
<td>Yes</td>
</tr>
<tr>
<td>NT</td>
<td>Tanami</td>
<td>430km</td>
<td>No</td>
<td>VIC</td>
<td>Golden Plains South</td>
<td>30km</td>
<td>No</td>
</tr>
<tr>
<td>NT</td>
<td>Barkly</td>
<td>576km</td>
<td>No</td>
<td>VIC</td>
<td>Pakenham North</td>
<td>17km</td>
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<tr>
<td>NT</td>
<td>Thamarrurr</td>
<td>256km</td>
<td>No</td>
<td>VIC</td>
<td>Warragul</td>
<td>34km</td>
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<tr>
<td>QLD</td>
<td>Southern Downs</td>
<td>21km</td>
<td>No</td>
<td>VIC</td>
<td>Leongatha</td>
<td>42km</td>
<td>Yes</td>
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<td>QLD</td>
<td>Crows Nest</td>
<td>35km</td>
<td>No</td>
<td>VIC</td>
<td>Upper Yarra Valley</td>
<td>70km</td>
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<tr>
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<td>Kilcoy</td>
<td>36km</td>
<td>Yes</td>
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<td>Yarram</td>
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<tr>
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<td>Tara</td>
<td>43km</td>
<td>Yes</td>
<td>VIC</td>
<td>Creswick</td>
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<td>South Mackay</td>
<td>96km</td>
<td>Yes</td>
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<td>Palm Island</td>
<td>51km</td>
<td>Yes</td>
<td>VIC</td>
<td>Heathcote</td>
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<td>Yes</td>
</tr>
<tr>
<td>QLD</td>
<td>Herberton</td>
<td>40km</td>
<td>No</td>
<td>VIC</td>
<td>Rochester</td>
<td>26km</td>
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</tr>
<tr>
<td>QLD</td>
<td>Aurukun</td>
<td>280km</td>
<td>No</td>
<td>VIC</td>
<td>Cobram</td>
<td>34km</td>
<td>Yes</td>
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<tr>
<td>QLD</td>
<td>Carpentaria</td>
<td>450km</td>
<td>No</td>
<td>WA</td>
<td>Mandurah</td>
<td>26km</td>
<td>Yes</td>
</tr>
<tr>
<td>SA</td>
<td>Ceduna</td>
<td>378km</td>
<td>Yes</td>
<td>WA</td>
<td>Manjimup</td>
<td>112km</td>
<td>Yes</td>
</tr>
<tr>
<td>SA</td>
<td>Goyder</td>
<td>35km</td>
<td>Yes</td>
<td>WA</td>
<td>Halls Creek</td>
<td>146km</td>
<td>No</td>
</tr>
</tbody>
</table>

9.5 Discussion

Routine dental check-ups offer an opportunity for early detection and prevention of dental disease. The timeless proverb proclaiming that “prevention is better than cure” rings especially true in personal health matters. In the context of subsidised dental care (from tax payer perspective), prevention can also be cheaper than cure.

Eighty per cent of the identified areas of relative need are located outside metropolitan areas. The results were consistent with previous research findings indicating that metropolitan residents generally enjoy better access to public dental care facilities. Building a public dental clinic in a country setting may not be as cost
effective as building a similar clinic in a metropolitan area, in part, due to differences in population densities.

However, findings also indicate that around 50% of the identified areas of relative need are located in the vicinity of a public hospital. Delivery of subsidised dental care through the existing public health infrastructure, where available, may offer an opportunity to improve access to dental care for those layers of our society that need it most, while minimising capital expenditure and the costs associated with more complex, late stage intervention.

**Table 9.2: Metro locations: Identified areas of relative need for a public dental clinic.**

<table>
<thead>
<tr>
<th>State</th>
<th>Suburb</th>
<th>Nearest public dental clinic</th>
<th>Public Hospital in the immediate vicinity</th>
<th>State</th>
<th>Suburb</th>
<th>Nearest public dental clinic</th>
<th>Public Hospital in the immediate vicinity</th>
</tr>
</thead>
<tbody>
<tr>
<td>NT</td>
<td>Weddell</td>
<td>38km</td>
<td>No</td>
<td>TAS</td>
<td>Dodges Ferry</td>
<td>41km</td>
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<td>QLD</td>
<td>Jimboomba</td>
<td>25km</td>
<td>No</td>
<td>TAS</td>
<td>Bridgewater</td>
<td>14km</td>
<td>No</td>
</tr>
<tr>
<td>QLD</td>
<td>Redland Islands</td>
<td>20km</td>
<td>No</td>
<td>VIC</td>
<td>Melton</td>
<td>18km</td>
<td>Yes</td>
</tr>
<tr>
<td>QLD</td>
<td>Beachmere</td>
<td>17km</td>
<td>No</td>
<td>WA</td>
<td>Forrestfield</td>
<td>13km</td>
<td>No</td>
</tr>
<tr>
<td>SA</td>
<td>Hackham West</td>
<td>14km</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**9.6 Conclusion**

The areas of relative need identified in this study represent the most disadvantaged (0.1%) of the Australian population. Country residents are more likely to experience dental disease when compared with metropolitan counterparts. Regular dental check-ups can aid prevention and early identification of dental disease. Access to subsidised dental care can potentially be improved in half (50%) of the identified areas by offering subsidised dental care to the eligible population through the existing publicly owned
hospital network. Offering subsidised dental care through the existing public hospital network, where available, in turn, may help to control the cost of service delivery by minimising capital expenditure.
Chapter Ten

10. Shortage of dentists in Outer Regional and Remote areas and long public dental waiting lists: Changes over the past decade.

This chapter has been submitted for publication in the Australian Journal of Rural Health.

Dudko Y, Kruger E, Tennant M. Shortage of dentists in Outer Regional and Remote areas and long public dental waiting lists: Changes over the past decade. (Appendix F).
10.1 Abstract

Shortage of dentists in Outer Regional and Remote areas of Australia and long public dental waiting lists have been the subject of media attention over the last decade. A number of State and Federal initiatives were introduced over the years to address these problems. This study aims to gauge whether the waiting lists and shortage of dentists in Outer Regional and Remote areas have seen a positive change over the last decade. This evaluation study analysed and compared the number of dentists FTE per 100,000 population, eligible population and waiting list size (NSW and QLD) at various points in time over the last decade. The data were extracted from practitioner registry reports. There was a significant improvement in the number of dentists practicing in Outer Regional and Remote areas of Australia. Public dental waiting lists in NSW and QLD (as of September 2016) were found to have surpassed their pre-National Partnership Agreement levels in 2012. The growth of public dental waiting lists exceeded the growth of the eligible population by a significant margin. The dentist to population ratios in Outer Regional and Remote areas have seen a significant improvement (34.0% and 26.0% respectively). The reduction in the number of people on the public dental waiting list was significant but brief.

10.2 What is known about the topic?

- Shortage of dentists and long public dental waiting lists have been the subject of debate at the government level and, over the years, have seen an increase in allocation of public funds in an effort to address the policy needs.
• An evaluation study is required to assess the dynamics of any changes.

10.3 What does this paper add?

• This study gauges the changes in the public dental waiting lists and distribution of dentists over the last decade.

• At the State and Federal level these findings offer direction for policy and service delivery.
10.4 Introduction

Over the years the shortage of dentists in Outer Regional and Remote areas of Australia have received much public attention. In 2005 there were, 28.5 and 19.8 Full Time Equivalent (FTE) dentists per 100,000 population working in the Outer Regional and Remote areas of Australia, respectively (AIHW, 2008). The rate was better in Major Cities (56.2) but still thought to be suboptimal (AIHW, 2008). Various governments have moved to address the chronic shortage of dentists in Outer Regional and Remote areas in a number of ways. The primary initiatives over the last 10 years have included; overseas trained dentist migration scheme, graduate initiatives (including increased proportion of students with rural background studying dentistry and Voluntary Dental Graduate Year Programme (VDGYP)) and financial incentives for existing dental practitioners to relocate to Outer Regional or Remote areas.

_Overseas trained dentists:_ Australian immigration policy makes provision for occupations that are deemed to be in short supply in the Australian labour market. In 2008 dentists were included on the Skilled Occupation List (SOL) with a view to make it easier for overseas trained dentists to immigrate to Australia. In 2014, Dental Tribune reported that Australia had the highest percentage (25.0%) of overseas trained dentists in the world (Balasubramanian, 2014). Importantly, there is currently no ongoing data collection and analysis of the outcomes of this initiative in addressing the disparity between rural and metropolitan residents. It is noted that dentists were removed from the SOL in mid-2015.
Local graduates: The numbers of local graduates were increased through founding of a number of new dental schools across the country, and expansion of graduates from existing schools. Over the last decade the annual number of dental graduates in Australia doubled and is currently approaching 550 (Insight Economics, 2012). This is expected to be a relatively stable number for the foreseeable future.

First launched in 2013, the VDGYP offered 50 positions per year to new graduates to work in public dental clinics across Australia (DHSV, 2013). The program aimed to provide services to patients in Outer Regional and Remote areas (DHSV, 2013). The program was discontinued in 2015 due to funding cuts.

Importantly, governments have moved dental education balance substantially from the core of cities to regional Australia. We now see the majority of graduates having either been trained in regional Australia or having experienced substantial clinical placements (in their final year of dental studies) in these areas (The Australian Dental Students’ Association, 2017). This investment in regional Australia, estimated at over half a billion dollars and an ongoing of some A$150+ million dollars per year is a very substantial investment in the future of country Australia (Australian Government, 2015).

Relocation grant: The Dental Relocation and Infrastructure Support Scheme (DRISS) was introduced in 2012-13 federal budget and allocates $78 million over a four year
period to improve dental services in rural and remote areas (Rural Health West, 2016).

The scheme aims to improve workforce distribution and service delivery in rural and remote areas by offering financial incentives for dentists to move there. Relocation grants up to A$120,000 and infrastructure grants up to A$250,000 are available to help pay for equipment and fit-out of dental clinics (Rural Health West, 2016).

In Australia access to subsidised dental care is available through networks of public dental clinics supported by the State. The eligibility criteria may differ slightly between States and Territories but generally is subject to a person being a holder of either a Health Care Card (HCC) or a Pension Concession Card (PCC) (Dudko, 2015). The demand for subsidised dental care exceeds the capacity of the public dental health system to provide the service, resulting in waiting lists for non-urgent treatment. In some cases waiting times as long as 24 months have been reported (Dudko, 2015). The long public dental waiting lists have also been the subject of a Federal initiative – National Partnership Agreement (NPA) (McArthur, 2015).

In 2012 the Commonwealth Government committed A$1.3 billion over 4 years several years to State and Territory governments to support additional dental services for adults under the deferred NPA (Swan, 2012). The measure was aimed at reducing long wait times to see a public dentist by giving eligible public dental patients an option to seek limited treatment from a private dentist, thus also improving geographic access to primary oral healthcare services, especially for the Outer Regional and Remote residents (Dudko, 2016). In the 2015-16 financial year the NPA provided States and
Territories A$155 million for additional services to treat approximately 178,000 public dental patients (Department of Health, 2016).

This study evaluated historic records examining the distribution of the dental workforce nationally over the last decade, and the dynamics of the public dental waiting lists in two large States of Australia (New South Wales and Queensland 2012-16). The aim was to gauge whether the waiting lists and shortage of dentists in Outer Regional and Remote areas have seen a positive change over the last decade.

10.5 Method

This retrospective study analysed statistical data from a series of published sources and integrated data for analysis. No confidential or secure data was accessed therefore no ethics approval was required.

10.5.1 Number of dentists:

Full time Equivalent (FTE) number of dentists per 100,000 population (rate) was collected from the Dental Board of Australia and the Australian Institute of Health and Welfare reports for years 2005-06, 2009, 2011-14.
10.5.2 Geographic distribution of dentists:

Australian Standard Geographic Classification (ASGC) Remoteness Structure (RA) was used to categorise distribution of dentists nationally. The index divides Australia into broad geographic areas that share attributes associated with relative remoteness. The populated localities are rated as either: Major Cities, Inner Regional, Outer Regional, Remote and Very Remote areas. The data for Remote and Very Remote areas were combined and referred to as Remote throughout the text for consistency with the source data from the AIHW. ASGC-RA standard is endorsed by the Australian Bureau of Statistics as a measure of remoteness (Australian Bureau of Statistics, 2011).

10.5.3 Waiting list size:

Waiting list data (NSW and QLD) were collected from the respective State’s Dental Health Services websites and media releases. The data were collected for 2012-16 timeframe.

10.5.4 Eligible population:

Health Care Card and Pension Concession Card Holder data for years 2006, 2009, 2011-16 was obtained from the Department of Human Services website.
10.6 Results

The national FTE rate of dentists in Outer Regional, and Remote areas has seen a steady increase over the years and in 2014 was recorded as 38.3 and 25.0, respectively (Table 1). This represents a 34.0% and 26.0% increase on reported 2005 rates (AIHW, 2008). The FTE rate of dentists employed in Major Cities in 2014 was higher at 63.1, and has also increased from 2005 levels of 56.2 (an increase of 13.0%) (AIHW, 2008).

Table 10.1: Number of dentists (FTE) per 100,000 population by remoteness.

[FTE = fulltime equivalent.]


<table>
<thead>
<tr>
<th></th>
<th>Major cities</th>
<th>Inner Regional</th>
<th>Outer Regional</th>
<th>Remote / Very remote</th>
<th>Australia / average</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>63.1</td>
<td>42.7</td>
<td>38.3</td>
<td>25.0</td>
<td>56.4</td>
</tr>
<tr>
<td>2013</td>
<td>63.1</td>
<td>41.1</td>
<td>38.1</td>
<td>21.4</td>
<td>55.9</td>
</tr>
<tr>
<td>2012</td>
<td>64.3</td>
<td>42.2</td>
<td>36.1</td>
<td>21.5</td>
<td>56.9</td>
</tr>
<tr>
<td>2011</td>
<td>62.8</td>
<td>41.3</td>
<td>34.4</td>
<td>22.6</td>
<td>55.4</td>
</tr>
<tr>
<td>2009</td>
<td>62.4</td>
<td>40.0</td>
<td>30.4</td>
<td>23.1</td>
<td>54.1</td>
</tr>
<tr>
<td>2006</td>
<td>59.5</td>
<td>33.1</td>
<td>27.5</td>
<td>17.9</td>
<td>50.3</td>
</tr>
<tr>
<td>2005</td>
<td>58.6</td>
<td>34.6</td>
<td>28.5</td>
<td>19.8</td>
<td>49.5</td>
</tr>
</tbody>
</table>

The number of publically employed dentists has risen significantly over the decade (2006-16) and now stands at 2,570, representing a 56.5% increase (Table 2). Privately employed dentist numbers have also recorded an increase over the same time frame and stood at 13,693 in 2016, a 56.0% improvement.
Table 10.2: Ratio of registered dentists to eligible and general (no HCC or PCC) population.


<table>
<thead>
<tr>
<th>Year</th>
<th>n. public dentists</th>
<th>n. Elig Pop</th>
<th>Elig:Dent ratio</th>
<th>n. private dentists</th>
<th>n. Non-Elig Pop</th>
<th>Non-Elig:Dent ratio</th>
<th>n. Total registered dentists</th>
<th>n. Total population</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>2,570</td>
<td>5,613,514</td>
<td>2,184</td>
<td>13,693</td>
<td>18,554,789</td>
<td>1,355</td>
<td>16,263</td>
<td>24,168,303</td>
</tr>
<tr>
<td>2015</td>
<td>2,510</td>
<td>5,516,451</td>
<td>2,198</td>
<td>13,378</td>
<td>18,279,212</td>
<td>1,366</td>
<td>15,888</td>
<td>23,795,663</td>
</tr>
<tr>
<td>2014</td>
<td>2,471</td>
<td>5,372,756</td>
<td>2,174</td>
<td>13,167</td>
<td>18,040,244</td>
<td>1,370</td>
<td>15,638</td>
<td>23,413,000</td>
</tr>
<tr>
<td>2013</td>
<td>2,373</td>
<td>5,310,141</td>
<td>2,238</td>
<td>12,647</td>
<td>17,851,859</td>
<td>1,412</td>
<td>15,020</td>
<td>23,162,000</td>
</tr>
<tr>
<td>2012</td>
<td>2,271</td>
<td>5,175,950</td>
<td>2,279</td>
<td>12,101</td>
<td>17,547,050</td>
<td>1,450</td>
<td>14,372</td>
<td>22,723,000</td>
</tr>
<tr>
<td>2011</td>
<td>2,240</td>
<td>5,126,787</td>
<td>2,289</td>
<td>11,939</td>
<td>17,213,213</td>
<td>1,442</td>
<td>14,179</td>
<td>22,340,000</td>
</tr>
<tr>
<td>2009</td>
<td>1,878</td>
<td>4,944,900</td>
<td>2,633</td>
<td>10,004</td>
<td>17,210,500</td>
<td>1,720</td>
<td>11,882</td>
<td>22,155,400</td>
</tr>
<tr>
<td>2006</td>
<td>1,644</td>
<td>4,781,826</td>
<td>2,909</td>
<td>8,760</td>
<td>16,066,934</td>
<td>1,834</td>
<td>10,404</td>
<td>20,848,760</td>
</tr>
</tbody>
</table>

10.6.1 Effect of the NPA on the public dental waiting lists.

A brief reduction in the number of people on the public dental waiting lists was recorded for 2013-14 (Table 3). However, overall, public general dental waiting lists had recorded growth from 2012 to 2016 and were reported as 107,332 for NSW and 154,400 for QLD as at September 2016 (Table 3). This represents a 24.8% increase in the number of people waiting to receive non-emergency dental care in NSW and an 18.3% increase for QLD. Waiting lists in both States have grown faster than the total eligible population.

Table 10.3: Number of people on the public dental waiting lists (NSW and QLD).

Source: Dental Health Services website 2012-16.

<table>
<thead>
<tr>
<th>Year</th>
<th>NSW</th>
<th>QLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>107,332</td>
<td>154,400</td>
</tr>
<tr>
<td>2015</td>
<td>99,000</td>
<td>106,104</td>
</tr>
<tr>
<td>2014</td>
<td>77,000</td>
<td>86,000</td>
</tr>
<tr>
<td>2013</td>
<td>66,000</td>
<td>77,146</td>
</tr>
<tr>
<td>2012</td>
<td>86,000</td>
<td>130,546</td>
</tr>
</tbody>
</table>
10.6.2 Eligible population dynamics.

The eligible population also grew over the last decade (2006-16) and stood at 5,613,514 in September 2016, representing a 17.5% increase over the period (Table 4). Growth in the eligible population during the 2012-16 timeframe, coincidental with the waiting list data, amounted to an 8.5% increase.

Table 10.4: Composition of the eligible population (national).


<table>
<thead>
<tr>
<th>Year</th>
<th>Health Care Card</th>
<th>Pension Concession Card</th>
<th>Total Eligible Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>1,488,313 (27%)</td>
<td>4,125,201 (73%)</td>
<td>5,613,514</td>
</tr>
<tr>
<td>2015</td>
<td>1,466,234 (27%)</td>
<td>4,050,217 (73%)</td>
<td>5,516,451</td>
</tr>
<tr>
<td>2014</td>
<td>1,451,280 (27%)</td>
<td>3,921,476 (73%)</td>
<td>5,372,756</td>
</tr>
<tr>
<td>2013</td>
<td>1,461,723 (28%)</td>
<td>3,848,418 (72%)</td>
<td>5,310,141</td>
</tr>
<tr>
<td>2012</td>
<td>1,456,932 (28%)</td>
<td>3,719,018 (72%)</td>
<td>5,175,950</td>
</tr>
<tr>
<td>2011</td>
<td>1,462,591 (29%)</td>
<td>3,664,196 (71%)</td>
<td>5,126,787</td>
</tr>
<tr>
<td>2009</td>
<td>1,387,418 (28%)</td>
<td>3,557,482 (72%)</td>
<td>4,944,900</td>
</tr>
<tr>
<td>2006</td>
<td>1,341,664 (28%)</td>
<td>3,440,162 (72%)</td>
<td>4,781,826</td>
</tr>
</tbody>
</table>

The Pension Concession Card holders, on average, accounted for 72.0% of the total eligible population. The Health Care Card holders accounted for the remaining 28.0% of the eligible population, nationally. The proportion of representatives from each eligible group has remained relatively consistent over the timeframe.
10.6.3 Dentist to population ratio.

Findings indicate that the ratio of both public and private dentists to eligible and non-eligible population, respectively, has decreased (more dentists per 100,000 population) (Table 2). Eligible population to public dentist ratio stood at 2,184 in 2016, representing a 33.0% improvement over the 10 year period. General population (non-eligible for public care) to private dentist ratio has also improved over the same period and was reported as 1,355 in 2016, a positive change of 35.5%.

10.7 Discussion

It is clear that the rates of dentists employed in Outer Regional and Remote areas, at the national level, have seen a positive change (an increase of 34.0% and 26.0% respectively). However, it must be noted that, in terms of dentist to population ratios, Outer Regional and Remote areas (25.0 and 38.3 FTE, respectively) were still up to 61.0% worse off when compared to Major Cities (63.1 FTE).

Figures from Graduate Careers Australia 2005 indicate that 95.0% of newly graduated dentists were able to find full-time employment soon after completing their course (Graduate Careers Australia, 2005). In 2015 the figure was lower at 86.7% (Graduate Careers Australia, 2015). The data indicate that an increasing number of newly graduated dentists were unable to find full-time employment (5% in 2005 compared to 13.3% in 2015) (Graduate Careers Australia, 2005; Graduate Careers Australia, 2015).
This seems to suggest that the dental health labour market is becoming more competitive.

The majority of dentists (approximately 85%) are privately employed (AIHW, 2008). Fewer dentists (approximately 9%) are employed within state or territory governments (AIHW, 2008). The NPA, in essence, aimed to reduce the public dental waiting lists by utilising the services of privately employed dentists. Previous research, however, has found that it is more cost effective to provide subsidised dental care to eligible patients through public dental clinics (Dudko, 2015). A brief reduction in the public dental waiting lists (NSW and QLD) was noted in 2013-14. The reduction appears to follow implementation of the NPA. However, 2015 and 2016 data indicate that the reduction was temporary and public dental waiting lists have in fact grown when compared to 2012 data. Interestingly, the rate of growth of the public dental waiting list in NSW and QLD is 2 – 3 times that of the rate of growth of the eligible population over the same period.

Considering that it is not common practice for Dental Health Services to actively promote availability of public dental care to the eligible population, the findings may indicate that the size of the public dental waiting list may not be directly dependant on the size of the eligible population and other factors may need to be considered.
Although the eligible population grew by 8.5% over the last decade, the composition has remained relatively steady over the period with PCC holders representing a clear majority at 72.0% and HCC holders accounted for the remaining 28.0%. By way of comparison, Australian population grew by 15.5% over the same period.

Evidence links lower socioeconomic status with higher rates of dental decay (AIHW, 2014). Thus an argument could be made that public dental patients have higher demand for dental services when compared to private patients. While the eligible population-to-public dentist ratio (2,184:1) in 2016 has improved (33.0%) significantly over the years, public patients had access to far fewer dentists when compared to private patients (1,355:1) in 2016.

It may not be possible to achieve true equality in dentist-to-population ratios when comparing Outer Regional and Remote residents to populations residing in Major Cities. This is because geographic realities (vast land areas) in Outer Regional and Remote Australia and population distribution are such that provision of services, similar to those available in densely populated urban areas, may not be economically viable or practical. Public health dentistry may need to find alternative and innovative ways of bringing dental health to Outer Regional and Remote populations. Adoption of tele-dentistry and making use of auxiliary oral health providers (therapists, hygienists and oral health therapists) may help to bridge this gap (Estai, 2016).
10.8 Conclusion

It is apparent that the overall change in the number of dentists (FTE) practising in Outer Regional and Remote areas has been positive. The dentist-to-population ratio in these areas has seen a significant improvement (34.0% and 26.0% respectively). Although much improved, the number of dentists (FTE) per 100,000 population in Outer Regional and Remote areas is still lower (38.3 and 25.0, respectively) when compared to Major Cities (63.1). Furthermore, the expected associated benefits specifically for the public dental patients may be limited as the majority of dentists are privately employed (approximately 85%) (AIHW, 2008).

The reduction in the number of people on the public dental waiting lists that initially followed implementation of the NPA appears to have been brief. The waiting lists (NSW and QLD) are now longer than they were prior to implementation of the NPA.

Graduate employment data (and empirical indicators) point to the dental health labour market becoming more competitive in the cores of our Major Cities. In its 2005 report AIHW estimated dental workforce projections from 2005 to 2020 (AIHW, 2008). The number of dentists currently registered (2017) has already exceeded the estimates in the report for the year 2020 (AIHW, 2008; Dental Board of Australia, 2016).

Given it is more cost effective to provide subsidised dental care through public dental clinics (Dudko, 2015) a strong argument could be made that during a time of good labour force supply, policy should be to widen and strengthen the government-provided dental network so that when the economic tide changes (in the next cycle)
government safety-net dentistry is in a far stronger position than it was during this cycle (ie in the early 2000’s).
Chapter Eleven

11. Discussion and Conclusions
11.1 Introduction

The research outlined in this thesis consists of a number of studies which examined the distribution and composition of the national dental waiting list, and types of dental treatment most commonly provided in various clinical settings. The research also compared costs of providing subsidised dental care via private and public clinical pathways, and formulated a mathematical model for identifying and ranking areas of relative need for future service rollout.

11.2 Public versus Private clinical pathway

Recent research into the mix of care most commonly provided in private and public clinical settings has concluded that significant differences do exist. The contrast may reflect limited resources available to the public sector, resulting in greater emphasis on delivery of emergency care. This is evident by public patients receiving a higher percentage of extractions and much lower rates of preventive and routine maintenance services.

Indigenous patients have been found to be at much higher risk of receiving an extraction compared with other public patients. This is consistent with previous findings indicating that Aboriginal and Torres Strait Islander people experience significantly higher levels of edentulism by comparison to all other groups.

This inequality is further compounded by the scientific link that shows that people with multiple missing teeth are more likely to experience chronic systemic diseases, such as CVD or CKD.
In terms of annual expenditure, services delivered in private clinical settings on average amounted to $47,000 per 100 patients. This was in contrast to the general public and Indigenous patients who were likely to receive about $21,000 and $16,000 worth of services respectively, per 100 patients.

When compared with international data; in the USA there does not appear to be as much difference between dental services mixes received through private versus public pathways as there is in Australia. This finding provides further evidence that more needs to be done to help close the gap.

Interestingly, public patients treated in private clinical settings (as shown by CDDS data) were more likely to receive similar cost of services per capita as private patients. This finding indicates that, in a fee-for-service environment, the choice of service provision may be influenced by factors other than disease.

The level of education, availability of private health cover, geographic location, financial position and cultural values of an individual could influence their decision to seek dental services and the type of treatment they may choose. In essence, tooth loss is a combination of multiple factors that may contribute to unfavourable dental visiting pattern.

However, greater frequency of tooth loss among lower socio-economic groups can also, in part, be attributed to the subsidised dental care delivery system itself. When high rate of emergency services provided through public dental clinics is viewed in the
context of long waiting lists (people expressing their desire to receive routine and preventive dental care), one can appreciate that resources that would foster a more favourable pattern of dental visits do not exist. Patients having to wait for prolonged periods of time, in some cases up to 27 months, to receive routine (including preventive) dental care, may experience further deterioration of oral health; in some cases possibly leading to seeking emergency care for relief of pain.

11.3 Estimated cost of resetting national dental waiting list to zero

There is scientific evidence to show a link between edentulism and chronic systemic conditions, highlighting the urgency of addressing dental problems early. Our data analysis found that public dental clinics were providing more extractions and less preventive services (as patients have to be off the waiting list to receive preventive care), when compared to mix of care received by private patients. Thus, it was interesting to see what it would take to reset the national waiting list to zero. The objective was to estimate what financial commitment would be required to make it possible for the eligible population to follow a more favourable dental visiting pattern of attendance that would ultimately allow the focus to shift to a more preventive care.

Modelling of delivery of subsidised care through public versus private clinics showed that it is more cost effective to treat patients by publically employed dentists when compared to subcontracting the work out to private sector. The entire waiting list (263,043 people) could theoretically be covered by a team of some 360 dentists and nurses in just 12 months, if they do no other work but remove people off the waiting
list. Such a result could be achieved by continuing to deliver dental services through the public dental clinics, where available, and employing more dental teams if demand for services and clinical facilities allow. The financial commitment to eliminate completely the waiting lists that remain in Australia was estimated to be between $46 million and $90 million.

There are additional benefits to treating eligible patients through public dental clinics. The issue associated with provision of fixed prostheses are chief among those. It has been well documented that complex restorations such as crowns and bridges require ongoing maintenance and good oral hygiene. Therefore, by definition, patients with a history of generalised decay (which is typically caused by poor oral hygiene) are not always suitable candidates for complex restorative procedures, because under such conditions these restorations are more likely to fail. Of course, the requirement and techniques for maintaining good oral hygiene can be explained to patients before such restorations are undertaken. However, patient compliance with such recommendations can only be accurately assessed over time. Thus, provision of subsidised complex restorative procedures through public dental clinics may provide a better safety net for the taxpayer, because there are stricter controls for providing such high-maintenance and expensive restorations.

It is acknowledged that geographic access to public dental clinics could still be a barrier to receiving timely care in some communities because the reach of public dental clinics is limited. This is especially true for rural and remote communities where distance to a nearest public dental clinic may be considered to be excessive. Thus, in areas that do not have a large enough population to warrant building a public dental clinic,
subcontracting of public dental services to private clinics should be increased. This approach, although more expensive, could potentially have an added bonus of providing more favourable terms for private practitioners to set up practice in country towns, consequently offering additional benefits for the rural and remote communities.

The ability to address waiting list backlog would require a mix of service models depending on service availability at different locations. The additional cost of increased service delivery will, in part, be offset by reduction in progression of dental disease and decrease in the rate dental emergencies that is likely to follow.

11.4 Characteristics of the eligible population in WA

Distribution of the eligible population closely follows that of the unemployed and not in the labour force population. This is in light of the fact that a person has to be in possession of a Pension Concession Card or a Health Care Card to be eligible for subsidised dental care. Also, up to 80% of those eligible for subsidised dental care were, in fact, Pension Concession Card holders. In other words the elderly, or those who have retired. The unemployed population made up less than 20% of the overall eligible population. This is a significant finding because it indicates that the demand for subsidised dental services is unlikely to fall with improvement in economic climate (ie. reduction in the national rate of unemployment). In fact, the opposite is more likely to be true as the population continues to age.
Sixty five per cent of the eligible population was residing in metropolitan areas, and the remaining 35% residing in regional and remote areas. This is also interesting because most government dental clinics are located in metropolitan areas, while over a third of their potential clients are residing in the rural and remote areas. This disparity is brought in to contrast even further with findings that show rural and remote residents are up to 40% less likely to have received or even are registered to receive subsidised dental care when compared to metropolitan residents.

Rural and remote residents had to travel further to obtain the same services as those residing in metropolitan areas. Geographical remoteness has often been identified as one of the main barriers to obtaining health related services (ARCPOH, 2009). In an emergency situation most people will travel 100km, or even further if necessary, to see a dentist, provided they have access to transport. The same distance and time investment could be viewed from a completely different perspective by the eligible population when it comes to non-emergency dental care. Travel to see a dentist for preventive dental care needs to be considered in the context of the everyday travel activities for a particular community. When considered in these terms one can begin to understand how prioritisation of trips to see a dentist for routine care might occur.

Yet another interesting finding was that only 18% of those eligible for subsidised dental care are registered with the service. This could be due to the fact that offers of subsidised dental care are generally not featured in the mass media, thus it is also possible that people are simply not aware that such a service exists. This also implies that demand for services could potentially grow significantly in a very short time,
should the existence of the service become more widely known. However, current waiting times for routine dental care indicate that the capacity of the system to deal with any increase in demand for service is currently not available.

It is also possible that the waiting lists are indeed self-limiting, meaning that people are put off by the long waiting times, and therefore choose not to register. Some may see this as a good point as the cost of service delivery is also minimised. But it could also be argued that this is false economy on the basis of the subsequent cost of emergency dental treatment which is likely to be paid for by the taxpayer. This contingency may impact on the systemic health of an individual with possible subsequent admission to a general medical hospital, which could outweigh the cost of providing preventive dental services by far.

11.5 Can geographic access be improved by offering public dental care through private dental clinics?

Geographic Information System modelling revealed that utilisation of the existing network of private dental clinics across Australia to deliver subsidised dental care could dramatically reduce the national dental waiting list. Moreover it could improve geographic access and, in the medium to long term, could help shift focus from emergency to preventive care.

Nationally, 4.7 million people are eligible for subsidised dental care, indicating that around 20% of Australians are in possession of either a Pension Concession Card or a
Health Care Card. Of the total eligible population, 2.8 million (60%) resided in metropolitan areas, and 1.9 million (40%) resided in the rural and remote areas of the country. A large proportion of the metropolitan eligible population (72%) is located within a 5km range of a government dental clinic. In contrast, only 66,000 (3%) of the eligible rural and remote residents were located within a 5km range of government dental clinic.

People on the waiting lists in all States and Territories across Australia are likely to benefit from a reduction in travel distance if offered the option of being able to access subsidised treatment either through a government or a private clinical pathway. However, the biggest improvement (59%) in geographic access to subsidised dental care was evident for the rural and remote population. This is a significant finding considering that rural and remote residents are consistently at a disadvantage compared with their metropolitan counterparts when geographic access to health related services is considered (ARCPH, 2009).

However, previous experience with the Chronic Disease Dental Scheme (CDDS) shows that writing an “open cheque” in terms of the types of services that can be provided to treat public patients in a private setting can be very expensive (Lam, 2012), and may not necessarily yield the much desired results. Thus a framework with appropriate safeguards may need to be put in place should this option be considered. Provided safeguards can be implemented, the improvement in geographic access to subsidised dental care could help foster the culture of preventive care among the most vulnerable members of our communities by simplifying the process of obtaining routine care.
Geographic locations of private dental clinics are driven by market forces and economic circumstances (Tennant, 2013). In many cases private dental services cannot be sustained in rural and remote areas, in part due to lack of dentists, high costs and low population density (Dudko 2015). Thus provision of subsidised dental care through private clinics in rural and remote areas could have additional benefits of improving services availability for entire communities where existing socio-economic dynamics do not otherwise allow for private practice set up.

11.6 Selecting a location for a primary healthcare facility

Treating eligible patients through public dental clinics is the cheapest option (Dudko, 2015a). Thus, developing a comprehensive network of public dental clinics is likely to be a prudent investment in the long term, in areas where population characteristics support such an investment. Public health infrastructure, however, represents a significant investment of public funds, and the key factor is deciding where to build those clinics.

Site selection for new health facilities is a multilevel process which consists of both objective and subjective considerations. An example of an objective consideration may include demographics of the population and any other typical statistical data that help to identify local needs. Subjective considerations may consist of public opinion which can often be gauged by holding consultations with the communities concerned, and may consider variables such as perceived need, environmental factors, transportation and streetscape. Both objective and subjective factors are important
contributors to the decision making process, and in some cases compromises may need to be considered to accommodate one or the other.

Representatives of lower socioeconomic groups are more likely to utilise health facilities (Glover, 2004). Optimal location of new facilities plays a critical role in improving geographic access for those who are more likely to use them. Australia is big, and according to the Australian Bureau of Statistics about two thirds of the nation’s geography could be considered to be low socio-economic areas. Clearly there is a need for a method of differentiating between and ranking of areas with similar socio-economic and demographic characteristics.

Our research shows that it is possible to improve both qualitative and quantitative attributes of the results as well as to rank prospective sites for future health infrastructure by including relevant statistical data into a mathematically weighted formula.

Publically available statistical data such as the IRSAD index, level of those not in the labour force and the usual resident population, can be used for this purpose. The approach described in this thesis effectively weighs IRSAD with respect to these attribute data thereby improving relevance by further qualifying findings. The process, in effect, ensures that population characteristics support the project in question.

The method also allows for “smoothing” of typical statistic data by repeating the calculation at SA2, SA3 and SA4 level and then adding the results to produce an
aggregate value at SA1 level. In this way socio-economic index and population data of SA2, SA3 and SA4 have an equal opportunity to influence the ranking of its subordinate SA1. The method effectively identifies SA1s that meet the predetermined criteria but also confirms that the SEIFA index and population data of the surrounding SA1s, SA2 and SA3s supports the selection of that particular SA1. Thus one can be sure that the selected SA1 is not an “outlier” (ie. not surrounded by high socio-economic areas) but in fact is an “epicentre” of a cluster of low socio-economic areas and thus should be a focus of attention.

11.7 Reducing capital expenditure on government dental clinics by utilising existing publically owned infrastructure: general medical hospitals

Application of the mathematical method to identify and rank areas of relative need for new public dental clinics has returned 49 results (SA1 areas) that met the criteria. The previously described mathematical method of site selection allowed for a set of weighted statistical parameters to be considered together for each Statistical Area 1 and compare those to adjacent, as well as superior, Statistical Areas (SA1, SA2, SA3 and SA4), producing “smoothed” ranking of each SA1 across the country.

There are approximately 55 000 SA1s in Australia. The identified 49 SA1s are the lowest 0.1% of the total with respect to the socio-economic index, usual resident population and unemployment or not in the labour force status. This revolutionary mathematical approach allowed for identification of areas of relative need with very high accuracy and precision, and makes it easier to prioritise future service provision.
Combining this mathematical approach with a Geographic Information System can yield additional benefits. Mapping the 49 SA1s identified by the method allowed for visual appreciation of any existing infrastructure. In this case, qualified SA1s had been further considered in relation to the existing public medical hospital network.

Somewhat unsurprisingly, and consistent with previous research findings, identifying rural and remote residents to be at a geographic disadvantage with respect to access to public dental clinics, 80% of the identified SA1s (39) were located outside metropolitan areas. However, 50% (20 SA1s) of those were located in the immediate vicinity of publically owned health infrastructure, a general medical hospital. In these cases, delivery of subsidised dental care through existing public health infrastructure, where available, may be an option. Such an approach may offer an opportunity to reduce dental waiting lists and improve geographic access to dental care services, while minimising capital expenditure on new public dental clinics.

A perfect example of such a location would be Smithton, TAS. This location is one of the 49 SA1s identified by the method and is located 92km from the nearest public dental clinic. But there is a general medical hospital in the immediate vicinity that could potentially facilitate a public dental clinic.

Additional measures, such as contracting the work out to the private dentists, may be required in identified areas of relative need that are not located in the vicinity of a public medical hospital. In such cases, an agreement with private sector dentists in
areas on need could help reduce public dental waiting lists, and improve services in rural and remote centres.

11.8 Why not include dental under Medicare?

Current annual expenditure on dentistry in Australia is around $10 billion. Around 75% of this amount is paid for by individuals and private health insurance companies, and only the remaining 25% is paid for by various State and Federal programs. This is despite the fact that only between 20% and 50% of people attend dental appointments in a given year. Potentially, demand for services could be much higher should dentistry become covered under Medicare and therefore become more affordable from an individual’s perspective.

Medicare is, of course, funded through our tax and levies. Current annual expenditure of $10 billion on dental care is roughly equal to about $400 per every person in Australia (based on 25 million people). For an average family with two children, taking into account possible doubling of the demand for services, the annual additional cost in income tax and levies would be in the vicinity of $3 500. This figure is likely to grow as people visiting their dentist under this scheme begin to opt more frequently for more expensive treatment such as implants as opposed to simple removable prosthesis such as dentures.

Considering that around 20% of the Australian population is in possession of either a Pension Concession Card or a Health Care Card the actual financial burden on the gainfully employed population could be even greater. There are other Centrelink
entitlements such as Austudy that could further inflate to cost of Medicare. In fact at the extreme limit of the scheme, it could add up to $7 000 per year per working family.

In addition, the market force will drive the prices for dental services up, due to increased demand. Patients would still be left to pay the “gap”, as they currently are with medical services. The proportion covered by Medicare will be likely to erode over time unless higher taxes or levies are imposed to keep up with inflation.

Thus, it seems that inclusion of dental services under Medicare may not be a financially viable option, at this stage. A financially responsible solution appears to be up-regulation of the government sector dentistry to identified areas of relative need, while allowing private patients to continue to fund their own treatment.

11.9 Use of allied health auxiliaries to reduce dental waiting lists

Allowing dental hygienists and therapists to carry out check-ups on waiting listed patients could be another way forward. Recent research showed that there was little difference in the rate of detection of decay by hygienists and therapists when compared to dentists. The false positive rate of detection was 8% (Macey et. al., 2015). In other words 8 out of 100 patients, following check-up by auxiliaries, were referred to a dentist for treatment when no treatment was necessary. At a glance this may seem like an unacceptably high error rate. However, the need for any work would be confirmed by the dentist assigned to do the work.
The false negative rate was about, 7% of patients who had decay that auxiliaries failed to identify (Macey et. al., 2015). However, dentists sometimes also miss decay or choose to monitor a particular lesion for a greater degree of certainty. More frequent check-up visits are likely to offer greater protection against undetected decay than being seen by a highly trained professional on a less regular basis.

It is common for private patients to receive 6 monthly reminders in the mail from their dentist for a check-up. Public patients are less fortunate in this area with an average recall time being about 18 months. In this way mid-level dental professionals such as hygienists and therapists could prove instrumental in reducing dental waiting lists and bringing recall times (subsequent check-up), closer to the 6 months; a time frame that private patients have become accustomed to.

Diagnostic procedures account for approximately 18% of all services delivered through the public dental care system. In the section titled “funding of dental care” the annual expenditure on dental services was discussed. Currently State and Federal governments annually spend about $1.5 billion on subsidised dental care, the rest of expenditure is largely privately funded. Auxiliary dental providers are cheaper to employ, compared with employing a dentist (about a third to half the cost of employing a dentist, depending on level of experience). Thus, though implementation of this approach, one could see a reduction in labour costs associated with employing dental professionals within the government sector (a saving of between $135 million and $190 million annually). In essence, the model places dental auxiliaries at the centre of the check-up system that could see millions of routine dental procedures provided each year at a significantly reduced cost.
11.10 Study limitations

This research compares the care accessed by people of vastly different backgrounds. Those differences include economic opportunity, gender, age and cultural values, and can all impact on the type of treatment a person chooses. Type of care chosen can also differ depending on the prevalent economic climate. For example: recent studies have shown that the demand for dental services in the USA has fallen since the Global Financial Crisis (GFC) of 2008. Although Australia has remained largely unaffected by the GFC (ADA, 2013), it has been acknowledged at government level that the public’s discretionary expenditure has decreased presumably due to the sizable shift to a culture of saving. These factors are, however, mitigated in a subsidised dental care environment as fees are controlled by the Department of Veteran’s Affairs and any charges to patients are subsidised, in some cases (AMS-based pathway for example) by up to 100%.

The actual income of privately employed dentists may differ from the self-reported amount used to calculate the hourly rate. This could possibly be due to tax deductible expenditure that may occur prior to the end of financial year. Publically employed dentists (assuming FTE 1.0) would not be entitled to such deductions therefore pay gap between the two groups may in actual fact be greater. The significance of this limitation is that treatment of public patients by contracting the work out to private sector may be more expensive than initially thought. However, given that the findings in this thesis indicate that in is more cost effective to treat public patients through government dental clinics, any additional increase in the cost on contracting public
work out to private sector dentists would only further support findings and suggestions made within this thesis.

This research found that geographic distribution of the eligible population closely follows that of the unemployed and not in the labour force population. This was based on the detailed analysis and modelling of the population in Western Australia, and may therefore differ slightly between States and Territories. However, since the eligibility status within the population is dynamic, any slight variation in geographic distribution of the eligible population is likely to be insignificant. Census data is collected every 5 years and can be used to gauge changes in the distribution of the eligible population.

The improvement of geographic access that is to be gained by the eligible population in rural and remote areas was calculated using the physical address (and the longitude and latitude) obtained from previously published research (as at August 2012). The actual number and location of private clinics may vary with the prevalent economic climate. It could be argued that due to slow down in the resource sector, smaller towns that are reliant on mining activity may experience a reduction in population that could render some country dental practices no longer viable. This limitation, however, would also be partially mitigated by the increased numbers of new graduates (and, until recently, overseas trained dentists) in Australia who have been moving to rural and remote areas in an effort to secure employment.

11.11 Future research

This thesis presents good evidence for cost efficiency in treating eligible patients through government dental clinics. A large percentage (80%) of the identified areas of
relative need are located outside metropolitan areas, and geographically remote from existing government dental clinics. Fifty percent of the identified areas are located in the vicinity of a public medical hospital, and a suggestion had been made to, where possible, utilise existing public facilities (ie placing a dental clinic into the identified medical hospitals) rather than building new clinics in rural and remote areas. Thus one direction for future research would be to gauge the level of utilisation of the identified medical hospitals to see if the facilities can accommodate such an expansion and provide comparative costs for the project.

Another possible direction for future research would be to conduct studies into the possibility of allocating public patients to private health insurance companies. The idea can be viewed as an extension of what already happens in the resource sector. The author is referring to the fact that in some cases when resource companies apply for a mining licence, in a particular area of commercial interest, it is common for certain conditions to be attached to such licences. In some cases a resource company may be required to contribute to the local community infrastructure for example, or perhaps to employ a certain percentage of the local community members. All of these additional expenses can be classed as cost of doing business.

Therefore, there could be a case for inclusion of a condition on licences of all publically listed private health insurance companies in Australia obliging them to provide free basic cover to a certain percentage of population eligible for subsidised dental care. This mandatory allocation could be based on market capitalisation, for example. This only needs to be a basic level of cover that does not include complex restorative dental work.
Of course, it could be argued that such an arrangement will unfairly allocate high risk clients and result in premium increases for the paying members. However, such an argument could be countered by acknowledging the benefits private health insurance companies are currently receiving from membership fees paid by the low risk members who earn over $80 000 and therefore are charged Medicare levy surcharge if they do not have private health cover (hospital). There is likely to be a percentage of people in this category who consider themselves to be fit, unlikely to benefit from such insurance cover in the foreseeable future, and who probably wouldn’t have purchased the cover had it not been, in effect, a mandatory purchase.

Such an arrangement would likely have an immediate positive impact on the national dental waiting list as the eligible population would be free to obtain basic and preventive care (subject to annual limits) at private dental clinics, and therefore may be worth exploring.

Much of the methodology in this study is specific to Australia. However, it could easily be adapted to countries where Census data is available.

**11.12 Conclusions**

In summary, a socially responsible and sustainable public dental care system needs to be multifaceted and employ a number of initiatives.

It is apparent that socio-economically disadvantaged members of our communities with limited opportunity to seek dental care privately are at a further disadvantage due to unfavourable visiting patterns offered by the under resourced public dental clinics.
Rural and remote residents are at a significant disadvantage by comparison to their metropolitan counterparts with respect to geographic access to subsidised dental care, and are up to 40% less likely to be registered for treatment. The findings also suggest that the demand for subsidised dental care is unlikely to fall significantly with improvements in economic climate, but in fact is likely to rise as more baby boomers reach their retirement.

Inclusion of dental care under Medicare is not a viable option for Australia at this point in time. A systematic up-regulation of the government sector, treating the financially disadvantaged members of our communities first and those with access difficulties, the aged and infirm, and then slowly growing the system outwards could help address the problem in a financially responsible manner.

Identifying and ranking areas of relative need for government dental clinics by combining a mathematical approach with Geographic Information Systems can yield significant advantages over conventional methods of site selection. These advantages are both qualitative and quantitative. Quality of the information is significantly improved due to an increase in specificity of data used through the weighing and smoothing process. Quantitative improvement is achieved via a more obvious choice of sites with similar qualitative characteristics.
Access to subsidised dental care can potentially be improved for the rural and remote residents (anywhere up to 50%) by offering subsidised dental care to the eligible population through the existing publicly owned medical hospital network. Installing dental clinics at key locations, where rooms are available, may help to control the cost of service delivery by minimising capital expenditure.

Involving mid-level providers (Hygienists and Therapists) in routine check-ups could also be an option to re-direct our health system and reduce costs (in particular in the government sector) and thus extend access and reduce wait times for routine care. In essence this model places mid-level providers at the core of the check-up system, and could see some 10 million routine adult dental examinations provided at a significantly lower cost every year.

Ongoing arrangements with the private sector, especially in rural and remote areas, should also be considered. If appropriate safeguards are implemented, it might be possible for all: the regional private patients, public patients and the taxpayer to benefit from such an agreement. Limited partnership with the private sector may offer the extra financial incentive needed for private clinics to remain open (and for new clinics to open) in rural and remote centres. Such an approach may improve primary health services availability for the general population, offer a much needed expansion of the safety net for the geographically disadvantaged low income earners, and provide a welcome reprieve to the taxpayer with respect to capital expenditure and the cost of subsidising more expensive emergency dental care.
11.13 Key recommendation

Provision of subsidised dental care through public dental clinics in most cases remains the more cost effective option. Therefore upregulation of the public dental system by employing more dentists and investing in new public dental clinics should be considered to help meet the needs of eligible patients into the future.
References


Dudko Y, Kruger E, Tennant M. Selecting a location for a primary healthcare facility: combining a mathematical approach with a Geographic Information System to rank areas of relative need. Submitted to Asia Pacific Journal of Health Management.

Dunn L (2013). What the US can learn from healthcare delivery overseas: Q&A with Harvard Business School’s Regina E. Herzlinger. (Becker’s Hospital Review: Chicago, IL, United States of America). Available from:


Lonergan Study, 2014


Appendices
National dental waitlists: what would it take to reset to zero?

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Abstract

Objective. Over the years, long public dental waitlists across Australia have received much attention from the media. The issue for eligible patients, namely a further deterioration of dental health because of not being able to address dental concerns relatively quickly, has been the subject of several state and Federal initiatives. The present study provides a cost model for eliminating public dental waitlists across Australia and compares these results with the cost of contracting out public dental care to private clinics.

Methods. Waitlist data from across Australia were collected from publicly available sources and confirmed through direct communication with each individual State or Territory Dental Health body. Average costs associated with employing key dental personnel and performance figures were used from previously published data to estimate the potential financial commitment and probable public benefits.

Results. The cost model suggests that, on average, it would be more than twice as expensive to contract the work out to private dental clinics as to treat eligible patients within public dental clinics. It is estimated that the cost of eliminating the legacy dental waiting lists (over 12 months) would be between A$50 and A$100 million depending on the method adopted. The effort would require some 360 dental teams.

Conclusion. The design of the Australian public dental care system that is targeted at meeting the needs of eligible patients into the future, in addition to being effective and sustainable, must also offer a level of protection to the taxpayer. The ability to address waitlist backlog identified in the present study clearly would require a mix of service models depending on service availability at different locations. Further research is needed to optimise the mix of service providers to address community needs.

What is known about the topic? Long public dental waitlists across Australia have received much attention from the media. The topic has been the subject of debate at the government level and, over the years, has seen an increase in allocation of public funds in an effort to address the policy needs.

What does this paper add? This study calculates the actual number of people on the public dental waitlist, provides a detailed analysis of the distribution of the demand for the services and offers a cost model for resetting public dental waitlists across Australia.

What are the implications for practitioners? This study carries no implications for individual practitioners at the clinical level. However, at the state and national levels, this model offers direction to a more cost-effective allocation of public funds and human resources.

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assistance of privately funded insurance. The level of health insurance in Australia fluctuates, but currently approximately 45% of the population is covered. Market forces set the costs of care in this pathway (without any government interference), although there is some effect of insurance-driven schemes on the fee-for-service arrangement within a minority of practices.

Consistent with the 1946 amendment to the Australian Constitution, and strong social policy positions held by sequential Australian governments since World War II, people in poverty have access to subsidised health services, inclusive of dental care. Subsidised dental care is provided through a series of public (State and Territory run) dental clinics distributed across Australia. Public dental clinics are usually located in major centres and provide access to a limited range of dental treatments. Some locations also contract out services to private dentists.

The cost of dental care to eligible patients is subsidised by State governments, with various co-payment approaches taken by individual States and Territories, but universally based on the income level of the patient. The demand for dental services from eligible patients exceeds the capacity of State and Territory public dental services to provide treatment, resulting in waiting lists, with historical wait times of 27 months reported. Long waiting time for an appointment has been identified as one of the main reasons of patient dissatisfaction and has frequently been the source of news stories in the national media.

More recently, the Commonwealth Government has committed $1.3 billion over several years to State and Territory governments to support additional dental services for adults. This funding is being provided through a National Partnership Agreement (NPA) for adult dental services. The measure is aimed at reducing long wait times to see a public dentist by providing eligible public dental patients with an authority to seek limited treatment from a private dentist. The current NPA for public dental patients ended in March 2015 and a cut-down 12-month extension was put in place. The second NPA was originally scheduled to start on 1 July 2014, but the Budget proposed its deferral until 2015–16. Although early reports suggest that the NPA has had some success in reducing the national dental waitlist, the initiative is deemed too new to determine with any degree of certainty whether the effect will be long lasting, cost-effective and sustainable.

The public dental system in Australia is highly dynamic and the waitlists tend to provide a buffer between the demand and available public resources. Therefore, waitlists may not be inherently bad as long as the eligible patients are able to access the required care within the desirable time frames. Patients attending the Government Dental Clinics with acute problems are prioritised and appointments are made immediately for the most urgent cases, whereas others are placed onto the waiting list.

The present study examined, at the national level, dental waitlists for routine dental care and modelled the total workforce and financial commitment that would be required to eliminate current waitlists. Obviously, eliminating waiting lists is not a real outcome, but it does provide a solid basis for determining the magnitude of the national waitlist and its effect on total system performance. Based on these findings, the paper attempts to identify a cost-effective and sustainable approach to addressing the demand for subsidised dental care into the future that would also allow the desirable time frames for routine dental care to be maintained.

Methods
All data used in the present study were grouped into total numbers for regions, therefore no ethics approval was required.

Waitlist size
All waitlist data for each State and Territory were collected from websites or confirmed through direct communication with various jurisdictional bodies. The data were collected for a single time-point (mid-2013). This time point was chosen specifically because any large-scale effect from the NPA would be unlikely so early in the implementation process (within a couple of months).

Value of care
Previously published data identifying the average mix of care via various clinical pathways in Western Australia was used to represent the monetary value of a typical low-, middle- and high-cost dental treatment plan per 1000 patients.

Primary model approach
Operator efficiency
Efficiency data (i.e. the time taken for an operator to complete care on patients) for public dental service dentists were collected from previously published work. In short, the average number of patient visits per treatment plan (mean (s.d.) 3 ± 1.8) and the average number of patients seen per day (10 patients) by a public dentist was used as the benchmark activity. Assuming a full-time equivalent (FTE) of 7.6-h work day (38 h per week), the average number of patients a single public dentist would be able to treat per year was calculated. ‘Work year’ was defined as a calendar year minus weekends (104 days), public holidays (12 days), annual leave (20 days), Continued Professional Development leave (5 days) and personal leave days (~4 days). The actual number of work days for a public dentist has been calculated to be 220 (365 – (104 + 12 + 20 + 5 + 4)).

Alternative model approach
An alternative approach would be to provide subsidised dental care through the existing network of private dental clinics around Australia to complement the effort of the government dental clinics. In this model, a private dentist would be reimbursed for service provision to eligible patients in line with the Department of Veteran’s Affairs (DVA) dental fee schedule. A previous study from our group identified the mix of care a patient is likely to receive via four different clinical pathways in Australia, including public, Chronic Disease Dental Scheme (CDDS), private and Aboriginal Medical Services (AMS)-based care. In the present study we have rested on the most commonly used dental treatment item numbers identified in each clinical pathway and monetary value assigned using the 2013 DVA dental fee schedule per 1000 patients treated.

Results
Waitlist size
The total number of patients currently waitlisted for public dental care in the Australian Capital Territory (ACT; n = 165),
New South Wales (NSW; n = 42 000), Queensland (Qld; n = 62 513), South Australia (SA; n = 12 454), Tasmania (Tas.; n = 17 225), Victoria (Vic.; n = 116 864) and Western Australia (WA; n = 11 822) was obtained from state Dental Health Services websites or through written requests for data to the department (Table 1). The Northern Territory (NT) did not report its data and offers of participation were declined. Notwithstanding this, it is estimated that the number of people on the NT public dental waiting list would be very small compared with other States and Territories.

Primary model approach

Operating teams required to eliminate the national waiting list

The cost of providing a dental service in terms of subsidies, dentist and assistant wages per 1000 patients can be calculated.

Applying the methodology, it was modelled that, on average, a public dentist is able to complete 2200 patient visits (appointments) per work year (220 days per year x 10 patients per day). Extending this, on average, a public dentist is able to complete the treatment for approximately 733 patients per work year (2200 patient visits x 0.7 visits per patient to complete an average treatment).

Given that the waitlist at the time of the present study was 263 043 people, it is estimated that 359 (263 043 / 733) dental teams will be able to completely eliminate the waiting lists in 1 year assuming they undertake no other care than remove patients from the waitlist. It is noted that many government clinics are also teaching facilities where students are also rostered to provide endpoint dental care under supervision, which may affect output calculations.

Cost model

The Australian Dental Association estimates the average salary for a dentist (in 2013) was A$92 000. The average wage for a dental nurse for the same year was A$49 000. The addition of superannuation entitlements (and various other on-costs) adds approximately 20% to the dentist and nurse labour costs. This translates to A$101 per hour for both the dentist and the nurse (A$92 000 + A$49 000.00 + 20% x 20 work days per year x 7.6 h per day). This equates to A$231 127 (in salary and wages per 1000 patients treated). The study does not account for costs associated with administration, reception, materials or laboratory work because direct labour costs are the most substantial cost component (some 265%) of the overall costs.

The total cost in terms of dentist and nurse wages can now also be calculated with regard to elimination of all the dental waitlists right around Australia by multiplying the cost of treating 1000 patients by the total number of patients waitlisted in thousands (A$231 127 x 63.043 = A$60 786 401; excluding patient co-payments).

Sensitivity analysis

The estimated cost is based on an ‘average’ course of care that spans over three appointments. The dental team’s time is the main cost determinant in this equation; it would therefore follow that price would change depending on the number of appointments a patient requires to complete their course of care. Taking into account the standard deviation of the sample for the length of course of care (1.8 appointments), a cost spread was established (Table 2). The cost of providing dental care has been shown (Table 2) to be very sensitive to the number of appointments required to complete patient course of care. The cost spectrum spans between A$24 478 781 (1.2 appointments) and A$97 024 988 (4.8 appointments), with an average of A$60 786 401 (three appointments), excluding patient co-payments (Table 2).

Summary of model outcome

In short, it is estimated that it will take 359 public dental teams 12 months with a cost estimated at A$60 million to eliminate the waiting lists that remain in Australia. Most of the teams (n = 169) would need to be based in Victoria, whereas 86 teams would be needed in Qld and the remaining 104 would be located throughout the other States and Territories.

Alternative model approach

It is recognised that even though Australia has a sizeable network of public dental clinics throughout the country, long waitlists and geographic remoteness of towns and cities can make it difficult for eligible patients to access the services in a timely manner. It has been reported that the wait time for eligible patients on the public dental waitlist for routine dental care in Australia is beyond optimal. Therefore, it would be reasonable to conclude that there is a shortage of government dentists doing the work. If this statement is correct, it would follow that in order to completely eliminate all the current waitlists in Australia, either more funds need to be allocated to employing public dentists (and building new clinics) or consideration must be given to contracting the work out to private dentists.

Table 1. Average cost (A$) of treating public dental patients across each State and Territory

<table>
<thead>
<tr>
<th>State</th>
<th>ACT</th>
<th>NSW</th>
<th>Qld</th>
<th>SA</th>
<th>Tasmania</th>
<th>Victoria</th>
<th>WA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-payment value</td>
<td>~20%</td>
<td>Nil</td>
<td>Nil</td>
<td>$155 max</td>
<td>$44/app</td>
<td>$26.50/app</td>
<td>25%</td>
</tr>
<tr>
<td>No. people on waitlist</td>
<td>165</td>
<td>42 000</td>
<td>62 513</td>
<td>12 454</td>
<td>17 225</td>
<td>116 864</td>
<td>11 822</td>
</tr>
<tr>
<td>State population</td>
<td>386 000</td>
<td>7 432 200</td>
<td>4 676 400</td>
<td>1 674 700</td>
<td>513 400</td>
<td>5 768 600</td>
<td>2 535 70</td>
</tr>
<tr>
<td>No. people on waitlist per 1000 population</td>
<td>0.5</td>
<td>6</td>
<td>13</td>
<td>7</td>
<td>33</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>Cost of labour</td>
<td>$38 115</td>
<td>$9 707 334</td>
<td>$14 440 503</td>
<td>$2 876 874</td>
<td>$3 978 975</td>
<td>$26 995 584</td>
<td>$2 730 882</td>
</tr>
<tr>
<td>Less patient co-payment</td>
<td>$6 913</td>
<td>0</td>
<td>0</td>
<td>$1 930 370</td>
<td>$2 273 700</td>
<td>$9 290 688</td>
<td>$618 09</td>
</tr>
<tr>
<td>Net cost</td>
<td>$31 202</td>
<td>$9 707 334</td>
<td>$14 440 503</td>
<td>$9 466 504</td>
<td>$1 705 275</td>
<td>$17 704 896</td>
<td>$2 112 782</td>
</tr>
<tr>
<td>Total cost</td>
<td>$46 648 502</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
work identified the average cost and compared the types of services a patient was likely to receive via four clinical pathways, including public, CDDS, private and AMS. A concise overview of the findings has been included below to help understand the composition of the cost associated with the alternative approach model.

Previous studies found that patients attending public dental clinics, on average, received treatment to the value of A$209 523 per 1000 patients. In this pathway, 7% of the total value was attributed to extractions, 4.8% to crowns and bridges and 50% for the provision of simple fillings. In this setting, between 50% and 75% of the treatment cost is subsidised by the government, depending on patient eligibility. The CDDS, which, until recently, provided eligible people (not based on economic eligibility but on health-based factors) the ability to claim rebates from the national government health financing system (Medicare) for dental treatment provided by private dentists. The CDDS, introduced in 2007, entitled people with chronic medical conditions (directly related to their dental health) to be covered for dental treatment up to the value of A$4250 over a 2-year period. In the CDDS pathway, patients received approximately A$470 062 worth of treatment per 1000 patients. Extractions accounted for only 2% of the workload. Crowns and bridges made up 18% of the bill, whereas simple fillings contributed 27% to the overall total.

The private care pathway showed similar financial results to the CDDS. On average, A$477 790 worth of treatment per 1000 patients was provided. Extractions made up 1.9% of the total cost, with crowns and bridges accounting for 15.9% and simple fillings for 47% of the total amount.

In short, patients receiving treatment through both the CDDS and private pathways received fewer extractions and more than threefold as many complex (crown and bridge) restorations as those being treated through the public pathway. Because the now historic CDDS was paid for by Medicare and analysis of both CDDS and private clinical pathways offers an objective overview of the type and frequency of services delivered, these pathways can be viewed as an example of the kind of cost the taxpayer may be expected to meet should serious consideration be given for the work to be contracted out to the private sector and the spectrum of service delivery in terms of dental item numbers is not restricted. Projecting these findings over our national dental waitlists, the cost of eliminating current dental waitlists by contracting the work out to private clinics is likely to be A$111 415 509 including patient co-payment. As a comparison, our previous calculation found that 359 strategically located government-employed dental teams, not undertaking any other activities except treating patients on the waitlist, would have the capacity to eliminate Australia’s entire dental waitlist for a total of A$46 648 502 once patient co-payment is taken into account (Table 1).

Discussion

A recent inquiry into Adult Dental Services in Australia by the ADA (March 2013) has concluded that ‘the NPA is unlikely to reach the level of funding that was expended under the CDDS in any given year’.

Therefore, experience with the CDDS can provide some insight into the costs associated with ‘contracting out’ of public dental care. As both the CDDS and the private pathway examples demonstrate, such care is more expensive compared with the public pathway. However, it must be noted that, compared with the public pathway, CDDS and private pathways have higher rates of provision of endodontics and crown and bridge services. These services are generally more labour intensive and thus more expensive. Conversely, the public pathway has a higher rate of extractions and simple restorative services. These differences may reflect the predominance of emergency or problem visiting for public dental care and the subsequent lack of opportunity for more comprehensive and preventive dental care. Changes in patients’ personal circumstances may also create a situation whereby patients move in and out of eligibility without ever reaching the top of the waitlist. The difference in cost may also reflect the tighter rationing of services within a course of care in the public dental services. The criteria for the provision of complex restorations, such as crowns and bridges, is complex and may require ‘standardisation’ should serious consideration be given to contracting out these types of dental services. In addition, it has been well documented that such complex restorations require ongoing maintenance and good oral hygiene. Therefore, by definition, patients with a history of generalised decay are not always optimal candidates for complex restorative procedures, because under such conditions these restorations are more likely to be a risky long-term clinical decision. Of course, the requirements and techniques for maintaining good oral hygiene can be explained to patients before such restorations are undertaken. However, patient compliance with such recommendations can only be accurately assessed over time. Thus, provision of subsidised complex restorative procedures through public dental clinics may provide a better safety net for the taxpayer because there are stricter controls for providing such high-maintenance and expensive restorations.

The subject of long dental waitlists is not new and there are many opinions on what should be done to reduce them. The true number of eligible patients who would like to access subsidised dental care could be even higher than reported because of the fact that prolonged wait times may discourage people from applying.

Adding to the debate, several studies have linked poor oral health and systemic diseases, highlighting the urgency of addressing dental problems early. In more recent years, it has been suggested that perhaps dental care should be included under the Medicare scheme, offering the Australian public universal access to dental services. Although such a move could potentially reduce the waiting lists by allowing unlimited access to dental care privately, the cost associated with such an initiative is likely

Table 2. Effects of variation in the number of appointments on dental teams, co-payment and net labour costs

<table>
<thead>
<tr>
<th>No.</th>
<th>No. teams</th>
<th>Team labour</th>
<th>Approximate</th>
<th>Estimated net appointments required cost (AS)</th>
<th>co-payment (AS)</th>
<th>cost (AS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2</td>
<td>143</td>
<td>2478781</td>
<td>5647096</td>
<td>18830875</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 (mean)</td>
<td>359</td>
<td>6076627</td>
<td>14119765</td>
<td>46648502</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.8</td>
<td>574</td>
<td>9702498</td>
<td>22591624</td>
<td>74433364</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
to be prohibitive and has been estimated to be up to A$11 billion annually.\textsuperscript{18} Arguably the most cost-effective approach would be to continue to deliver public dental services through the public dental clinics, where available, and employing more dental teams if demand for services and clinical facilities allow. Standardising the classification of the currently available dental services through the public dental clinics as either ‘essential or medically essential’ or ‘elective’ could also be an option. This classification effectively creates two waitlists ‘essential’ and ‘elective’, not too dissimilar to what public hospitals operate under. This clear distinction allows publicly employed dentists to work quicker through the ‘essential’ waiting lists by focusing initially on elements of dentistry that are fundamental to arresting progression of disease. This sort of triaging of patients in the public sector has been effective in several places previously\textsuperscript{19} and is a common practice in NSW and Qld. Reducing progression of disease is likely to improve the overall health of the patient and may reduce the amount of dental work required during future ‘elective’ visits.

In areas that do not have a large enough population to warrant building a public dental clinic, the level of subcontracting of public dental services to private clinics should be increased. This approach, although more expensive, could potentially have an added bonus of providing more favourable terms for private practitioners to set up practice in country towns, offering additional benefits for the rural and remote communities.

In conclusion, in addition to being effective and sustainable, the design of the Australian public dental care system that is targeted at meeting the needs of eligible patients into the future must also offer a level of protection to the taxpayer. The ability to address waitlist backlog identified in the present study clearly would require a mix of service models depending on service availability at different locations. It is estimated that the cost of eliminating the legacy dental waiting lists (over 12 months) would be between A$50 and A$100 million depending on the method adopted. The effort would require some 360 dental teams, with most based in Victoria. Different approaches to addressing this legacy were considered and variations in the cost and manpower issues presented. Further research is needed to optimise the mix of service providers to address community needs.

Competing interests

None declared.

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References


Geographic distribution of point-in-time access to subsidised dental services in Western Australia

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Abstract. Dental Health Services (DHS) is the largest public primary oral healthcare provider in WA. The objective of this study was to calculate probable distance patients are expected to travel to the nearest clinic, gauge utilisation rates and predict the direction of likely changes in future demand for subsidised dental care. Eligible population data was collected from the Department of Human Services and the Australian Bureau of Statistics websites and integrated with the waiting list and the recall list data provided by the DHS. In total, 65% of the eligible WA population are residing in the metropolitan area; however, only 19% of those are either on the waiting list or have already received subsidised care. In all, 35% of the total eligible WA population are residing in country areas. A total of 30% of the eligible country WA patients are located within a 100-km range of a Government Dental Clinic, with only 11% of those either on the waiting list or having already received subsidised dental care. Country WA residents are at a significant disadvantage by comparison to their metropolitan counterparts. Eligible WA country residents are up to 40% less likely to receive treatment when compared to the metropolitan residents.

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Introduction

Western Australia (WA) is a State within Australia that occupies over one-third of the continent. With a total land area of 2.6 $\times 10^6$ km$^2$ and home to ~2.6 million people (Australian Bureau of Statistics 2014), WA is the second largest country subdivision in the world. The WA residents account for 11% of the total population of Australia, with 92% residing in the south-western corner of the State (Australian Bureau of Statistics 2014).

Until 1946, the Commonwealth of Australia, with the exception of its responsibility for the health of war veterans, did not have the constitutional power to offer health, pharmaceutical or dental services and benefits. In 1946, constitutional amendment gave the Commonwealth the authority to provide and fund a wide range of health services and benefits (Biggs 2008).

Today, the adult dental care system in WA consists of an intricate combination of private and public service providers. The majority of dental care is provided by the private practice pathway, through a distributed collection of settings (Lam et al. 2012). In this private practice pathway, the patient is responsible for the cost of any treatment, with or without the assistance of privately funded insurance (Dudko et al. 2015). The level of health insurance in Australia fluctuates, but currently ~45% of the population is covered (Kruger et al. 2011). Market forces set the costs of care in this pathway; there is no government price control in the market, although there is some effect of insurance driven schemes on the fee-for-service arrangement within a minority of practices (Dudko et al. 2015).

Consistent with the 1946 amendment to the Australian Constitution, and strong social policy positions held by sequential Australian governments, people on low income have access to subsidised health services, inclusive of dental care. A majority of subsidised adult dental care is provided through a series of public (State run) dental clinics distributed across WA (Tennant and Kruger 2013). Dental Health Services (DHS) is the largest public primary oral healthcare provider in WA.

DHS provides subsidised dental care to Western Australians aged 17 years and older who hold a current Health Care or Pension Concession card. The cost of dental care to eligible patients is subsidised by the State government, with three co-payment approaches (no co-payment, 25% co-payment, 50% co-payment) that are based on the income level of the patient (Dental Health Services 2008). Public dental clinics provide access to a limited range of dental treatment (general and emergency) for eligible patients (Biggs 2008). Some locations also contract out services to private dentists.

The demand for dental services from eligible patients exceeds the capacity of State public dental services to provide treatment, resulting in waiting lists, with historical wait times of 24 months reported (Dental Health Services 2014). Long waiting time for an appointment has been identified as one of the main reasons of patient dissatisfaction (Chu and Lo 1999) and has frequently been...
The lower socioeconomic groups do not receive adequate, timely access to primary care, with historic waiting times for adult general dental care of up to 24 months in Western Australia.

This study looks at the level of service utilisation by the eligible population and provides a detailed analysis of the geographic distribution of the actual and potential demand for services.

No individual level data was used and no identification of patients was possible with the grouped data provided. Thus, ethics approval was not required. We have also taken the additional step of de-identifying the clinics to protect reputations.

This retrospective study collected Pension Concession Card and Health Care Card holder’s (eligible people, \( n = 426 \, 955 \)) distribution data from the Department of Human Services website (distributed by electorate) (Department of Human Services 2011). These data were re-distributed to boundaries (Statistical Area level 2; SA2) that are consistent with the 2011 Census. Census data for ‘unemployed’ and those ‘not in the labour force’ (\( n = 583 \, 872 \)) by SA2 were used to provide the relative proportions of eligible people to each SA2 within a given electoral boundary. Where electoral boundaries were split across a SA2, the SA2 was split proportionally (on area) and eligible people were evenly redistributed based on different proportions (Fig. 1).

Recall and waitlist data
Recall and waitlist data (single point-in-time, October 2012) was provided by the DHS. All data used in this study was grouped into total numbers for SA2.

Geographic analysis
Quantum Geographic Information System (ver. 2.8.1) free and open source software (see www.qgis.org) was used to map distribution of the eligible and waitlisted population across Western Australia by SA2, and to plot the locations of Government Dental Clinics.

The SA2 is an area defined in the Australian Statistical Geography Standard (ASGS) and consists of one or more whole Statistical Areas level 1 (SA1s). Wherever possible, SA2s are based on officially gazetted State suburbs and localities. In urban areas, SA2s largely conform to whole suburbs and combinations of whole suburbs, whereas in rural areas, they define functional zones of social and economic links. Geography is also taken into account in SA2 design. SA2s cover, in aggregate, the whole of Australia without gaps or overlaps (Australian Bureau of Statistics 2006).

Centroid (geometric centre) was recorded for each of the SA2s and the numbers of eligible people within a 5- and 10-km radius (excluding overlaps) for each of the metropolitan clinics (Table 1), and within a 5-, 10- and 100-km radius (excluding overlaps) for each of the country clinics (Table 2) was calculated. Metropolitan area was defined as a 50km radius from the General Post Office (GPO). Essentially, if a centroid fell within the 15 predetermined radius, then the population of that SA2 would be counted as ‘residing within’ that radius. One hundred-kilometre radius buffers were also calculated for the most peripheral metropolitan clinics, to account for the eligible country population residing within the buffer zone.

These numbers were cross-referenced with the waitlist and recall list data to estimate the percentage of eligible people that have registered, or were routinely receiving, subsidised dental care.

When the estimated eligibility by SA2 was overlayed with the actual eligibility by electorate, a close correlation was observed (Table 3). It was also apparent that not every person who is ‘not in the labour force’, or is ‘unemployed’, has a Pension Concession Card or a Health Care Card, possibly due to other variables in means testing. Data finds that less than 73% of those identified through Census data as either ‘unemployed’ or ‘not in the labour force’ were likely to be in possession of a Pension Concession Card or a Health Care Card (when cross-referenced with the Department of Human Services data) (Department of Human Services 2011).

The analysis of point-in-time utilisation of individual Government Dental Clinics found stark differences in the rates of utilisation relative to the eligible population across the State (Tables 1 and Table 2) with, on average, much higher rates of clinic utilisation by the metropolitan residents.

There were 426 955 people in WA eligible for subsidised dental care (Department of Human Services 2011). The majority of those eligible for subsidised dental care resided in the Perth metropolitan area (276 568 or 65%). In all, 41.5% (177 325) of the eligible population residing in the metropolitan area were located within a 5-km radius of a Government Dental Clinic (Fig. 2). However, of those who were eligible and resided within the Perth metropolitan area, only 52 158 (or 19%) have received non-emergency dental care (recall patients) or had been placed on the waiting list for subsidised dental care (Table 1).

Outside the metropolitan area, there were 126 004 eligible people residing within 100 km of a Government Dental Clinic (Fig. 3). However, only ~11.5% of those were registered to receive the service, a much lower rate (40% reduction) by comparison to the metropolitan population (19%) (Table 2).
Even with a further increase in the ‘service area’ radius of the outermost (peripheral) metropolitan clinics to 100 km (to account for the people residing relatively close to the city), 24,383 (6%) eligible people had been identified to be residing outside the 100-km travel range of a Government Dental Clinic.

Fig. 1. Eligibility data was available at electoral boundary level (bold lines). Each Statistical Area level 2 (SA2) (thin lines) had the number of eligible people distributed to it based on the 2011 Census distribution of ‘unemployed’ and ‘not in the labour’ force (dots, 10). When electoral boundaries cross through a SA2, the SA2 was divided on area and the relevant numbers applied in two parts before rebinding to form a single number of eligible people for each electoral division.

Table 1. Distribution and utilisation of the Western Australian metropolitan Government Dental Clinics by the eligible population

<table>
<thead>
<tr>
<th>Perth Metropolitan Government Dental Clinic by code</th>
<th>Eligible population within a 5-km range (n)</th>
<th>Eligible population outside a 5-km radius but within a 10-km radius (n)</th>
<th>Eligible population outside the 50-km metropolitan radius but within a 100-km radius (n)</th>
<th>Total eligible population radius (n)</th>
<th>Actual number of people on the waiting list (n)</th>
<th>Actual number of people on the recall list (n)</th>
<th>Total number of people registered for subsidised dental care (n)</th>
<th>Percentage of eligible population registered for subsidised dental care</th>
</tr>
</thead>
<tbody>
<tr>
<td>1011</td>
<td>12,474</td>
<td>1464</td>
<td>0</td>
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<td>326,276</td>
<td>21,611</td>
<td>30,547</td>
<td>52,158</td>
<td>15.98</td>
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</table>
It was noted that, on average, eligible people resided in areas with higher rates of unemployment, within the metropolitan area, and were more likely to use the service than eligible people residing in areas with lower rates of unemployment. Such a relationship could not be demonstrated for the country population. The weighted average for utilisation of Government Dental Clinics across the State (people on the recall and waiting lists divided by the total eligible population for each of

Table 2. Distribution and utilisation of Western Australian country Government Dental Clinics by the eligible population
There are 426,955 people in Western Australia eligible for subsidised dental care, where no data were present zero is entered to show that no eligible population meets that criteria

<table>
<thead>
<tr>
<th>WA Country Government Dental Clinics</th>
<th>Eligible population within a 5-km range (n)</th>
<th>Eligible population outside a 5-km radius but within a 10-km radius (n)</th>
<th>Eligible population outside the 10-km radius but within a 100-km radius (n)</th>
<th>Total eligible population (n)</th>
<th>Actual number of people on the waiting list (n)</th>
<th>Actual number of people on the recall list (n)</th>
<th>Total number of people registered for subsidised care (n)</th>
<th>Percentage of eligible population registered for subsidised dental care</th>
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Table 3. Actual vs. estimated distribution of the eligible population
SA2, Statistical Area level 2

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<tr>
<th>Electorate by code</th>
<th>Health Care Card holders</th>
<th>Pension Concession Card holders</th>
<th>Total eligible population by electorate</th>
<th>Estimated eligible population by SA2</th>
<th>Percentage of actual eligible population</th>
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<td>426,955</td>
<td>425,562</td>
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the clinics) was calculated to be 18%. This finding is in agreement with the DHS annual report that estimates access to dental services for eligible adults to be at 18% (Dental Health Services 2014).

5 Discussion

Good dental health is fundamental to a person’s overall health, wellbeing and quality of life. Thus, timely access to primary oral healthcare services is critical in reducing the burden of dental disease on individuals and communities. Preventive dental care reduces the incidence of disease, facilitates early detection of problems and reduces the need for extensive restorative or emergency treatments at a later stage (Metropolitan Health Service 2013).

The subject of timely access to dental care for the eligible population is not new, and there are many opinions on what should be done to improve it. Over the years, long public dental waitlists have received much attention from the media. The issue for eligible patients, a further deterioration of dental health while waitlisted, has been the subject of a new State and Federal initiative – National Partnership Agreement (NPA; Dudko et al. 2016). The Commonwealth Government committed A$1.3 billion over several years to State and Territory governments to support additional dental services for adults under the NPA. Of that, close to A$30 million was allocated to treat more public dental patients in WA (Metropolitan Health Service 2013). The measure is aimed at reducing long wait times to see a public dentist by giving eligible public dental patients an option to seek limited treatment from a private dentist, thus also improving access to primary oral healthcare services, especially for the country residents (Dudko et al. 2016). The current NPA for public dental patients ended in March 2015 and a cut-down 12-month extension was put in place. The second NPA was originally scheduled to start on 1 July 2014, but the Budget proposed its deferral until 2015–16 (Dudko et al. 2016). Although early reports suggest that the NPA has had some success in reducing the State’s dental waitlist and has improved access to primary oral healthcare services, the initiative is deemed too new to determine with any degree of certainty whether the effect will be long-
last lasting, cost-effective or sustainable (Metropolitan Health Service 2013).

The current study examined the socioeconomic composition of the West Australian population, and identified the number of people eligible for subsidised dental care, as well as their residential location within the State down to SA2 level.

Results clearly indicate that Government Dental Clinics are used by only a fraction of the eligible population (19% in the metropolitan area and 11.5% in the rest of Western Australia). Even though this represents an underutilisation of care by the eligible population, the wait times to see a dentist for non-urgent dental care can be up to 24 months (Dental Health Services 2014). It is clear that public services and resources would not cope in a scenario where all (or even an increased proportion) of all those persons eligible for public care attempt to use the service.

There could be several reasons why more eligible people don’t register for subsidised dental care. For example, changes in patients’ personal circumstances may create a situation whereby patients move in and out of eligibility and therefore don’t register with the service as they may feel that their eligibility may change before they get to the top of the waitlist (Dudko et al. 2015). As offers of subsidised dental care are generally not featured in the mass media, it is also possible that people are simply not aware that such a service exists. It is also possible that the waitlists are indeed self-limiting, meaning that people are put off by the long wait times. Some may see this as a good point as the cost of service delivery is also minimised.

In a vast and relatively scarcely populated State like Western Australia, or indeed the entire country of Australia, it could be argued that travelling for 100 km to see a dentist should not be considered excessive. However, one must remember that in ‘round-trip’ terms, a patient residing 100 km away from the nearest clinic will still be travelling for 200 km in total, and spending most probably over 2 h in the car, as roads rarely follow a straight line. Furthermore, the travel needs to be considered in the context of the everyday travel activities for a particular community. When thought of in these terms, one can begin to understand how prioritisation of trips to see a dentist for routine care might occur.

Geographical remoteness has often been identified as one of the main barriers of accessing health-related services (Australian Research Centre for Population Oral Health 2009). In an emergency situation, most people will consider travelling 100 km, or even further if necessary, to see a dentist, provided they have access to transport; the same distance and time investment could be viewed from a completely different perspective by the eligible population when it comes to non-emergency dental care. As this study found that high numbers of the eligible population reside within a relatively close distance to a Government Dental Clinic, it must be assumed that geographical or physical distance alone is not the only barrier to accessing services.

Conclusion

In summary, this research found that country WA residents were at a significant disadvantage by comparison to their metropolitan counterparts when access to subsidised primary care is considered. Eligible WA country residents were up to 40% less likely to receive treatment when compared to metropolitan residents. With utilisation rates by the eligible population at ~18%, a future increase in demand for subsidised dental care is a real possibility. Considering that an average waiting time for non-urgent dental care was ~24 months (Dental Health Services 2014), any increase in the uptake of the service could result in substantially longer wait times.

Limitations

There are some limitations of this study. The data used in this study is from 2011 to 2012, and thus some changes in levels of eligibility and geographic distribution of the eligible population may have occurred. The WA eligible population and recall and waiting list sample is relatively small when compared to national data. Therefore, the findings may be different when all of Western Australia is considered. Further research is needed and could focus on applying the methodology outlined in this study at the national level.

Conflicts of interest

None declared.

Acknowledgements

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References


A national analysis of dental waiting lists and point-in-time geographic access to subsidised dental care: can geographic access be improved by offering public dental care through private dental clinics?

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International Research Collaborative, School of Anatomy, Physiology and Human Biology, The University of Western Australia, Perth, Western Australia, Australia

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Dudko Y, Kruger E, Tennant M

A national analysis of dental waiting lists and point-in-time geographic access to subsidised dental care: can geographic access be improved by offering public dental care through private dental clinics?

Rural and Remote Health 17: 3814. (Online) 2017

Available: http://www.rrh.org.au

ABSTRACT

Introduction: Australia is one of the least densely populated countries in the world, with a population concentrated on or around coastal areas. Up to 33% of the Australian population are likely to have untreated dental decay, while people with inadequate dentition (fewer than 21 teeth) account for up to 34% of Australian adults. Historically, inadequate access to public dental care has resulted in long waiting lists, received much media coverage and been the subject of a new federal and state initiative. The objective of this research was to gauge the potential for reducing the national dental waiting list through geographical advantage, which could arise from subcontracting the delivery of subsidised dental care to the existing network of private dental clinics across Australia.

Methods: Eligible population data were collected from the Australian Bureau of Statistics website. Waiting list data from across Australia were collected from publicly available sources and confirmed through direct communication with each individual state or territory dental health body. Quantum geographic information system software was used to map distribution of the eligible population across Australia by statistical area, and to plot locations of government and private dental clinics. Catchment areas of 5 km for metropolitan clinics and 5 km and 50 km for rural clinics were defined. The number of people on the waiting list and those eligible for subsidised dental care covered by each of the catchment areas was calculated. Percentage of the eligible population and
those on the waiting list that could benefit from the potential improvement in geographic access was ascertained for metropolitan and rural residents.

Results: Fifty percent of people on the waiting list resided within metropolitan areas. Rural and remote residents made up 47% of the population waiting to receive care. The utilisation of both government and private dental clinics for the delivery of subsidised dental care to the eligible population has the potential to improve geographic access for up to 25% of those residing within metropolitan areas and up to 59% for eligible country residents.

Conclusions: This research finds that utilisation of the existing network of private dental practices across Australia for delivery of subsidised dental care could dramatically increase geographic reach, reduce waiting lists, and possibly make good oral health a more realistic goal to achieve for the economically disadvantaged members of the community. In addition, this approach has the potential to improve service availability in rural and remote areas for entire communities where existing socioeconomic dynamics do not foster new practice start-up.

Key words: Australia, dental public health, geographic information systems, health service mapping, rural and remote access.

Introduction

Australia is the sixth largest nation in the world, with a total area of more than 7 million km$^2$, and a very low population density of just three people/km$^2$. This makes Australia one of the least densely populated countries on earth. Some parts of Australia are even less densely populated. The Northern Territory, for example, has been recorded to hold 0.2 people/km$^2$. Much of Australia (45%) is desert, and this is the main reason why most of the population is concentrated on or around coastal areas.

Australians have generally enjoyed good dental health. The overall toll of poor oral health has reduced sharply during the 20th century with the introduction of fluoridated water and better understanding of dental disease. But the health gains have not been equally shared across all socioeconomic groups. It has been acknowledged by Australia’s National Oral Health Plan that low income earners are at a greater risk of dental disease compared to more affluent Australians. Aboriginal and Torres Strait Islander people experience significantly higher levels of dental disease compared to all other groups. Rural residents are less likely to follow a prevention-oriented pattern of dental attendance. It has also been found that concession card holders are less likely to visit a dentist on a regular basis and have a higher rate of dental disease. Poor dental health has been found to be more prevalent among those without private health insurance.

Ryan and Whelan have noted an increase in the disadvantaged population in outer urban areas of major capital cities. These areas are often characterised by low-cost housing and poor provision of services such as public transport. There is evidence that mobility rates decrease as area socioeconomic disadvantage rises.

Nationally, access to oral health care is available through several clinical pathways. The majority (about 85%) of dental care is provided in a private practice pathway. When seeing a dentist privately, a patient is responsible for meeting the cost of service provided. In some cases the cost of treatment in this pathway is partially paid for by private health insurance, when available. Prevalence of privately insured persons varies from year to year, but at the present time about 45% of the population is covered. Market forces set the costs of care in this pathway; there is no government interference in the market, although there is some effect of insurance-driven schemes on the fee-for-service model within some practices.

Low income earners are able to obtain subsidised dental care through a large network of public dental clinics across Australia. In this pathway the cost associated with provision
of dental care is taxpayer subsidised by between 25% and 100% of the benchmark Department of Veteran’s Affairs fee, depending on patient income. The level of subsidy varies between Australian states and territories. In some cases levels of subsidy can differ between population groups. The federal fee schedule has been reported to be between 20% and 40% less than a similar mix of care in the private pathway.

In addition to the above pathways, Aboriginal and Torres Strait Islander people are able to access oral health care through a network of Aboriginal medical services clinics. Generally, services provided at these clinics are free of charge to the patient.

Caries and periodontitis have been identified as the two most common diseases that result in chronic damage to oral health. If not identified early, these two diseases can have a cumulative cost to individuals and taxpayers. Easy and timely access to preventive dental care could help to identify problems early, thereby reducing the severity and cost of treatment. Many Australians understand the importance of seeing a dentist regularly but not all are able to do so. Up to 33% of the Australian population are likely to have untreated dental decay, while people with inadequate dentition (fewer than 21 teeth) account for up to 34% of Australian adults. Historically, demand for subsidised dental care has outstripped the ability of the public system to provide care, resulting in waiting lists, with wait times of in some cases 24 months.

The aim of this study was to gauge the potential for reducing national dental waiting lists through geographical advantage, which could arise from subcontracting the delivery of subsidised dental care out to the existing network of private dental clinics across Australia.

Methods

Waiting list data

All waiting list data (number of people waiting to receive non-emergency dental care) for each state and territory were collected from websites or confirmed through direct communication with various jurisdictional bodies. The

Northern Territory declined to participate. The data were collected for a single time point (mid-2012). This time point was chosen specifically because of its proximity in time to the available Census 2011 data.

Eligible population

Previous research found a close correlation between the 'unemployed' and 'not in the labour force' Census 2011 data and the distribution of eligible (for subsidised dental care) population, as provided by the Department of Human Services. Eligibility for subsidised dental care was found to be about 75% of the total 'unemployed' or 'not in the labour force' sample obtained from the Australian Bureau of Statistics. Eligibility criteria do differ slightly between states.

This retrospective study collected the 'unemployed' and 'not in the labour force' Census 2011 data from the ABS website (Statistical Area Level 2) to represent the eligible population (n=4,746,422) for subsidised dental care across Australia.

Government and private practice locations

Physical address (and the longitude and latitude) for each dental practice in Australia (collated from a number of open sources) as at August 2012 was obtained from previously published research and formed the basis of practice locations.

Geographic analysis

The Statistical Area 2 (SA2) is a unit of statistical geography that contains one or more Statistical Areas 1 (SA1s). In urban settings SA2s mostly follow officially gazetted suburb dimensions. In rural areas SA2s can outline a functional zone with socioeconomic links. Geography is also a consideration in SA2 design. When combined, SA2s cover the whole of the continent without gaps or overlaps.

Quantum Geographic Information System v2.8.1 (QGIS; http://www.qgis.org) was used to map and analyse the distribution of the eligible population and waiting list patients across Australia by SA2, and to correlate this with the locations of government and private dental clinics.

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Ethics approval

This retrospective study analysed statistical data and previously published literature. No individual-level data were used and no identification of patients was possible with the grouped data provided. Thus ethics approval was not required.

Results

There are 373,259 people on the national waiting list. The total numbers of patients currently waitlisted for public dental care in the Australian Capital Territory, New South Wales, Queensland, South Australia, Tasmania, Victoria and Western Australia were obtained from state dental health services websites or through written requests for data to the relevant department (Tables 1, 2). The Northern Territory did not report its data and offers of participation were declined. Notwithstanding this, it is estimated that the number of people on the Northern Territory public dental waiting list would be very small compared with other states and territories.

There are 4.75 million people in Australia eligible for subsidised dental care. The eligible population comprises those residing within metropolitan areas (n=2.84 million) and those residing outside metropolitan areas (n=1.90 million). In this study, a metropolitan area was defined as being within a 50 km radius of the general post office of one of the capital cities. The centroid was calculated for each of the SA2s, and the numbers of eligible people within a 5 km radius of a government clinic, and within a 5 km radius of a government or private clinic in a metropolitan area, were calculated (Table 1). A similar calculation was performed for the eligible population residing outside metropolitan areas (Table 2). For this second group an additional range to 50 km was recorded. Essentially if a centroid fell within the predetermined distance then the population of that SA2 would be counted as 'residing within' that distance. The calculations were cumulative (ie eligible population residing within a 50 km radius also included those residing within a 5 km radius).

Seventy two percent (weighted average) of the eligible population and about 142,000 of those on the waiting list are residing in metropolitan areas and are located within a 5 km range of a government dental clinic. When both government and private clinics are considered, 97% of the eligible population, and 191,000 of those on the waiting list residing in metropolitan areas, are found to be within 5 km of a dental clinic, representing a 25% improvement in geographical accessibility (Table 1).

In contrast, only 38% (weighted average) of the eligible population, and 66,000 of those on the waiting list residing outside metropolitan areas, are located within 5 km of a government dental clinic. When availability of private dental clinics is taken into account, 64% of the eligible population, and 112,000 of those on the waiting list, are within 5 km of a dental clinic, representing a potential 59% improvement in accessibility (Table 2).

The Northern Territory had the lowest percentage of population eligible for subsidised care, at 15% (Table 3), and had the lowest accessibility, with only 19% of the eligible city residents residing within 5 km and only 4% of the eligible rural residents located within 50 km of a government dental clinic. The Northern Territory figures are in stark contrast with the findings for New South Wales where 82% of the eligible metropolitan population are residing within 5 km of a government dental clinic. Country residents in New South Wales have also enjoyed better access to subsidised dental care, compared to people in the Northern Territory (and all other states), with almost all (97%) residing within 50 km of a government dental clinic. Twenty one percent of the total New South Wales population are eligible for subsidised dental care (Table 3). This figure is comparable with those of other states and territories.

The results show that 96% (weighted average) coverage of the eligible population, and 168,000 people that are on the waiting list, can be achieved for most states and territories when the service area radius of both government and private dental clinics located outside metropolitan areas is increased to 50 km (Fig1).
Table 1: Distribution within metropolitan areas of the Australian population eligible for subsidised dental care

<table>
<thead>
<tr>
<th>State/territory</th>
<th>Number on waiting list</th>
<th>Number within 5 km of government clinic (n(%))</th>
<th>Number within 5 km of government or private clinic (n(%))</th>
<th>Number residing within metropolitan area (n(%))</th>
<th>Total eligible number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australian Capital Territory</td>
<td>2129</td>
<td>18 296 (29.8%)</td>
<td>61 435 (99.9%)</td>
<td>61 485 (99.7%)</td>
<td>61 666</td>
</tr>
<tr>
<td>New South Wales</td>
<td>39 183</td>
<td>709 194 (81.7%)</td>
<td>848 436 (97.7%)</td>
<td>867 976 (94.3%)</td>
<td>1 597 396</td>
</tr>
<tr>
<td>Northern Territory</td>
<td>Not available</td>
<td>3 099 (18.8%)</td>
<td>13 047 (79.4%)</td>
<td>16 442 (46.5%)</td>
<td>35 393</td>
</tr>
<tr>
<td>Queensland</td>
<td>48 728</td>
<td>279 349 (69.8%)</td>
<td>387 654 (96.9%)</td>
<td>400 128 (44.1%)</td>
<td>908 456</td>
</tr>
<tr>
<td>South Australia</td>
<td>5211</td>
<td>169 646 (57.3%)</td>
<td>285 582 (96.5%)</td>
<td>295 821 (77.1%)</td>
<td>383 593</td>
</tr>
<tr>
<td>Tasmania</td>
<td>6323</td>
<td>10 090 (18.1%)</td>
<td>37 972 (67.9%)</td>
<td>55 889 (44.8%)</td>
<td>124 672</td>
</tr>
<tr>
<td>Victoria</td>
<td>74 606</td>
<td>604 149 (73.6%)</td>
<td>796 941 (97.1%)</td>
<td>820 910 (68.6%)</td>
<td>1 197 339</td>
</tr>
<tr>
<td>Western Australia</td>
<td>21 611</td>
<td>171 957 (54.2%)</td>
<td>305 799 (96.4%)</td>
<td>317 202 (73.4%)</td>
<td>417 907</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>197 791</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>2 835 953</strong> (59.7%)</td>
</tr>
</tbody>
</table>

Table 2: Distribution outside metropolitan areas of the Australian population eligible for subsidised dental care

<table>
<thead>
<tr>
<th>State/territory</th>
<th>Number on waiting list</th>
<th>Number within 5 km of government clinic (n(%))</th>
<th>Number within 5 km of government or private clinic (n(%))</th>
<th>Number within 50 km of government clinic (n(%))</th>
<th>Number within 50 km of government or private clinic (n(%))</th>
<th>Number residing outside metropolitan area (n(%))</th>
<th>Total eligible number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australian Capital Territory</td>
<td>181</td>
<td>0</td>
<td></td>
<td>181 (0.3%)</td>
<td>181 (0.3%)</td>
<td>181 (0.3%)</td>
<td>61 666</td>
</tr>
<tr>
<td>New South Wales</td>
<td>28 915</td>
<td>102 192 (41.3%)</td>
<td></td>
<td>703 327 (96.7%)</td>
<td>713 770 (98.3%)</td>
<td>729 420 (45.7%)</td>
<td>1 597 396</td>
</tr>
<tr>
<td>Northern Territory</td>
<td>Not available</td>
<td>0</td>
<td></td>
<td>588 (4.2%)</td>
<td>4903 (25.9%)</td>
<td>18 951 (53.5%)</td>
<td>35 393</td>
</tr>
<tr>
<td>Queensland</td>
<td>81 818</td>
<td>205 112 (40.4%)</td>
<td></td>
<td>443 799 (87.7%)</td>
<td>479 436 (94.3%)</td>
<td>508 228 (55.9%)</td>
<td>908 456</td>
</tr>
<tr>
<td>South Australia</td>
<td>6665</td>
<td>20 299 (23.1%)</td>
<td></td>
<td>41 894 (47.7%)</td>
<td>82 567 (94.1%)</td>
<td>87 772 (22.9%)</td>
<td>383 593</td>
</tr>
<tr>
<td>Tasmania</td>
<td>10 902</td>
<td>2 090 (12.5%)</td>
<td></td>
<td>50 088 (77.2%)</td>
<td>64 389 (93.6%)</td>
<td>68 781 (55.2%)</td>
<td>124 672</td>
</tr>
<tr>
<td>Victoria</td>
<td>42 258</td>
<td>113 799 (30.2%)</td>
<td></td>
<td>366 185 (94.6%)</td>
<td>369 604 (97.9%)</td>
<td>376 429 (31.4%)</td>
<td>1 197 339</td>
</tr>
<tr>
<td>Western Australia</td>
<td>4/09</td>
<td>28 199 (23.4%)</td>
<td></td>
<td>78 409 (65.3%)</td>
<td>104 413 (86.5%)</td>
<td>130 704 (27.6%)</td>
<td>437 907</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>175 468</strong></td>
<td></td>
<td></td>
<td><strong>86 848</strong></td>
<td><strong>105 184</strong></td>
<td><strong>136 749</strong></td>
<td><strong>4 746 422</strong></td>
</tr>
</tbody>
</table>

Table 3: Australian state and territory population and dental subsidy eligibility data

<table>
<thead>
<tr>
<th>State/territory</th>
<th>Eligible population (#)</th>
<th>Number on waiting list</th>
<th>Eligible population on waiting list (%)</th>
<th>Total population</th>
<th>% eligible for subsidised care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australian Capital Territory</td>
<td>61 666</td>
<td>2310</td>
<td>3.7</td>
<td>386 000</td>
<td>16.0</td>
</tr>
<tr>
<td>New South Wales</td>
<td>1 597 396</td>
<td>68 118</td>
<td>4.3</td>
<td>7 432 200</td>
<td>21.5</td>
</tr>
<tr>
<td>Northern Territory</td>
<td>35 393</td>
<td>Not available</td>
<td>Not available</td>
<td>234 800</td>
<td>15.1</td>
</tr>
<tr>
<td>Queensland</td>
<td>908 456</td>
<td>130 546</td>
<td>14.4</td>
<td>4 676 400</td>
<td>19.4</td>
</tr>
<tr>
<td>South Australia</td>
<td>383 593</td>
<td>11 876</td>
<td>3.1</td>
<td>1 674 700</td>
<td>22.9</td>
</tr>
<tr>
<td>Tasmania</td>
<td>124 672</td>
<td>17 225</td>
<td>13.8</td>
<td>513 400</td>
<td>24.3</td>
</tr>
<tr>
<td>Victoria</td>
<td>1 197 339</td>
<td>116 864</td>
<td>9.8</td>
<td>5 768 600</td>
<td>20.8</td>
</tr>
<tr>
<td>Western Australia</td>
<td>437 907</td>
<td>26 320</td>
<td>6.0</td>
<td>2 533 700</td>
<td>17.3</td>
</tr>
</tbody>
</table>
Discussion

Good dental health is fundamental to a person’s overall health, wellbeing and quality of life. Thus, timely access to primary oral healthcare services is critical in reducing the burden of dental disease on individuals and communities. Preventive dental care reduces the incidence of disease, facilitates early detection of problems and reduces the need for extensive restorative or emergency treatments at a later stage.

The present study examined a time-point distribution of the eligible (for subsidised dental care) population and those on the waiting lists across Australia, and calculated expected improvement in geographical accessibility to basic dental care and the potential impact on the national waiting list, should private dental clinics be considered for a more permanent role as a safety net for those eligible for subsidised dental care. The potential improvement in geographical access (and thus the capacity of the public dental care system) can be enjoyed by a significant percentage of those on the national dental waiting list, and is therefore likely to have a positive effect on the average waiting time for routine dental care.

Interpretation of results

Distance has often been identified as one of the main barriers to obtaining health-related services. However, it should be remembered that the distance a person is willing able to travel to obtain a health-related service may differ depending on the setting.

Distance needs to be considered in the context of everyday travel activities for a particular community. For example, 5 km of travel for a city resident with a low income using several modes of public transport can be considered a significant distance. The same distance in a country setting may not be seen as excessive, perhaps because town centres are generally smaller, with the majority of services often available close to the town centre. Use of public transport is more likely to involve a single mode of transport. When thought of in these terms, it is easier to see why prioritisation of trips to see a dentist for routine care differs with place of residence.

This reasoning formed the basis for nominating a 5 km travel distance to attend a dental clinic for city residents, and a 5 km
(to allow for comparison) and 50 km range for those residing outside a metropolitan area.

The present study’s model found that people on the waiting lists in all Australian states and territories could benefit from the reduction in travel distance, should they have the option of choosing to obtain subsidised dental care through either a government or private dental clinic. The highest increase in the availability and/or spatial accessibility of dental care (up by 59%) was noted for those residing outside metropolitan areas. This is a significant finding considering that rural and remote residents are consistently at a disadvantage compared to their metropolitan counterparts when it comes to accessing health-related services.

Impact of distance on dental health

A person’s place of residence, and more precisely travel distance to dental services, has been found to have a significant impact on the rate of hospitalisation for potentially preventable dental conditions. The rate of hospitalisation was shown to increase markedly with the increase in distance to dental services.

Key statistics and issues

The number of people eligible for subsidised dental care (4.7 million) represents 20% of the total population of Australia (24 million). Those on the waiting list (Table 3) represent 10% of the total population eligible for subsidised dental care or 1.6% of the total population of Australia. An annual report published by the Dental Health Services of Western Australia states that, in 2012–2013, 18% of the eligible population actually received subsidised dental care. Although the figures for other states and territories are unknown they are expected to be similar. Although this represents an underutilisation of care by the eligible population, the wait times to see a dentist for non-urgent dental care can be up to 24 months. It is of concern to consider a scenario where all (or even increased proportions) of all those persons eligible for public care would demand and utilise subsidised care. With such long existing waiting lists, it is clear that public services and resources alone would not cope with increased demand for service.

When this is considered in the context of the current economic climate, namely the end of the mining boom, rising rate of unemployment and an ageing population, future increase in demand for subsidised dental care is a real possibility. Thus a more permanent arrangement utilising existing networks of private dental clinics may need to be considered, especially for those residing in rural and remote areas of Australia.

National Partnership Agreement

In 2012 the Commonwealth Government committed A$1.3 billion over several years to state and territory governments to support additional dental services for adults under the National Partnership Agreement (NPA). The measure is aimed at reducing long wait times to see a public dentist by providing eligible public dental patients with an authority to seek limited treatment from a private dentist, thus also improving access to dental care services, especially for rural residents.

The current NPA for public dental patients ended in March 2015 and a cut-down 12-month extension was put in place. The second NPA was originally scheduled to start on 1 July 2014, but the federal budget proposed its deferral until 2015–2016.

Although early reports suggest that the NPA has had some success in reducing the states’ dental waiting lists and has improved access to primary oral healthcare services, the initiative is deemed too new to determine with any degree of certainty whether the effect will be long lasting, cost-effective or sustainable.

Economic considerations

Rolling out taxpayer-subsidised government dental clinics and supporting infrastructure in regional areas is expensive, requires extensive consultation, may not be viable, and may
not reach many eligible people due to the relatively low population density of most regional centres in Australia. The solution needs to be effective and sustainable, and preferably benefit other layers of communities.

Locations of private dental clinics have been shown to be driven by market forces and the economy. In a lot of cases private dental services cannot be sustained in many rural and remote areas, in part due to lack of dentists, high costs and low population density.

The dental labour force in Australia is likely to continue to grow. Currently around 500 new dentists graduate from Australian universities every year. This is a 100% increase on 2005 numbers. The new graduates are expected to have an impact of the numbers of practising dentists across the country, which is projected to increase by about 50% to around 15 000 by the 2020. The number of dentists per 100 000 population is also expected to rise to around 28% in the next 4–5 years.

The increased number of dentists in Australia is already having an impact on the ability of new graduates to secure employment, while a significant number of those with jobs consider themselves to be underemployed. This situation is likely to result in downward pressure on remuneration within the sector.

It seems that an ongoing arrangement with the private sector in rural and remote areas could be the answer to the current and expected future growth in demand for subsidised dental care. In line with the opportunities afforded by the NPA, small-scale elements of this type of arrangement currently operate in some locations, and an expansion of this strategy may need to be considered. If appropriate safeguards are implemented, it might be possible for regional private patients, public patients and taxpayers to benefit from such an arrangement. A long-term agreement to provide a predetermined set of dental services to public patients may provide the extra financial incentive needed for private clinics to remain open (or for new clinics to open) in rural and remote centres. This approach may improve primary health services availability for the general population, offer a much-needed safety net for the geographically disadvantaged low income earners, and provide a welcome reprieve for the taxpayer with respect to capital expenditure and the cost of subsidising more expensive emergency dental care.

Conclusions

Dental health plays an integral part in the overall health of an individual and by extension in communities. Prevention and early detection of dental problems can minimise the need for complex and often expensive restorative work, and therefore reduce demand on the public healthcare system.

The present research found that utilisation of the existing network of private dental clinics across Australia to deliver subsidised dental care could dramatically reduce the national dental waiting list, increase geographic reach and possibly make good oral health a more realistic goal to achieve for the economically disadvantaged members of Australian communities.

Previous experience with the Chronic Disease Dental Scheme shows that writing an 'open cheque' in terms of the types of services that can be provided to treat public patients in a private setting can be very expensive and may not necessarily yield the desired results. A framework with appropriate safeguards in place that would allow for subsidised dental services delivery at private clinics has the potential to reduce waiting lists, improve access for greater eligible population and increase service availability in rural and remote areas for entire communities where existing socioeconomic dynamics do not otherwise foster private practice set-up. Improvement in access to primary dental care could help promote preventive treatment by simplifying the process to obtaining such care and making it more affordable.

References


Selecting a location for a primary healthcare facility: combining a mathematical approach with a Geographic Information System to rank areas of relative need

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Abstract. Geographic Information Systems have become an invaluable tool in many industries as it can help to conceptualise available data and answer questions visually. The software allows for integration of key statistics and geographic data for a more detailed analysis. The objective of this study was to show how mathematically weighted, publicly available, relevant demographics data can be integrated with Geographic Information Systems to identify and rank potential locations for new primary healthcare facilities. Index of Relative Socio-economic Advantage and Disadvantage was mathematically weighted with respect to the usual resident population and the number of people not in the labour force data, at Statistical Area level 1 (SA1). Smoothing was applied by repeating the process at Statistical Area level 2, 3 and 4 to produce a quasi-index of priority. A total of 229 SA1 areas were identified and preselected as potential primary healthcare facility infrastructure sites across Australia. The quasi-index was incorporated into a Geographic Information System to produce a map identifying and ranking areas of relative need. Combining a mathematical approach with Geographic Information Systems can yield significant qualitative and quantitative advantages over conventional methods of site selection.

Additional keywords: infrastructure, primary health care facilities, site selection.

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Introduction

Primary health care plays a major role in Australia’s healthcare system and includes health care provided in dental clinics, medical practices, nursing homes, Aboriginal Medical Services, hospices, old age homes and other allied health facilities (Department of Health 2013). Primary healthcare facilities are commonly considered to be an important part of a community infrastructure (Finkler and Ward 1999). Prior to choosing a location for a primary healthcare facility, the proposal usually undergoes a rigorous decision-making process, where potential sites, cost and benefits to communities are considered (Finkler and Ward 1999).

Over the years, advances in technology in Australia and changing patient expectations have paved the way for the shift away from the traditional centralised healthcare delivery model to a ‘hub and spoke’ model (Govindarajan and Ramanurti 2013). Improvements in medical knowledge and technology make it possible to complete many procedures in a single day in ambulatory care or outpatient clinics (Govindarajan and Ramanurti 2013). Named after a bicycle wheel, where the spokes are centrally connected at the hub, the model allows for multiple practising sites to act in a supporting role (spokes) to the secondary site (hub) such as a hospital. The model allows for provision of services to patients at more accessible locations and closer to areas of greater relative need (Govindarajan and Ramanurti 2013).

Australia’s healthcare system is a multilevel network of public, private and non-government providers (Australian Institute of Health and Welfare 2014). The Australian Government’s contributions to funding the healthcare system includes Medicare, which offers free or subsidised treatment by healthcare professionals such as general practitioners, specialists and optometrists (but does not cover dental) (Australian Institute of Health and Welfare 2014).

Identifying areas of greater relative need for a new primary healthcare facility plays a critical role in improving accessibility for those members of the community who are more likely to use it (Dunn 2013). Site selection for new primary healthcare facilities is a multilevel process, which consists of both objective and subjective considerations (Richards et al. 1999). An example of an objective consideration may include demographics of the population and any other statistics data relevant to the target population (Richards et al. 1999). Subjective considerations may consist of public opinion, which can often be gauged by holding consultations with the communities concerned, and may consider variables such as perceived need, environmental factors,
transportation and streetscape to name a few (Richards et al. 1999). Both objective and subjective factors are important contributors to the decision-making process, however, and in some cases, trade-off may need to be considered to accommodate one or the other (Vickery 2011).

With the advent of computer-based Geographic Information Systems (GIS), decision-makers are able to integrate and visualise statistics and geographic data to assist in their decision-making process (Perera et al. 2010; Turk et al. 2014). GIS allows users to map and conduct spatial analysis for both spatial and attribute data, such as socioeconomic indices (Perera et al. 2010; Turk et al. 2014). Visual presentation of the attribute data can help us to better understand relationships between objective and subjective variables, thereby further improving the objectivity of the decision-making process (Boulos 2005). Examples of such information may include target population statistics data (such as number of people not in the labour force) and its relationship to the natural geographic boundaries, transport routes and proximity to other healthcare facilities.

Previous studies have found that lower socioeconomic status is associated with higher burden of disease and mortality rates (Glover et al. 2004; Rocha et al. 2013; Hoebel et al. 2016). The aim of this study therefore was to develop an approach to combine publically available population statistics data with GIS software to help identify and prioritise potential sites for primary healthcare facility infrastructure based on the location of the chosen target population.

Methods

Only publically available, de-identified population statistics data from the Australian Bureau of Statistics (ABS) was used in this study. Thus, ethics approval was not required.

Australian Statistical Geography Standard

The Australian Statistical Geography Standard (ASGS) consists of:

- SA1s – Generally have a population of between 200 and 800 people, with an average of 400 people (Australian Bureau of Statistics 2017a).
- SA2s – Are medium-sized areas and consists of whole SA1s. SA2s largely follow official suburb outlines and generally have a population range of between 3000 and 25 000 people, with an average of 10 000 people (Australian Bureau of Statistics 2017a).
- SA3s – Consist of whole SA2s and generally have populations between 30 000 to 130 000 people (Australian Bureau of Statistics 2017a). Typically, these are functional areas of regional cities or large urban transport and service hubs (Australian Bureau of Statistics 2017a).
- SA4s – These are the largest sub-state areas of all and consist of whole SA3s and cover the whole of Australia (Australian Bureau of Statistics 2017a).

Index of Relative Socio-Economic Advantage and Disadvantage data

Index of Relative Socio-Economic Advantage and Disadvantage (IRSAD) (Australian Bureau of Statistics 2016), covering all of Australia, was obtained from the ABS website at Statistical Area Level 1 (SA1) (Australian Bureau of Statistics 2017b). The IRSAD has been developed by the ABS to rank areas in Australia according to relative socioeconomic advantage and disadvantage (Australian Bureau of Statistics 2017b).

Resident population data

Usual resident population data (Australian Bureau of Statistics 2016), covering all of Australia, were also obtained from the ABS website at SA1 level. The SA1 has been designed for use in the Census of Population and Housing as the smallest unit for the processing and release of Census data (Australian Bureau of Statistics 2017a). Approximately 55 000 SA1s cover the whole of Australia without gaps or overlaps (Australian Bureau of Statistics 2017a). SA1s are considered to be the basic building blocks of the Australian Statistical Geography Standard (ASGS), and are used for the aggregation of statistics to larger Census geographic areas (Australian Bureau of Statistics 2017a).

Hospitals data

Existing public hospitals location data (latitude and longitude) were collected from the www.myhospitals.gov.au website. The location data cover all general public hospitals with emergency departments across Australia. The location data were integrated into the GIS software to allow for visual assessment of proximity to the identified areas of relative need.

Geographic analysis

Quantum Geographic Information System (ver. 2.8.1) free and open source software (see www.qgis.org) was used to map the IRSAD index and results of statistical analysis.

Processing of IRSAD and resident population data

IRSAD data were weighted with respect to two factors to provide specificity for lower socioeconomic areas; ‘usual resident population’ and the number of those ‘not in the labour force’, thus making it possible to rank statistical areas relative to each other:

\[ S_{area} \equiv I_{IRSAD} \times \frac{N_{notlab}}{N_{pop}} \]

where \( S_{area} \) is the score assigned to a SA1; \( I_{IRSAD} \) is the Relative Index of Socio-Economic Advantage and Disadvantage of a SA1; \( N_{pop} \) is the usual resident population of a SA1; \( N_{notlab} \) is the number of people not in the labour force of a SA1.
The process was repeated at SA2, SA3 and SA4 levels to allow for ’smoothing’ of the results. In this way, the variables pertaining to SA2, SA3 and SA4 areas have an equal opportunity to influence the ranking of the lower level SAs. The results were added to produce an aggregate value. An extract from the table is shown in Table 1. Each number was multiplied by 10 000 to simplify the process, as resulting raw numbers were at the third decimal point. Approximately 55 000 results were produced (equating to the number of SA1s in Australia). The resulting values were ranked from lowest to highest. The lowest 10% of all SA1s were identified and preselected. Finally, one SA1 (lowest ranking) was selected from each of its superior SA3s.

**Computing available data**

In order to automate the mathematical process, a computer program was written. The program was built with python (ver. 3.5.1) free and open source programming software (see www.python.org), and utilises a hierarchal tree data structure in conjunction with a recursive algorithm to achieve the results.

In short, the program reads the Comma-Separated Value data file available from the ABS to build a first data branch at SA1 level using the described weighting formula. With the first branch built, the program then used the SA1 results to build the next branch at SA2 level by a recursive algorithm. The process was then repeated to calculate results at SA3 and SA4 levels. Finally, a report was generated in the form of a Comma-Separated Value data file that allows for the aggregate values to be calculated for each statistical area, and ranked from lowest to highest.

**Results**

Using the above method, 229 SA1 areas (0.4% of all SA1s) have been identified and preselected as potential public health infrastructure sites across Australia. By incorporating these processed data into QGIS software a layered map was produced (Fig. 1), highlighting the relationship between preselected SA1s and IRSAD and the existing public hospital network. The resultant values for the preselected SA1s are projected over the map and range from 0 to 1 whereby a lower number represents an area of relatively greater need, thus allowing us to rank and prioritise these areas for services delivery.

Fig. 1 depicts an extract from the map of Australia as an example of identified and ranked areas of relative need. Darker shaded areas correspond to low socioeconomic status, as identified by the IRSAD. Readers will notice that similarly shaded areas exist, yet only some display numeric values. The superimposed values identify areas of relative need. The identified areas of relative need can now be considered in terms of distance to existing community health infrastructure, such as hospitals (dots), and ultimately be included in the overall decision-making process.

**Discussion**

Medicare aims to make healthcare services accessible to all Australians, irrespective of their socioeconomic status or other circumstances (Australian Institute of Health and Welfare 2014). However, research by National Health Performance Authority (2013) indicates that this may not always be the case. Analysis of GP visits found that in some metropolitan areas, relatively healthier populations (as identified by the proportion of people with chronic medical conditions) receive higher than average number of GP services (National Health Performance Authority 2013), whereas in some regional areas less healthy populations receive lower than average number of GP services (National Health Performance Authority 2013).

The Australian Primary Health Care Research Institute identified location and distance to primary healthcare services as one of the most important barriers in achieving equity in health care (Wakerman et al. 2015). It is not uncommon for the IRSAD index to be used in conjunction with GIS software to create a map of socioeconomic distribution. However, the method described in this paper allows for further ranking of identical (with respect to the IRSAD) SA1s across the country, based on additional attribute data such as the size of the population and the level of population not in the labour force. This approach effectively weighs IRSAD with respect to additional attribute data, thereby improving relevance, by further qualifying the result.

Furthermore, the method allows for ’smoothing’ of chosen statistics data by repeating the calculation at SA2, SA3 and SA4 level and then adding the results to produce an aggregate value at SA1 level. In this way, socioeconomic index and population data of SA2, SA3 and SA4 have an equal opportunity to influence the ranking of its subordinate, SA1. The method effectively identifies SA1s that meet the predetermined criteria, but also confirms that the IRSAD and population data of the surrounding SA1s, SA2 and SA3s supports the selection of that particular SA1. Thus, we can be sure that the selected SA1 is not an ”outlier” (i.e. not surrounded by high socioeconomic areas) but in fact is

### Table 1. An extract from the calculations table

<table>
<thead>
<tr>
<th>SA4 ID</th>
<th>SA3 ID</th>
<th>SA2 ID</th>
<th>SA1 ID</th>
<th>Weighed SA4</th>
<th>Weighed SA3</th>
<th>Weighed SA2</th>
<th>Weighed SA1</th>
<th>Sum of weighed SA1, 2, 3 and 4</th>
<th>Sum x 10 000</th>
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<td>0.000020</td>
<td>0.000007</td>
<td>0.000001</td>
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<td>0.510000</td>
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<td>3132114</td>
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<td>311051328</td>
<td>3132806</td>
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<td>0.000000</td>
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</tr>
<tr>
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<td>313011362</td>
<td>3136203</td>
<td>0.000021</td>
<td>0.000011</td>
<td>0.000008</td>
<td>0.000001</td>
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</tr>
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<td>3136605</td>
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<tr>
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<td>0.000063</td>
<td>0.630000</td>
</tr>
</tbody>
</table>
a centre of a cluster of low socioeconomic areas and thus should be a focus of attention.

According to the ABS, ~4% of all SA1s in Australia do not have a listed IRSAD. However, the effect of this limitation is mitigated through the mathematical process, as each SA1 has its superior level (SA2), which does have an IRSAD listed and therefore an average for the area can be calculated.

Conclusion
Planning for primary healthcare infrastructure requires consideration of a unique set of circumstances in each individual case. Although circumstances surrounding each project can be expected to differ, such projects are almost universally aimed at addressing the long-term needs of the target community. Thus, a thorough understanding of the community’s health needs is required. A systematic approach, therefore, can help to identify priority areas for primary healthcare facility projects and avoid costly mistakes.

Combining a mathematical approach with Geographic Information Systems can yield significant advantages over conventional methods of site selection. These advantages are both qualitative and quantitative. Quality of the information is significantly improved because of an increase in specificity of data used through inclusion of statistical variables that more precisely characterise the target population and the weighting and smoothing process. Quantitative improvement is achieved by a more obvious choice of sites with similar qualitative characteristics from which a selection can be made. The described method is based on statistical data from the ABS. Thus, application of the method produces precise and consistent results.

An example of an application of this method can be seen where it was applied to identify and rank areas of need for new public dental clinics (Dudko et al. 2017).

Conflicts of interest
The authors declare that they have no conflicts of interest.

References


Identifying and Ranking Areas of Relative Need for New Public Dental Clinics Using a State-of-the-Art Data Simulation Approach

Y Dudko, D Robey, E Kruger and M Tennant

Abstract

Background: Lower socioeconomic groups and country residents are more likely to experience dental disease. Previous research has found that it is generally more cost effective to provide subsidised dental care through publically employed dentists when compared to subcontracting the work out to the private sector.

Objective: The primary objective of this study was to identify and rank areas of relative need for new public dental care facilities across Australia. The secondary objective was to gauge how many of these areas are located in the vicinity of an existing public hospital (medical) with a view to utilise existing infrastructure for future service rollout.

Methods: Usual resident population, employment status and socioeconomic distribution data was downloaded from the Australian Bureau of Statistics website at Statistical Area 1 level. A mathematical weighing formula was applied to those variables, which subsequently allowed for ranking of the results based on magnitude of the product values. The findings were considered in terms of proximity to existing public health infrastructure.

Results: A total of 49 SA1 areas were identified and preselected as potential sites for new public dental clinics across Australia. Eighty per cent of the identified areas of relative need were located outside metropolitan areas. Fifty per cent of those were found to be in close proximity to an existing public hospital (medical).

Conclusion: Offering subsidised dental care through existing public hospitals may be an option. Such an approach has a potential to improve access to subsidised dental care in regional centres while minimising capital expenditure on infrastructure.

Abbreviations: ABS - Australian Bureau of Statistics; ASGS - Australian Statistical Geography Standard; SEIFA - Socio-Economic Indexes for Areas.

Key words: dental public health; access to oral care; oral health policy; rural health infrastructure.

Introduction

The majority of Australians have access to high quality dental care services, and generally have good oral health largely due to the availability of fluoridated water and our much improved understanding of dental disease. Although the overall incidence of dental disease has reduced significantly by the end of the twentieth century, the improvements in oral health have not been equally shared across all socioeconomic groups. [1] It has been acknowledged by Australia’s National Oral Health Plan that people representing low socioeconomic groups continue to experience greater levels of dental disease by comparison to their more affluent counterparts. [2]

A report titled ‘Oral health and access to dental care – rural and remote dwellers’ published by the Australian Institute of Health and Welfare noted that country residents are more...
likely to display symptomatic patterns of dental attendance when compared to metropolitan residents. Country residents are also more likely to experience complete tooth loss, and to not have seen a dentist in a couple of years for routine dental care. In short, statistically, country residents experience higher rates of dental disease and are less likely to receive preventive care. [3]

The demand for subsidised dental care across the country has remained consistently high over the years and often exceeds the capacity of State public dental services to provide treatment, resulting in waiting lists, with historical wait times of two years reported. [4]

Prolonged waiting time for an appointment has been identified as one of the main factors resulting in patient dissatisfaction [5] and has frequently been the source of news stories in the national media. [6]

Over the years a number of State and federal initiatives were undertaken in an effort to meet the demand for subsidised dental care. Most recently the Commonwealth Government committed A$1.3 billion over several years to State and Territory governments to support additional dental services for adults under the National Partnership Agreement.

The measure is aimed at reducing long wait times to see a public dentist by providing eligible public dental patients with an authority to seek limited treatment from a private dentist. [7]

Previous studies have found that it is generally more cost effective to provide subsidised dental care through public dental clinics when compared to contracting the work out to private sector. [7] Thus further investment in public dental health infrastructure may need to be considered in order for us to continue cost effectively meet the demand of our growing eligible population.

The objective of this study was to identify and rank areas of relative need for new public dental clinics, and to gauge what percentage of the areas identified were located in the vicinity of an existing public hospital network (with a view to strategically place dental chairs in some of the existing public hospitals rather than build new dedicated public dental clinics).

Methods
Only open access, non-identifying data was used in this research. Thus ethics approval was not required.

Australian Statistical Geography Standard
Australian Statistical Geography Standard (ASGS) was used throughout this study. This nationally agreed approach to geographic analysis of population divides the country into four levels of clustering based around size. These are described as SA1 to SA4, SA1 being the smallest with about 400 people per area, SA2 closely reflects suburbs with about 10,000 people per area, SA3 areas have about 80,000 people each while SA4 are statebased. [8]

Socio-Economic Indexes for Areas data
The data outlining the socioeconomic index for areas (SEIFA) distribution across Australia was obtained from the Australian Bureau of Statistics (ABS) website at SA1 level. [9] SEIFA has been designed by the ABS to arrange SA1s across Australia by their relative socioeconomic advantage and disadvantage. [9] The SEIFA data at SA1 level is used to calculate the SEIFA index at SA2, SA3 and SA4 levels.

Resident population data
The population data spanning all of Australia was collected from the ABS website at SA1 level. There are approximately 55,000 SA1s in Australia, together covering the whole country without gaps or overlays. [8] SA1s are commonly acknowledged to be the fundamental building blocks of the ASGS. When used in aggregate, SA1s contribute to statistics at SA2, SA3 and SA4 levels.

Eligible population data
Distribution data for the ‘unemployed’ and ‘not in the labour force’ was obtained from the ABS website at SA1 level and subsequently used to represent the distribution of the population eligible for subsidised dental care. Previous research identified a close correlation between the distribution of the ‘unemployed’ and ‘not in the labour force’ Census 2011 data and the actual distribution of the population eligible for subsidised dental care across Australia. [10]

Public Hospital location data
Geographic location data for existing public hospital network was obtained from the www.myhospitals.gov.au website. Only publically owned hospitals with emergency departments were selected.

Public dental clinic location data
Previously published research provided the physical address (and geographic coordinates) for each public dental clinic in Australia (collated from a number of open sources) as at August 2012. [11]

Geographic analysis
Quantum Geographic Information System (version 2.8.1) software was used to map statistical data and quasi-index of relative need.
Processing of SEIFA, resident population and eligible population data
A previously developed mathematical approach to determination of areas of healthcare need, based on various smoothing functions of population disparities, was applied to the baseline data in this study. [12] In summary the method takes the SEIFA index for each SA1 and divides it by the usual resident and eligible population data to produce a weighted number. The process is repeated at SA2, SA3 and SA4 levels. The SA1 results were added to the SA2, SA3 and SA4 area results to which each SA1 in question belonged. Thus an aggregate value for each SA1 is produced. This fundamental mathematical approach provides a smoothing of the ‘wrinkles’ in the SEIFA index between nearby SA1s and thus brings to the foreground areas that are substantive in size and population. These smoothed aggregate values for each SA1 level were arranged in an ascending order, forming a quasi-index of relative need. The most ‘in need’ 10% per cent of the aggregate values (ie SA1s) were selected for further analysis in this study.

Geographic disqualification
Geographic filtering was applied disqualifying SA1s that were located in the vicinity (within 10km radius for metropolitan and 20km radius for country areas) of an existing public dental clinic.

Results
A total of 49 SA1 areas (0.1% of all SA1s) have been identified and preselected as potential public dental clinic sites across Australia. The preselection data was uploaded into QGIS software and formed a part of a layered map (Fig 1). The map allows for visual assessment of the spatial relationship between preselected sites, existing public dental clinics and the public hospital network.

Figure 1: Preselection data uploaded into QGIS software forming a layered map
The numeric values for the identified SA1s are projecting over the map and range from 0 to 1. Lower numbers identify areas of comparatively greater need, thus allowing us to rank and prioritise these areas for future service rollout.

An extract from the map of Australia (South West of WA) is an example of identified and ranked areas of relative need (Fig 1). Various shading indicates fluctuations in socioeconomic status of the population. Deeper shades indicate areas of low socioeconomic status, while lighter shades correspond to areas of higher socioeconomic status. While similarly shaded areas can be seen, only few display numeric values. Only areas with displayed values meet the weighting criteria of relatively higher population and eligibility levels.

Tables 1 and 2 (country and metropolitan areas, respectively) list identified areas or relative need for a public dental clinic. The majority (80%) of the identified areas of relative need are located outside metropolitan areas. Over a quarter (27%) of all the identified areas were located in Victoria. Queensland accounted for 24% of all the areas of relative need across the country. Tasmania was found to have more areas of relative need (14%) than New South Wales (12%). Northern Territory and Western Australia contributed 8% each to the total count of identified locations. South Australia made up 6% of the total, while no areas of relative need were identified in the Australian Capital Territory.

Significantly, fifty per cent of the identified areas of relative need outside metropolitan areas are located in the vicinity of an existing public hospital.

**Discussion**

Routine dental check-ups offer an opportunity for early detection and prevention of dental disease. For many of us the timeless proverb proclaiming that ‘prevention is better than cure’ rings especially true in personal health matters.

**Table 1. Country locations: Identified areas of relative need for public dental clinic**

<table>
<thead>
<tr>
<th>STATE</th>
<th>SUBURB</th>
<th>NEAREST PUBLIC DENTAL CLINIC VICINITY</th>
<th>PUBLIC HOSPITAL IN THE IMMEDIATE</th>
<th>STATE</th>
<th>SUBURB</th>
<th>NEAREST PUBLIC DENTAL CLINIC VICINITY</th>
<th>PUBLIC HOSPITAL IN THE IMMEDIATE</th>
</tr>
</thead>
<tbody>
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<td>Smithton</td>
<td>92km</td>
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</tr>
<tr>
<td>NSW</td>
<td>Katoomba</td>
<td>26km</td>
<td>Yes</td>
<td>TAS</td>
<td>George Town Central Highlands</td>
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<td>No</td>
</tr>
<tr>
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<td>Mudgee West</td>
<td>35km</td>
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<td>TAS</td>
<td>Geestown</td>
<td>55km</td>
<td>No</td>
</tr>
<tr>
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<td>No</td>
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<td>Forestier</td>
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</tr>
<tr>
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<td>VIC</td>
<td>Camperdown</td>
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<td>Yes</td>
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<tr>
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<td>No</td>
<td>VIC</td>
<td>Golden Plains South</td>
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<td>Tanami</td>
<td>430km</td>
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<td>VIC</td>
<td>Pakenham North Warragul</td>
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</table>

Asia Pacific Journal of Health Management 2017; 12: 1
Identifying and Ranking Areas of Relative Need for New Public Dental Clinics Using a State-of-the-Art Data Simulation Approach

Table 2: metro locations: Identified areas of relative need for a public dental clinic

<table>
<thead>
<tr>
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<th>NEAREST PUBLIC DENTAL CLINIC VICINITY</th>
<th>PUBLIC HOSPITAL IN THE IMMEDIATE STATE SUBURB</th>
<th>NEAREST PUBLIC DENTAL CLINIC VICINITY</th>
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<td>VIC</td>
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<td>Beachmere</td>
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<td>WA</td>
<td>No</td>
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<td>SA</td>
<td>Hackham West</td>
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<td>Yes</td>
<td>Forrestfield</td>
<td>Yes</td>
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</tbody>
</table>

In the context of subsidised dental care (from a tax payer perspective), prevention can also be cheaper than cure. Provision of subsidised dental care through public dental clinics has been found to be up to three times more cost effective when compared to contracting the work out to private sector. [13]

Eighty per cent of the identified areas of relative need are located outside metropolitan areas. The results were consistent with previous research findings indicating that metropolitan residents generally enjoy better access to public dental care facilities. [3]

Building a public dental clinic in a country setting may not be as cost effective as building a similar clinic in a metropolitan area, in part, due to differences in population densities. However, findings also indicate that around fifty per cent of the identified areas of relative need are located in the vicinity of a public hospital. Delivery of subsidised dental care through the existing public health infrastructure, where available, may offer an opportunity to improve access to dental care for those layers of our society that need it most, while minimising capital expenditure and the costs associated with more complex, late stage intervention.

Individual consideration may need to be given to each such case as existing public hospitals may lack the space required for a dental clinic. Co-location of dental facilities within public hospitals may be easier to enact as a part of new capital developments that meet the selection criteria. Although the cost of outfitting a dental clinic is likely to remain relatively static, shared site, development, utilities and building costs may result in significant savings when compared to building an independent public dental clinic. The co-location strategy may also help to improve patient outcomes (both medical and dental) by emphasising the link between dental health and the overall health of an individual and promoting preventive behaviour. Closer integration of medical and dental services can offer a more coordinated, efficient, patients-centred approach that meets both the medical and oral health needs of patients in a single setting. [14]

Poor oral health has been linked to chronic conditions such as heart disease and diabetes. [14] Co-location of medical and dental services has been found to simplify access to dental care and improve health outcomes by allowing for timely delivery of diagnostic and therapeutic care. [14] There are a number of examples where co-location of hospital and public dental clinics has been successfully implemented eg, Geraldton Hospital, Western Australia and Tully Hospital, Queensland. The demand for subsidised dental care remains consistently high, often exceeding the capacity of the public system to provide the service, resulting in long waiting lists. [4] Thus a strong argument could be made that our policy should be to widen and strengthen the government provided dental network to build the superstructure of a great compassionate system to leave no Australian behind. This research is based on quantitative data from the ABS.

Thus, application of the method produces consistent, precise and reliable results. The identification and ranking process described, however, may not address qualitative issues unique to each site. Additional qualitative considerations should be given to each proposed location as these will often complement and allow for refinement of the quantitative data.

Conclusion

The areas of relative need identified in this study represent the most disadvantaged (0.1%) of the Australian population. Country residents are more likely to experience dental disease when compared to metropolitan counterparts. Regular dental check-ups can aid prevention and early identification of dental disease. Access to subsidised dental care can potentially be improved in half (50%) of the...
identified areas by offering subsidised dental care to the eligible population through the existing publicly owned hospital network.

Offering subsidised dental care through the existing public hospital network, where available, in turn, may help to control the cost of service delivery by minimising capital expenditure.

**Acknowledgements**
None declared.

**Financial support**
Nil.

**Competing Interests**
The authors declare that they have no competing interests.

**References**
Appendix F

Original Research

Shortage of dentists in Outer Regional and Remote areas and long public dental waiting lists: Changes over the past decade

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Abstract

Objective: The shortage of dentists in Outer Regional and Remote areas of Australia and long public dental waiting lists have been the subject of media attention over the last decade. A number of state and federal initiatives were introduced over the years to address these problems. This study aims to gauge whether the waiting lists and shortage of dentists in Outer Regional and Remote areas have seen a positive change over the last decade.

Design: This evaluation study analysed and compared the number of dentists full-time equivalent per 100 000 population, eligible population and waiting list size (New South Wales and Queensland) at various points in time over the last decade.

Setting: National.

Participants: Data were extracted from practitioner registry reports.

Main outcome measures: Number of dentists practising in Outer Regional and Remote areas of Australia and number of people on the public dental waiting list (New South Wales and Queensland).

Results: There was a significant improvement in the number of dentists practising in Outer Regional and Remote areas of Australia. The public dental waiting lists in New South Wales and Queensland (as of September 2016) were found to have surpassed their pre National Partnership Agreement levels in 2012.

The growth of public dental waiting lists exceeded the growth of the eligible population by a significant margin.

Conclusion: The dentist-to-population ratios in Outer Regional and Remote areas have seen a significant improvement. The reduction in the number of people on the public dental waiting list was significant, but brief.

KEY WORDS: dental labour force, public dental health, rural and remote oral health, waiting lists.

Introduction

Over the years, the shortage of dentists in Outer Regional and Remote areas of Australia has received much public attention. In 2005, there were 28.5 and 19.8 full-time equivalent (FTE) dentists per 100 000 population working in the Outer Regional and Remote areas of Australia, respectively.¹ The rate was better in major cities (56.2) but still thought to be suboptimal.¹ Various governments have moved to address the chronic shortage of dentists in Outer Regional and Remote areas in a number of ways. The primary initiatives over the last 10 years have included overseas-trained dentist migration scheme, graduate initiatives (including increased proportion of students with rural background studying dentistry and Volunteer Dental Graduate Year Programme (VDGYP)) and financial incentives for existing dental practitioners to relocate to Outer Regional or Remote areas.

Overseas-trained dentists

Australian immigration policy makes provision for occupations that are deemed to be in short supply in the Australian labour market. In 2008, dentists were included on the Skilled Occupation List (SOL) with a view to make it easier for overseas-trained dentists to immigrate to Australia. In 2014, Dental Tribune

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What is already known on this subject:

- Shortage of dentists and long public dental waiting lists have been the subject of debate at the government level and, over the years, have seen an increase in allocation of public funds in an effort to address the policy needs.
- An evaluation study is required to assess the dynamics of any changes.

reported that Australia had the highest percentage (25.0%) of overseas-trained dentists in the world.\(^2\)

Importantly, there is currently no ongoing data collection and analysis of the outcomes of this initiative in addressing the disparity between rural and metropolitan residents. It is noted that dentists were removed from the SOL in mid-2015.

**Local graduates**

The number of local graduates was increased through founding of a number of new dental schools across the country and expansion of graduates from existing schools. Over the last decade, the annual number of dental graduates in Australia doubled and is currently approaching 550.\(^3\) This is expected to be a relatively stable number for the foreseeable future.

First launched in 2013, the VDGYP offered 50 positions per year to new graduates to work in public dental clinics across Australia.\(^4\) The program aimed to provide services to patients in Outer Regional and Remote areas.\(^4\) The program was discontinued in 2015 due to funding cuts.

Importantly, governments have moved dental education balance substantially from the core of cities to regional Australia. We now see the majority of graduates having either been trained in regional Australia or having experienced substantial clinical placements (in their final year of dental studies) in these areas.\(^5\) This investment in regional Australia, estimated at over half a billion dollars and an ongoing A$150+ million dollars per year, is a very substantial investment in the future of country Australia.\(^6\)

**Relocation grant**

The Dental Relocation and Infrastructure Support Scheme was introduced in 2012–2013 federal budget and allocates $78 million over a 4-year period to improve dental services in rural and remote areas.\(^7\)

The scheme aims to improve workforce distribution and service delivery in rural and remote areas by offering financial incentives for dentists to move there. Relocation grants up to A$120 000 and infrastructure grants up to A$250 000 are available to help pay for equipment and fit-out of dental clinics.\(^7\)

In Australia, access to subsidised dental care is available through networks of public dental clinics supported by the state. The eligibility criteria might differ slightly between states and territories, but generally is subject to a person being a holder of either a Health Care Card (HCC) or a Pension Concession Card (PCC).\(^5\) The demand for subsidised dental care exceeds the capacity of the public dental health system to provide the service, resulting in waiting lists for non-urgent treatment. In some cases, waiting times as long as 24 months have been reported.\(^8\) The long public dental waiting lists have also been the subject of a federal initiative: National Partnership Agreement (NPA).\(^9\)

In 2012, the Commonwealth Government committed A$1.3 billion over 4 years to state and territory governments to support additional dental services for adults under the NPA.\(^10\) The measure was aimed at reducing long wait times to see a public dentist by giving eligible public dental patients an option to seek limited treatment from a private dentist, thus also improving geographic access to primary oral health care services, especially for the Outer Regional and Remote residents.\(^11\) In the 2015–2016 financial year, the NPA provided states and territories A$155 million for additional services to treat approximately 178 000 public dental patients.\(^12\)

This study evaluated historical records examining the distribution of the dental workforce nationally over the last decade and the dynamics of the public dental waiting lists in two large states of Australia (New South Wales (NSW) and Queensland (QLD) 2012–2016). The aim was to gauge whether the waiting lists and shortage of dentists in Outer Regional and Remote areas have seen a positive change over the last decade.

**Method**

This retrospective study analysed statistical data from a series of published sources and integrated data for and service delivery in rural and remote areas by offering financial incentives for dentists to move there. Relocation grants up to A$120 000 and infrastructure grants up to A$250 000 are available to help pay for equipment and fit-out of dental clinics.\(^7\)

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**Method**

This retrospective study analysed statistical data from a series of published sources and integrated data for...
analysis. No confidential or secure data was accessed; therefore, no ethics approval was required.

**Number of dentists**

The FTE number of dentists per 100 000 population (rate) was collected from the Dental Board of Australia and the Australian Institute of Health and Welfare (AIHW) reports for years 2005–2006, 2009 and 2011–2014.

**Geographical distribution of dentists**

Australian Standard Geographic Classification (ASGC) Remoteness Structure (RA) was used to categorise distribution of dentists nationally. The index divides Australia into broad geographical areas that share attributes associated with relative remoteness. The populated localities are rated as either: Major Cities, Inner Regional, Outer Regional, Remote or Very Remote areas. The data for Remote and Very Remote areas were combined and referred to as ‘Remote’ throughout the text for consistency, with the source data from the AIHW. The ASGC-RA standard is endorsed by the Australian Bureau of Statistics as a measure of remoteness.13

<table>
<thead>
<tr>
<th>Year</th>
<th>Major cities</th>
<th>Inner regional</th>
<th>Outer regional</th>
<th>Remote/very remote</th>
<th>Australia/average</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>63.1</td>
<td>42.7</td>
<td>38.3</td>
<td>25.0</td>
<td>56.4</td>
</tr>
<tr>
<td>2013</td>
<td>63.1</td>
<td>41.1</td>
<td>38.1</td>
<td>21.4</td>
<td>55.9</td>
</tr>
<tr>
<td>2012</td>
<td>64.3</td>
<td>42.2</td>
<td>36.1</td>
<td>21.5</td>
<td>56.9</td>
</tr>
<tr>
<td>2011</td>
<td>62.8</td>
<td>41.3</td>
<td>34.4</td>
<td>22.6</td>
<td>55.4</td>
</tr>
<tr>
<td>2009</td>
<td>62.4</td>
<td>40.0</td>
<td>30.4</td>
<td>23.1</td>
<td>54.1</td>
</tr>
<tr>
<td>2008</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2007</td>
<td>59.5</td>
<td>33.1</td>
<td>27.5</td>
<td>17.9</td>
<td>50.3</td>
</tr>
<tr>
<td>2006</td>
<td>58.6</td>
<td>34.6</td>
<td>28.5</td>
<td>19.8</td>
<td>49.5</td>
</tr>
</tbody>
</table>


also recorded an increase over the same time frame and stood at 13 693 in 2016, a 56.0% improvement.

**Effect of the National Partnership Agreement on the public dental waiting lists**

A brief reduction in the number of people on the public dental waiting lists was recorded for 2013–2014 (Table 3). However, overall, public general dental waiting lists had recorded growth from 2012 to 2016 and were reported as 107 332 for NSW and 154 400 for QLD, as at September 2016 (Table 3). This represents a 24.8% increase in the number of people waiting to receive non-emergency dental care in NSW and an 18.3% increase for QLD. Waiting lists in both states have grown faster than the total eligible population.

**Eligible population dynamics**

The eligible population also increased over the last decade (2006–2016) and stood at 5 613 514 in September 2016, representing a 17.5% increase over the period (Table 4). Growth in the eligible population during the 2012–2016 time frame interval, coincidental with the waiting list data, amounted to an 8.5% increase.

The PCC holders, on average, accounted for 72.0% of the total eligible population. The HCC holders accounted for the remaining 28.0% of the eligible population nationally. The proportion of representatives from each eligible group has remained relatively consistent over the time frame.
TABLE 2: Ratio of registered dentists to eligible and general (no Health Care Card or Pension Concession Card) population

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of public dentists</th>
<th>No. of eligible population</th>
<th>Elig: Dent ratio</th>
<th>No. of private dentists</th>
<th>No. of non-eligible persons</th>
<th>Non-Elig: Dent ratio</th>
<th>No. of total registered dentists</th>
<th>No. of total population</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>2570</td>
<td>5 613 514</td>
<td>2184</td>
<td>13 693</td>
<td>18 554 789</td>
<td>1355</td>
<td>16 263</td>
<td>24 168 303</td>
</tr>
<tr>
<td>2015</td>
<td>2510</td>
<td>5 516 451</td>
<td>2198</td>
<td>13 378</td>
<td>18 279 212</td>
<td>1366</td>
<td>15 888</td>
<td>23 795 663</td>
</tr>
<tr>
<td>2014</td>
<td>2471</td>
<td>5 372 756</td>
<td>2174</td>
<td>13 167</td>
<td>18 040 244</td>
<td>1370</td>
<td>15 638</td>
<td>23 413 000</td>
</tr>
<tr>
<td>2013</td>
<td>2373</td>
<td>5 310 141</td>
<td>2238</td>
<td>12 647</td>
<td>17 851 859</td>
<td>1412</td>
<td>15 020</td>
<td>23 162 000</td>
</tr>
<tr>
<td>2012</td>
<td>2271</td>
<td>5 175 950</td>
<td>2279</td>
<td>12 101</td>
<td>17 547 050</td>
<td>1450</td>
<td>14 372</td>
<td>22 723 000</td>
</tr>
<tr>
<td>2011</td>
<td>2240</td>
<td>5 126 787</td>
<td>2289</td>
<td>11 939</td>
<td>17 213 213</td>
<td>1442</td>
<td>14 179</td>
<td>22 340 000</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>1878</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>1644</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


TABLE 3: Number of people on the public dental waiting lists (New South Wales (NSW) and Queensland (QLD))

<table>
<thead>
<tr>
<th>Year</th>
<th>NSW</th>
<th>QLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>107 332</td>
<td>154 400</td>
</tr>
<tr>
<td>2015</td>
<td>99 000</td>
<td>106 104</td>
</tr>
<tr>
<td>2014</td>
<td>77 000</td>
<td>86 000</td>
</tr>
<tr>
<td>2013</td>
<td>66 000</td>
<td>77 146</td>
</tr>
<tr>
<td>2012</td>
<td>86 000</td>
<td>130 546</td>
</tr>
</tbody>
</table>

Source: Dental Health Services website 2012–2016.

TABLE 4: Composition of the eligible population (national)

<table>
<thead>
<tr>
<th>Year</th>
<th>Health Care Card (n, %)</th>
<th>Pension Card (n, %)</th>
<th>Total eligible population</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>1 488 313 (27)</td>
<td>4 125 201 (73)</td>
<td>5 613 514</td>
</tr>
<tr>
<td>2015</td>
<td>1 466 234 (27)</td>
<td>4 050 217 (73)</td>
<td>5 516 451</td>
</tr>
<tr>
<td>2014</td>
<td>1 451 280 (27)</td>
<td>3 921 476 (73)</td>
<td>5 372 756</td>
</tr>
<tr>
<td>2013</td>
<td>1 461 723 (28)</td>
<td>3 848 418 (72)</td>
<td>5 310 141</td>
</tr>
<tr>
<td>2012</td>
<td>1 456 932 (28)</td>
<td>3 719 018 (72)</td>
<td>5 175 950</td>
</tr>
<tr>
<td>2011</td>
<td>1 462 591 (29)</td>
<td>3 664 196 (71)</td>
<td>5 126 787</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>1 387 418 (28)</td>
<td>3 557 482 (72)</td>
<td>4 944 900</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>1 341 664 (28)</td>
<td>3 440 162 (72)</td>
<td>4 781 826</td>
</tr>
</tbody>
</table>


Dentist-to-population ratio

The findings indicate that the ratio of both public and private dentists to eligible and non-eligible population, respectively, has decreased (more dentists per 100 000 population; Table 2). Eligible population-to-public dentist ratio stood at 2184 in 2016, representing a 33.0% improvement over the 10-year period. General population (non-eligible for public care)-to-private dentist ratio has also improved over the same period and was reported as 1355 in 2016, a positive change of 35.5%.

Discussion

It is clear that the rates of dentists employed in Outer Regional and Remote areas, at the national level, have seen a positive change (an increase of 34.0% and 26.0%, respectively). However, it must be noted that, in terms of dentist-to-population ratios, Outer Regional and Remote areas (25.0 and 38.3 FTE, respectively) are still up to 61.0% worse off when compared to Major Cities (63.1 FTE).

Figures from Graduate Careers Australia 2005 indicate that 95.0% of newly graduated dentists were able to find full-time employment soon after completing their course.14 In 2015, the figure was lower at 86.7%.15 The data indicate that an increasing number of newly graduated dentists were unable to find full-time employment (5% in 2005, compared to 13.3% in 2015).14,15 This seems to suggest that the dental health labour market is becoming more competitive.

The majority of dentists (approximately 85%) are privately employed.1 Fewer dentists (approximately...
9%) are employed within state or territory governments.1 The NPA, in essence, aimed to reduce the public dental waiting lists by utilising the services of privately employed dentists. Previous research, however, has found that it is more cost-effective to provide subsidised dental care to eligible patients through public dental clinics.8 A brief reduction in the public dental waiting lists (NSW and QLD) was noted in 2013–2014. The reduction appears to follow implementation of the NPA. However, 2015 and 2016 data indicate that the reduction was temporary and public dental waiting lists have, in fact, grown when compared to 2012 data. Interestingly, the rate of growth of the public dental waiting list in NSW and QLD is two-to-three times that of the rate of growth of the eligible population over the same period.

Considering that it is not common practice for dental health services to actively promote availability of public dental care to the eligible population, the findings might indicate that the size of the public dental waiting list might not be directly dependent on the size of the eligible population and other factors might need to be considered.

Although the eligible population grew by 8.5% over the last decade, the composition has remained relatively steady over the period, with PCC holders representing a clear majority at 72.0% and HCC holders respectively steady over the period, with PCC holders representing a clear majority at 72.0% and HCC holders accounted for the remaining 28.0%. By way of comparison, Australian population grew by 15.5% over the same period.

Evidence links lower socioeconomic status with higher rates of dental decay.16 Thus, an argument could be made that public dental patients have higher demand for dental services when compared to private patients. While the eligible population-to-public dentist ratio (2184:1) in 2016 has improved (33.0%) significantly over the years, public patients had access to far fewer dentists when compared to private patients (1355:1) in 2016.

It might not be possible to achieve true equality in dentist-to-population ratios when comparing Outer Regional and Remote residents to populations residing in Major Cities. This is because geographical realities (vast land areas) in Outer Regional and Remote Australia and population distribution are such that provision of services, similar to those available in densely populated urban areas, might not be economically viable or practical. Public health dentistry might need to find alternative and innovative ways of bringing dental health to Outer Regional and Remote populations. Adoption of teledentistry and making use of auxiliary oral health providers (therapists, hygienists and oral health therapists) might help to bridge this gap.17

Conclusion
It is apparent that the overall change in the number of dentists (FTE) practising in Outer Regional and Remote areas has been positive. The dentist-to-population ratio in Outer Regional and Remote areas has seen a significant improvement (34.0% and 26.0% respectively). Although much improved, the number of dentists (FTE) per 100 000 population in Outer Regional and Remote areas is still lower (38.3 and 25.0, respectively) when compared to Major Cities (63.1). Furthermore, the expected associated benefits specifically for the public dental patients might be limited as the majority of dentists are privately employed (approximately 85%).1

The reduction in the number of people on the public dental waiting lists that initially followed implementation of the NPA appears to have been brief. The waiting lists (NSW and QLD) are now longer than they were prior to implementation of the NPA.

Graduate employment data (and empirical indicators) point to the dental health labour market becoming more competitive in the core of our Major Cities. In its 2005 report, AIHW estimated dental workforce projections from 2005 to 2020.18 The number of dentists currently registered (2017) has already exceeded the estimates in the report for the year 2020.18,19

Given it is more cost-effective to provide subsidised dental care through public dental clinics, a strong argument could be made that during a time of good labour force supply, policy should be to widen and strengthen the government-provided dental network so that when the economic tide changes (in the next cycle), government safety-net dentistry is in a far stronger position than it was during this cycle (i.e. in the early 2000s).

References
Appendix G (communication):

Making dentistry part of Medicare: an impossible dream?


Contribution:
Dudko Y. acted in the following capacity: Sharing views, experiences and previous research findings, and assisting the team with drafting the manuscript.
Background

Historically there have been advocates for dentistry becoming part of Medicare. However, over the last 5 years views have changed. This has nothing to do with disease burden. In fact, the prevalence and economic impact of oral disease remains high. There are also an increasing number of studies associating oral disease with almost every systemic illness in the body. Why then have views changed?

It is clearly a really important issue. The cost of dental care to Australians is high; access for many is limited by income and various other barriers. The question as to why dentistry cannot simply be covered by Medicare has been asked many times. Surely that seems a very simple and logical solution? It is more complicated than that, however. Let us work our way through the reasons for changing minds and discuss some alternatives.

It is appropriate to start by stressing that we remain convinced of the importance of equity of access. Former US Secretary of Health, Frank Dobson, once said “inequality in health is the worst inequality of all”.

No Australian should be without good access to dental care, irrespective of income or place. This, as an underpinning philosophy, is an important premise to state and to hold.

Dentistry in Australia costs close to $10 billion per annum, including personal out-of-pocket expenses, as well as the collection of State and Federal Programs. It is a “rounded” amount, as the complexity in actually calculating it is unfathomable. Most, however, would concur at a number around this figure.
With some 25 million Australians, this comes to about $400 pa for every man, women and child. At first glance that does not seem too bad, and if we could all put in $400, we can create a fund to cover the dental costs of all Australians? No, it’s not that simple.

Only somewhere between 20% and 50% of people go to the dentist in a given year. So, if we suddenly announce that dental care is covered by Medicare, we could hypothesise that more people would turn up; the demand would be much higher.

Let’s say we double the “turn-up”; a not unreasonable scenario – we could certainly argue that it could be even higher. So the total now goes from $10 billion to $20 billion, and the cost per man, women and child now goes to $800 pa.

An average Australian household (2 adults and 2 children) would now have to put in $3,500 per year. We can start to hear people groan now.

Let us be clear: Australian households are already straining under far smaller numbers than that. If we continue the scenario, we could also hypothesise that about half the Australian population has health care cards/pension cards or find it difficult to pay the bills. A recent survey indicated that many Australian families found it difficult paying a one-off $150 health bill.

Given that one single dental visit averages over $200, it is not surprising that affordability of dental care has always been a concern. So we need the well-off to subsidise the not-so-well off. What could that look like? At the extreme edge that could be that half the families of Australia pay $7,000 pa to support the national dental scheme.

We suspect people are now starting to see this is not going to be politically palatable.
How does this number compare with other things?

The $20 billion per year is higher than the entire proposed National Disability Insurance scheme (NDIS). And the total Medicare levy income is about $10 billion per annum.

So to have a dental scheme would need something in the order of a doubling/tripling of the Medicare levy (or some other sort of tax funding arrangement). Is that a politically palatable outcome? We are not sure that is achievable.

But that is the financial side of the story, what about practically?

We should stop here and reflect on the current structure of dentistry in Australia. More than 85% of care is provided by independent private practice dentists in some sort of fee-for-service arrangement.

There are no price controls; it is a free market economy. What would happen if the government turned up with a Medicare plan? Clearly, price fixing (ie “you must charge the government rebate”) is not an option for the government. That is something that is way beyond what could happen in an economy like Australia.

So it would be a rebate to patients: meaning a gap would remain! And, how would that gap-fee be determined: by the free market? So, let us be clear, the efficiency of the government rebate in terms of care provided would be low and would have the tendency to continue to be eroded over time.

There has been one experiment with Federal subsidies to private dentistry and that was closed with a massive budget overrun and much questioning of the outcomes.
Nonsensical as it may sound, pouring more money into health does not necessarily relate to better health outcomes. But even more questionable is the issue of increased demand: if those currently not accessing care actually came to demand care, we could have a situation where the system would not cope.

In fact, if this was a “budget night decision”, the system would collapse under the load. We don’t have the workforce, capital, or systems in place to actually manage all the latent needs for dental care.

In the small State level systems (less than 15 per cent of all care), if suddenly the patient pool tripled (not an unlikely scenario), there would be unrealistic waiting lists.

So the “make dentistry part of Medicare” seems a near impossible dream and at best an improbable ask and something that Australia in its current (and foreseeable future) structure could not accommodate.

**What is an alternative?**

We are at an opportune moment in time in that sense: workforce shortages have diminished; dental disease in Australia has a strong linkage to poverty; and we have State-based safety net systems designed to provide care for those in need.

A systematic up-regulation of the government sector, addressing the poorer members of the Australian population first, as well as those with access difficulties, the aged and
infirmed and then slowly expanding outward could address Australia’s oral health in a controlled manner could be an option. The cost would be relatively tiny compared to the Medicare numbers, the efficiency of the expenditure would be far higher than subsidies in an uncapped fee-for-service model.

Just as importantly, it would also re-balance the 85:15 (private : public) power base of the wider sector to provide Australia with more balanced public dental care system into the future.
Appendix H (communication):

Talking teeth: does a UK study point the way to more, cheaper dental checkups?


Contribution to this publication:

Dudko Y. acted in the following capacity: Sharing views, experiences and previous research findings, and assisting the team with drafting the article.
Review of current public dental health initiatives

In March 2015 the world's leading dental scientific journal published a paper that has the potential to send shockwaves through the traditional models of dental care.

A group of the global leaders in dental public health proposed the idea of a "dental check-up" in focus for change. They have also called into question the fundamental structural foundations of the model of dental care as it has been for a 100 years.

So what did they actually question? Very simply: Could a mid-level dental provider do a check-up for dental decay and gum disease at an accuracy level equivalent to a fully-fledged dentist?

Why would this be a controversial question? Well, check-ups (or routine dental examinations) are completed by dentists and correspond to substantial amount of time spent by these expensive and highly skilled clinicians.

The argument at a population level is that if the answer to their study is that a mid-level provider can do check-ups with the same level (or nearly the same) as a high cost, highly trained provider then we have a way to move forward to a more cost-efficient model of care.
The obvious argument that is going to come: “this is Australia, this is not the UK – things are different here!” But, this argument is not strong. Australian mid-level providers (therapists and hygienists) have the same training levels as in the UK, as do dentists. Dental decay and gum disease is no different do diagnose in different countries and cost remains a major issue for the community, as well as the State provided care models.

The study of some 1900 patients from 10 practices where the dentist and mid-level provider had just one day’s special training (mainly about the study ethics and protocol) and ran over about 12 months. Each patient was examined by the dentist and the mid-level provider separately; with each taking about the same time (5min) to do the routine examination. This was a "real life" test of the idea, not something done under perfect laboratory conditions.

Putting aside the fact that many of the patients did have unmet need for care (about 30%); although this did enhance the rigour of the study, the answer was basically that there was little difference between the dentist and the mid-level providers (Macey et. at., 2015).

As was reported; screening for dental decay for every 100 patients, there was 65 without decay; eight would have been recommended for care because the mid-level provider thought they had decay (false positive) (Macey et. at., 2015). Now the immediate reaction is these numbers are high, but remember at the end of the day these people would be seen again by the person who was going to do the end-point care and they would have re-checked and not embarked on the filling if not needed. So this is not so significant. More
Interestingly, there was decay in 35 of each 100 patients of which the mid-level providers would have missed seven. This, for experts, is a sensitivity and specificity of 0.81 and 0.87 and as the paper’s authors muse (Macey et. at., 2015); "...that mid-level providers[ed] are capable of identifying disease in patients..." The gum disease check-up followed the same pattern.

But not withstanding this, those missed seven people with decay are important. The authors remind us that screening even by dentists alone is not 100% perfect and the regularity of re-review is the key protection in both cases.

So what does this mean for our health systems? Mid-level providers could re-direct our health system to reduce costs (in particular in the government sector) and thus extend access and reduce wait times for routine care. It is quite imaginable that this paper could lead governments to start thinking about mid-level providers being the check-up team that continues to monitor a population’s oral health and refers to more expert providers. Now, clearly there is more to check-ups than just dental decay and gum disease but the paper starts the discussion of a new structural foundation to the design of dental health systems.

As the authors report, in the UK about a half of all NHS care is taken with up with routine examinations. This is some 13million routine adult dental examinations of which, they estimate, about a quarter are for high risk patients. Even eliminating the high risk patients (i.e. they must be seen by a dentist) a new model that puts mid-level providers at the core of the check-up system could see some 10million routine adult dental examinations
provided at a significantly lower cost every year. We are now talking big savings and the release of resources to address more pressing issues that require higher-level skills.

Of the dental public health papers of 2015, you can see why this one stands-out as something that has the potentially to toss-out 100 years of history and start us on the re-design of our foundations. Making a dental system more effective and efficient is a vital part of society’s protection against one of its most pervasive disease burdens and something that in Australia alone costs $10billion per annum to treat.

Opportunity for renewal is here.
Reference:

Is mix of care influenced by the provider environment?
A comparison of four care pathways in oral health

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Abstract
Objective. In Australia, access to dental care has been available through several different pathways: (1) private practice; (2) public clinics; (3) Aboriginal Medical Services (AMS)-based clinics; and (4) until recently, the Chronic Disease Dental Scheme (CDDS). The aim of the present study was to compare the types of dental services most commonly delivered in the various clinical pathways based on the hypothesis that disease-driven care should lead to similar mixes of dental care provided.

Methods. Data from a series of previously published sources was used to identify and compare the most commonly performed dental procedures in the different pathways. A comparison was also made with the available international data (US).

Results. There was a marked difference between service mixes provided through the four pathways. Patients obtaining dental care through AMS-based and public pathways had more extractions and less restorative and preventive care compared with private and CDDS pathways. Compared with the international data, dental service mixes in Australia were found to be not as evenly distributed. Value of care provided through private and CDDS pathways were two- to threefold higher than that of AMS-based and public pathways.

Conclusion. The data indicate that the original hypothesis that the disease-driven care should lead to similar mixes of provided dental care, is not supported.

Additional keywords: care pathways, dental service mixes, oral health.

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Introduction
A majority of Australians have access to high-quality dental care services and generally have good oral health, largely as a result of improvements in personal oral hygiene at a population level. But there are also people in our society who are not benefiting and have missed out on the improvements.

Factors such as socioeconomic status, geographic isolation, fears and phobias, poor understanding of oral health, cultural and language barriers can play a role. Some people still consider that they only need to see a dentist when they are in pain. Financial barriers to preventive dental care tend to have a greater effect on people representing lower socioeconomic groups and those residing outside major cities.1

In Australia, access to dental care is through several different clinical pathways and it is financed in several different ways. The majority of dental care is provided in a private practice pathway,
through a distributed collection of settings, the majority of
which are situated in the densely populated capital cities. Previous research points to the distribution of these clinical settings being driven by population affluence and not necessarily disease burden.

In this private practice pathway, the patient is responsible for the costs of any treatment, with or without the assistance of privately funded insurance. The level of health insurance in Australia fluctuates, but currently, ~45% of the population is covered. Market forces set the costs of care in this pathway; there is no government interference in the market, although there is some effect of insurance driven schemes on the fee-for-service arrangement within a minority of practices.

Consistent with a strong social policy position held by sequential Australian governments since at least WWII, people in poverty have access to subsidised health services inclusive of dental care. Dental care is provided through a series of public dental clinics distributed across Australia. The cost of care is subsidised by State governments by between 25% and 100% of the benchmark Department of Veterans' Affairs fee (DVA), based on the income level of the patient. Variation on the level of subsidy is seen from jurisdiction to jurisdiction and in some cases, differences exist between population groups. Although the federal fee schedule is based loosely on private practice fees, it is estimated to range from 20% to 40% less than a similar basket of care in the private sector.

Aboriginal and Torres Strait Islander people, in addition to the two pathways outlined above, can also access dental care through a series of Aboriginal Medical Services (AMS)-based clinics distributed across Australia. On the whole, these clinics provide care at no cost to the patient.

The fourth and final pathway is the Chronic Disease Dental Scheme (CDDS) which, until recently, provided eligible people (not based on economic eligibility but on health-based factors) with the ability to claim from the national government health financing system (Medicare) rebates for dental treatment provided by private dentists. The CDDS, introduced in 2007, entitled Aboriginal and Torres Strait Islander people, in addition to the Esperance clinic is representative of a typical rural public dental patient service clinic. The total number of patients that contributed to the AMS data pool was ~2000, while for the public clinic ( Esperance), was originally collected by the Centre for Rural and Remote Oral Health (CRROH).

The AMS-based clinics offer services to mainly Indigenous Australians, while the Esperance clinic is representative of a typical rural public dental patient service clinic. The total number of patients that contributed to the AMS data pool was ~2000, while for the public clinic (Esperance) pathway, the number of patients was 1800; both from the period of 1999–2004.

Data representing the service mix of the CDDS pathway in Western Australia (and nationally) was obtained from previously published data and covers services provided between 2007 and 2009. These data represent a pooled sample of ~1000 patients for the WA data and 165 000 patients for the National data.

Private patient service mix data was collected from the most recently reported national mix data (1998) published by the Australian Institute of Health and Welfare and represented a pooled national sample of some 5700 patients split across country- and city-based settings (reported separately).

An additional non-Australian set of data was benchmarked for comparison (Table 2). The US comparison data was obtained from previously published study.

All data were de-identified during previous study and grouped, rendering it impossible to identify individuals, and thus ethical approval was not required for this present study.

To simplify the comparison between various pathways, the data was categorised into the eight most commonly provided service areas as defined by the Australian Dental Association item numbers, namely; Restorative, Diagnostic, Preventative, Periodontal, Endodontic, Removable Prosthodontics, Oral Surgery and Crowns and Bridges. A comparison was made

<table>
<thead>
<tr>
<th>Category vs location</th>
<th>Private</th>
<th>AMS</th>
<th>Public</th>
<th>CDDS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>City</td>
<td>Country</td>
<td></td>
<td>WA</td>
</tr>
<tr>
<td>Diagnostic</td>
<td>46.0%</td>
<td>42.0%</td>
<td>31.0%</td>
<td>42.2%</td>
</tr>
<tr>
<td>Preventive</td>
<td>26.0%</td>
<td>23.0%</td>
<td>7.7%</td>
<td>4.9%</td>
</tr>
<tr>
<td>Periodontics</td>
<td>N/A</td>
<td>N/A</td>
<td>1.6%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Oral surgery</td>
<td>7.0%</td>
<td>8.0%</td>
<td>23.2%</td>
<td>11.1%</td>
</tr>
<tr>
<td>Endodontics</td>
<td>8.0%</td>
<td>8.0%</td>
<td>1.7%</td>
<td>5.1%</td>
</tr>
<tr>
<td>Restorative</td>
<td>42.0%</td>
<td>43.0%</td>
<td>15.4%</td>
<td>21.8%</td>
</tr>
<tr>
<td>Crowns and bridges</td>
<td>6.0%</td>
<td>4.0%</td>
<td>0.8%</td>
<td>0.8%</td>
</tr>
<tr>
<td>Removable prosthodontics</td>
<td>7.0%</td>
<td>8.0%</td>
<td>0.2%</td>
<td>0.7%</td>
</tr>
</tbody>
</table>

Table 1. Percentage distribution of services by clinical pathway

Four clinical pathways (private practice, Aboriginal Medical Service (AMS)-based, public clinic based and the Chronic Disease Dental Scheme (CDDS)) were compared for the mix of care provided. N/A, not available; WA, Western Australia

Methods

This retrospective study collected data from a series of published sources and integrated these data for analysis (Table 1). Data used in evaluating service mix, delivered at the AMS-based clinics and a regional public dental clinic (Esperance), was originally collected by the Centre for Rural and Remote Oral Health (CRROH).

The AMS-based clinics offer services to mainly Indigenous Australians, while the Esperance clinic is representative of a typical rural public dental patient service clinic. The total number of patients that contributed to the AMS data pool was ~2000, while for the public clinic (Esperance) pathway, the number of patients was 1800; both from the period of 1999–2004.

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An additional non-Australian set of data was benchmarked for comparison (Table 2). The US comparison data was obtained from a previously published study.

All data were de-identified during previous study and grouped, rendering it impossible to identify individuals, and thus ethical approval was not required for this present study.

To simplify the comparison between various pathways, the data was categorised into the eight most commonly provided service areas as defined by the Australian Dental Association item numbers, namely; Restorative, Diagnostic, Preventative, Periodontal, Endodontic, Removable Prosthodontics, Oral Surgery and Crowns and Bridges. A comparison was made
between frequencies of these commonly provided services through each of the four pathways.

To better understand how dental care of Australians relates to the dental care received in other developed countries, Australian dental service mixes were compared with that commonly received by patients in the US (Table 2).

Although there is an agreement within available scientific literature that the general dynamic of dental health among Australians is positive, there are only a few comparisons of the actual service mix provided via different pathways. The ability to compare and contrast dental service mixes most commonly offered via different pathways may influence future policies.

For cost comparison purposes, the 13 most common procedures undertaken by dentists (as published by the Australian Dental Association) were used. In all four pathways, the cost estimates were based on the DVA schedule 2013 to normalise comparisons for time and price (Table 3).

The DVA schedule 2013 has changed over the years to account for inflation and other economic factors and therefore may not reflect precisely the cost of a particular treatment retrospectively (i.e. back in 2004). The DVA schedule 2013 is therefore used in this study purely to aid comparison, in monetary terms, of the relative service mix value via different pathways.

Results

Australian comparisons

There was a stark difference between the service mixes provided through the four pathways (Table 1). Diagnostic services, which include examination and X-rays, with the exception of the CDDS (Western Australia) clinical pathway, appear to be the most prevalent category of all, at ~40%.

Preventive services (clean, fluoride treatment and fissure sealant) in the private pathway are substantially higher by comparison to the services provided under the CDDS (Western Australia and National), public and the AMS-based pathways.

The data finds a significant difference in the number of extractions undertaken across sampled clinical pathways. A person attending an AMS-based clinic is more than two-to-threefold as likely to have an extraction as a patient in the public or private care pathway. Tooth extractions under the CDDS (Western Australia) were comparative to that of the public pathway, while tooth extractions via the CDDS pathway on the national level were the lowest out of all the clinical pathways.

Endodontics appear to be another area of contrast, with private patients being more than fourfold as likely to undergo a root canal therapy (RCT) as a patient in an AMS-based pathway. Restorative services also appear to be more prevalent in the private pathway, with up to 43% of cases being offered restorations. This is twice as frequent as the public pathway and almost threefold as frequent as the AMS-based pathway.

Provision of restorative services under the CDDS (Western Australia and National) was found to be moderate at ~24% and comparable to that of public pathway patients at the Esperance clinic. Crowns and bridges comprised a relatively small percentage of work carried out in private pathway, but are practically non-existent for the public and the AMS-based pathway patients. CDDS (Western Australia and National) had recorded the highest percentage fixed prosthodontic work out of all pathways, at 6.7%.

Removable prosthodontics-related procedures are also much more common via the private pathway at 7–8% in comparison to less than 1% for the public and 0.2% for the AMS-based pathways. However, at 21%, the CDDS (Western Australia and National) pathway patients received significantly more removable prosthodontic services than all the other pathways combined.

International comparison

When comparing dental service mix data from Australia and the US (Table 2), preventive services especially present a stark contrast. Teeth cleaning, fluoride treatments and fissure sealants

### Table 2. Percentage distribution of the service mix in the US, 2009

<table>
<thead>
<tr>
<th>Category vs location</th>
<th>Overall</th>
<th>Private</th>
<th>Public</th>
<th>Uninsured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic</td>
<td>45.0%</td>
<td>45.4%</td>
<td>41.1%</td>
<td>43.5%</td>
</tr>
<tr>
<td>Preventive</td>
<td>31.1%</td>
<td>31.9%</td>
<td>41.1%</td>
<td>43.5%</td>
</tr>
<tr>
<td>Periodontics</td>
<td>0.9%</td>
<td>0.9%</td>
<td>1.5%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Oral surgery</td>
<td>3.5%</td>
<td>2.7%</td>
<td>7.8%</td>
<td>7.0%</td>
</tr>
<tr>
<td>Endodontics</td>
<td>2.3%</td>
<td>2.4%</td>
<td>3.7%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Restorative</td>
<td>6.6%</td>
<td>6.3%</td>
<td>9.9%</td>
<td>7.7%</td>
</tr>
<tr>
<td>Crowns, bridges and dentures</td>
<td>7.3%</td>
<td>7.3%</td>
<td>8.2%</td>
<td>7.1%</td>
</tr>
</tbody>
</table>

### Table 3. Distribution of service mix value of care

<table>
<thead>
<tr>
<th>Category</th>
<th>Private</th>
<th>AMS</th>
<th>Public</th>
<th>CDDS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>City</td>
<td>Country</td>
<td>Australia</td>
<td>WA</td>
</tr>
<tr>
<td>Diagnostic</td>
<td>$4123.90</td>
<td>$3765.30</td>
<td>$2779.15</td>
<td>$3783.23</td>
</tr>
<tr>
<td>Preventive</td>
<td>$3529.50</td>
<td>$3122.25</td>
<td>$1045.28</td>
<td>$665.18</td>
</tr>
<tr>
<td>Periodontics</td>
<td>N/A</td>
<td>N/A</td>
<td>$113.44</td>
<td>$120.53</td>
</tr>
<tr>
<td>Oral surgery</td>
<td>$919.10</td>
<td>$1048.00</td>
<td>$3046.16</td>
<td>$1457.43</td>
</tr>
<tr>
<td>Endodontics</td>
<td>$2259.20</td>
<td>$2529.20</td>
<td>$537.46</td>
<td>$1621.37</td>
</tr>
<tr>
<td>Restorative</td>
<td>$22 415.40</td>
<td>$22 949.10</td>
<td>$8218.98</td>
<td>$11 634.66</td>
</tr>
<tr>
<td>Crowns and bridges</td>
<td>$7582.20</td>
<td>$5054.80</td>
<td>$0</td>
<td>$1010.96</td>
</tr>
<tr>
<td>Removable prosthodontics</td>
<td>$6679.75</td>
<td>$7634.00</td>
<td>$190.85</td>
<td>$667.98</td>
</tr>
<tr>
<td>Total value of treatment per 100 patients</td>
<td>$47 779.05</td>
<td>$46 102.65</td>
<td>$15 931.32</td>
<td>$20 952.34</td>
</tr>
</tbody>
</table>
appear to be prescribed much more frequently in the US than in
Australia.

The apparent emphasis of preventive care in the US is further
supported by the percentage of restorations prescribed. Patients
in Australia appear to be receiving, on average, four-to fivefold
as many fillings as their US counterparts.

Just like in Australia, public pathway patients in the US have
more extractions than private pathway patients. The percentage
of extractions in the US in the public pathway, at 7.8%, is not as
high as that in the Australian public pathway, at 11.1% and is
much lower than the percentage of extractions experienced by
the AMS-based pathway patients, at 23.2%.

Data from the US also shows that extracted teeth are more
commonly replaced via a bridge or removable dentures than in
Australia. Overall, in the US, there does not appear to be as
much difference between the dental service mixes received via
private versus public pathways as there is in Australia.

Value comparison

In monetary terms, the cost of services received by the AMS-
based pathways patients appears to be the lowest at $15 931.32
per 100 patients (Table 3). The value of treatment per 100 patients
via the public pathway was approximately $20 952.34, whereas
the private and CDDS pathway patients received, on average,
just over $47 000.00 worth of treatment per 100 patients.

Discussion

There are significant disparities in the dental service mixes
between the private, public, AMS-based and CDDS clinical
pathways. The data clearly shows that private patients, irrespec-
tive of whether they attend a clinic in the capital or non-capital
city, are much more likely to have their teeth restored rather
than extracted. It is also apparent that edentulous spaces (AMS-
based and public pathways) do not get filled by way of fixed or
removable prosthesis as they do in private clinics. Historically,
CDDS patients at the national level are less likely to have teeth
extracted and appear to have the largest representation among
fixed and removable prosthetics recipients.

When comparing the cost of treatment, it becomes apparent
that approximately threefold as much is spent on dental treatment
through private and CDDS pathways than AMS-based and
public pathways.

Factors other than disease affecting the type of treatment
provided

The substantial difference in the mix of care provided in the
different clinical pathways points to factors other than disease
affecting the type of treatment provided. It would be easy to
point to price as an important factor; however, the cost to patients
in the AMS-based and Public sector are substantially subsidised
by the taxpayer and thus the cost effect is ameliorated. More
interestingly, the various remuneration patterns of operators in
each sector may well play a role in the differences. In the private
sector, remuneration is based on fee-per-item, while the
AMS-based and Public sectors are salary-based models. Most
interestingly is the CDDS pathway, where care is provided in a
fee-for-service model (i.e. in the private sector), but the costs
are completely borne by the taxpayer. The mix of models of
remuneration may be one reason for the substantial differences
in the care provided in each pathway.10 In the early 1990s Sir
Kenneth Bloomfield conducted a review of the National Health
Scheme (NHS) in the United Kingdom.11 One of the common
themes that emerged from the consultation with the dental
professionals was that:

Some alleged that item of service payments encouraged
dentists to work faster and faster, even to intervene
unnecessarily.

The level of private health cover can influence the type of
treatment a patient agrees to. A majority of adults with health
insurance reported that their insurance paid some (78.7%) or all
(7.8%) of the dental costs of their last visit. Only 9.4% of insured
adults paid all their own dental expenses.12 Some insurance
funds have conditions attached to their policies that do not allow
rollover of the allocated policy funds into the next calendar year,
thus effectively encouraging the policy holder to ‘use’ the cover.
This could result in more frequent dental check-ups and preven-
tive care being delivered.

It has been acknowledged by the Australia’s National Oral
Health Plan that people representing low socioeconomic groups
experience greater levels of oral disease by comparison to the
more affluent groups.13 Aboriginal and Torres Strait Islander people experience sig-
ificantly higher levels of dental disease by comparison to all the
other groups.14

People living in non-capital city areas are more likely to have
a problem-oriented pattern of dental attendance.15 It has also
been found that concession card holders are less likely to visit a
dentist on a regular basis and have a higher rate of dental
disease.16 Poor oral health is also more prevalent amongpeople
without private health cover than those with private health
cover.17

A person’s culture can be another contributing factor. Culture
can be defined as a shared pattern of actions or beliefs
among a particular group of people that can influence life
choices, priorities and behavioural norms. Cultural background
may have an impact on individual’s recognition of illness and
care-seeking criteria.18

These findings suggest that the level of education, availability
of private health cover, geographic location, financial position
and cultural values of an individual could influence his or her
decision to seek dental services and the type of treatment they
may choose.

In addition, it is possible that public dental clinics may have
a variety of policies that influence the approach to restoring
extensively decayed teeth, but these policies remain hidden to
public view. Extraction and replacement of such teeth with a
removable prosthesis can be considered more economical and
thus could potentially be undertaken more often in public clinics.

Limitations

There are some limitations of this study. The data used to show
service mix in the private sector is not from the same year as
that used to present service mix for public and AMS-based
pathways. Furthermore, the CDDS data varies significantly,
depending on the year concerned. In an effort to obtain a more
balanced view of the CDDS, the aggregate values were used. However, resting the comparisons on proportions and the scale of the differences reported mitigates these limitations.

The study compares Australian (1999–2004) to the US (2009) data. Recent studies have shown that the demand for dental services in the US has fallen since the Global Financial Crisis (GFC) of 2008; however, Australia remained largely unaffected by the GFC at the time.

More importantly, this research also compares the care accessed by people of vastly different backgrounds and vastly different economic opportunity. These factors are clearly part of the composite of factors that influence the types of care provided in each pathway. However, it is noted that care in the government and AMS-based pathway is substantially (up to 100%) subsidised, so to some extent, these factors are mitigated by the implementation strategies of each pathway.

Conclusion

In summary, the data finds that there is a substantial difference between various dental care pathways in Australia in terms of mix of care provided. These differences in the types of care provided are proposed to be a result of factors other than disease. Against international data (US), which has a substantially different health service model, Australia also differs significantly. The gap in care mix between private and public patients in the US appeared to be small relative to Australian data. The data clearly finds that the original hypothesis of disease-driven care need was found to be not supported.

Competing Interests

None.

References