How to improve dental health and make oral health policy work

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Summary
The burden of oral disease in the form of caries and periodontal disease remain high throughout the world. These two conditions are the most prevalent medical illnesses with a significant strain on the general economy, health system and quality of life. Despite this, modern dentistry has made significant advances in new techniques and materials which have pushed the boundaries of what is considered possible. The ability to move teeth with invisible braces, to restore a jaw absent of any teeth with implants for a complete natural smile, or the use of precision lasers as cutting instruments are some truly remarkable achievements. Academically, the greatly improved understanding of the aetiology and pathogenesis of caries and periodontal disease is at the level where they can predictably be prevented or cured with simple and cost effective measures. It is therefore unfortunate that these achievements have not resulted in reducing the burden of disease or a change in the organisation and practice of dentistry.

Many have attributed the problem to be due to a lack of government support, making access and affordability to dental services out of reach for too many people. With increasing pressure from welfare groups and mounting evidence associating oral disease with almost every condition in the human body, the Australian Commonwealth Government introduced unprecedented policies for oral health. The Chronic Disease Dental Scheme (CDDS) represented the first national dental policy to attract government subsidy in its universal health insurance scheme Medicare. With a primary health focus, it provided access to private practice dentists with a generous subsidy to allow for a wide scope of dental services.

The CDDS experienced cost containment problems and was closed controversially and prematurely. With expenditure over $1 billion AUD in its first two years, it exceeded its budget and became the most expensive dental initiative in Australian history. Restorative services accounted for over two thirds of total expenditure with a disproportionately high utilisation in the state of New South Wales. Analysis of the CDDS demonstrated that when dentists have substantial influence over the course of care, patients being exempt from payment and financial responsibility directed to a third party such as health policy, there may
be a tendency to over-treat. Despite this, it was shown that oral health policy focused exclusively on primary health (prevention) is affordable.

Views expressed by various leaders, politicians and other stakeholders regarding the unintended consequences of the CDDS were many and varied. At a senate inquiry, some argued that policy was poorly conceived while others expressed concerns with the level of funding, inappropriate targeting or that dentistry was always going to be too expensive for Medicare.

Despite unprecedented policy, historically high funding, inclusion in Medicare, and advances in dentistry in understanding and treatment, the CDDS made little impact towards reducing the burden of oral disease. This begs the question; how to improve dental health and make oral health policy work? As such, the ultimate aim of this thesis is to explore the issues around this question. The thesis argues that increasing public health expenditure, without structural changes to the profession, will not improve dental health. This hypothesis can be tested by observing and reporting on patterns of care in the CDDS. In addition, this thesis explores other factors influencing presentation to the dentist and how this may affect oral health care.

As such, this thesis consists of three main sections and is based around a framework consisting of ideal attributes in an oral health system identified by leading health organisations. The first section explores oral health policies in Australia with particular emphasis on the CDDS. The second section addresses the need to improve population research and evidenced based dentistry where the application of e-Health and informatics is presented. Finally, the last section respects that there are other factors which influence patients seeking care. Using examples in the field of dental trauma, litigation and oncology, the importance of communication, consent and trust is highlighted.

The argument that the current private practice environment has competing objectives that is not ideal for delivering primary health policy is presented. Increased health expenditure does not necessarily translate to better health outcomes. Structural reform in key areas of the dental profession is needed before dentistry can be included in Medicare. There is a need to revisit policies
with emphasis on segregating services based on its contribution to health as well as implementing mechanisms to monitor policy. Revisiting the role of allied health professions is also necessary to improve the provision of primary care dentistry. It is about the right policies, an appropriate workforce balance, evidenced based care, consent, and communication; these principles constitute an ideal framework of care that can improve dental health and make oral health policy work.
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Thesis Format and Authorship

The regulations of The University of Western Australia provide the option for candidates for the Degree of Doctor of Philosophy to present their thesis as a series of papers which have been published in refereed journals, manuscripts that have been submitted for publication but not yet accepted, or manuscripts that could have been submitted.

In this particular thesis, all eleven papers (7 primary, 4 sole author) listed have undergone peer review and have been published. In all papers, the candidate was responsible for the work. The candidate collected and analysed the data. The data were processed and this information enabled the candidate to scrutinise existing theories. With this knowledge, the candidate created new knowledge, generated new concepts, methodologies and understandings. With permission, the candidate was given authority to submit the work for publication. During his candidature, the student was given permission to pursue other related interests where achievements included:

- Regular reviewer for Oral Health in the journal, Australian Health Review.
- Elected a Fellow of the Royal Australasian College of Dental Surgeons.
- Elected as Regional President of the Royal Australasian College of Dental Surgeons.
- Completed formal law units with high distinction and achieved Dean Honourable Mention (prerequisite knowledge required to complete chapter 10).
- Awarded Australian Postgraduate Scholarship

This thesis is comprised of a series of published papers in peer reviewed journals of which some has been co-authored.

PhD Candidate (Raymond Lam): 

Coordinating Supervisor (Winthrop Professor Marc Tennant): 

Publications arising from this thesis

A. Where the percentage contribution by the first author was estimated to be at least 80% as co-author:

1. Lam R, Kruger E, Tennant M. Experiences in the implementation of national policy: a retrospective analysis of the Australian Chronic Disease Dental Scheme. Australasian Medical Journal. 2012; 5(10): 551–559. [Chapter One]


B. Where the percentage contribution by the student was 100% as sole author:


General Introduction

“Beware the evil tooth worm, who has rooted itself in the deep, dark cavities of your being. This bone-chilling, bloodcurdling monster is small enough to fit in the palm of your hand, yet its presence will create considerable damage and cause you great pain. Once it gets under your gums, your teeth will never be the same again!"

“It was Hippocrates who first reported that the extraction of an infected tooth could cure arthritis. Later, in the 1900s, the dental practice routinely removed patients teeth to prevent systemic disease. It wasn’t until the early 2000s that sufficient population (epidemiological) data could be analysed to demonstrate a real link between rheumatoid arthritis and periodontal disease”

Within the lives of our elderly, there was a time when oral disease was rife. Almost every child and adult suffered from dental pain, pus and infection. It was considered a privilege to have all of one’s teeth removed and replaced with a complete set of false teeth. Society placed such a high expectation that it was considered a wonderful dowry for a newly-wed, likely in her early teens, to have all her teeth removed as a gift in marriage. Initially as rumour that spread as folklore, it was much better to have no teeth than to suffer the scourge of pain. Legend described how a spiritual worm would make its way into the tooth and eat its way into ones heart and soul. This became known as the tooth worm theory.

It is only within the last half century that the presentation of oral disease has changed. Gone are the days when every child was suffering from pain and abscesses. Although this may be attributable to discoveries such as antibiotics and our improved understanding of disease, dentistry has changed because of one principle instrument; community water fluoridation.\(^1\) Ranking alongside the seatbelt and discovering the hazard of tobacco smoking, water fluoridation has been considered one of the most pivotal public health initiatives of all time. Even in this modern day, water fluoridation is the most effective population measure to control caries.\(^2\) This had reduced dental decay in children to levels where statistical averages can no longer be reasonably used. \(^3\) Rates of edentulism in
adults are also seeing a complete reversal. It was only decades ago when at least three quarters of the population had a complete denture. There is now talk amongst the profession that complete dentures should no longer be taught in dental schools.\(^4\) It is inconceivable that the next generation of middle aged and geriatric adults would lose all their teeth. The stats are simple, people are keeping their teeth for longer and extractions of teeth are declining. Why then is the burden of oral disease still high?

Keeping teeth for longer and perhaps for life has been considered the ultimate outcome in dentistry. However, this presents with many challenges. There are more teeth that require maintenance and deteriorating teeth impacts quality of life. The current model for providing dental care is expensive. The problem is not the act of dentistry per se but rather who has access to care. It is a problem of social divide and inequality and has been described by the US General Surgeon as the ‘silent epidemic’.\(^5\) The remaining decay is worse and not evenly distributed but rather skewed towards the disadvantaged. These groups have the poorest access to care and suffer disproportionately. Oral disease not only impacts quality of life but affects the entire health system and economy. A large proportion of emergency admissions in overworked public hospitals are attributed to preventable dental diseases, which is the fourth most common presenting condition.\(^6\) Certain minority groups such as Indigenous children are 30 times more likely to end up in hospital as a result of severely affected teeth with facial cellulitis compared to wealthy Australians.\(^7\)

This highlights a few important questions. Firstly, are oral diseases really preventable and at what cost? Secondly, if oral diseases are preventable, why are they still prevalent?

Caries and periodontal disease are the most prevalent diseases in the community.\(^7\) Along with dental trauma, costs to society in managing these conditions are substantial.\(^8\) One pivotal moment in dentistry is the discovery that caries and periodontal disease are bacterial related diseases rather than diseases of voodoo or superstition. Many studies have conclusively shown that these diseases can be reversed or cured with simple measures; education, diet and plaque removal. The classic study by Loe demonstrated that with timely
removal of plaque, the precursor for periodontitis (gingivitis) resorts to a condition of health within days.\(^9\) Similarly, work by Featherstone has demonstrated that early carious lesions can be replenished and reversed without the need for drilling and placing a restoration.\(^10\) As such, placing a restoration is now considered the endpoint of disease where a chronic process has led to the irreversible loss of dental hard tissue. This results in enamel and dentine collapsing to form a cavity. Similarly, mature plaque in periodontal disease can trigger the body to inadvertently resorb the alveolar bone surrounding teeth. As a result, many patients develop a toothache, experience difficulty eating or notice their teeth moving. Unfortunately, this is typically the time in which many patients seek care.\(^11\) It is also common to find in this situation that many teeth, other than the one causing pain, require treatment as all teeth in that patient have the same environmental stressors. This partly explains why the disadvantaged have the majority of disease and why population averages may not be an accurate reflection of disease status.

The next and more complex issue is why are oral diseases prevalent when they are preventable? In theory, caries and periodontal disease can be eliminated if every person receives regular diagnostic and preventive care. Even with less than ideal brushing, a regular professional clean can reverse the effects of gingivitis predictably.\(^12\) Despite this simplicity, it has proven very difficult to achieve in practice. A large part of the problem is the way dental care is provided.

The provision of dental care in Australia is based on a private model within small businesses in a free market economy. Dentists have autonomy to set prices, establish clinics in locations of choice and favour particular treatments based on business and personal decisions. While this may be similar to the medical profession in GP clinics, one pivotal difference is the level of government support and expenditure. Medical services are heavily subsidised by the government under the universal insurance scheme Medicare. Patients can afford to visit the doctor because treatment is either fully subsidised (bulk billed) or reduced (co-contribution). Private medical practices are sustainable because Medicare ensures a constant supply of patients that can afford treatment. The number of adults requiring health care is not short with estimations placing at least 4 out of 5 adults suffering from at least one incurable or deteriorative condition.\(^13\) In
contrast, the exclusion of dentistry from Medicare requires patients to meet the full cost of treatment. Around 50% of the population have private health insurance which provides partial subsidy. For groups meeting financial disadvantage criteria, states and territories provide a safety net in the public system. Despite this, the public sector is under resourced and treat a disproportionate number of the population relative to its small workforce. With public wait lists reported to be up to 7 years, it is not surprising that treatment tends to be palliative. An overwhelming number of treatments in public clinics are focused on extracting teeth and treating infection with little time to focus on prevention. This is not an effective way to manage oral disease.

Comparing funding between doctors and dentists reveals a significant contrast in how health services are supported by governments. With Medicare, the average out of pocket expense for an initial examination to see a doctor ranges between $30-50. Compare this to a dentist for an initial examination and the out of pocket expense can vary from $165 to $400. This is significant given that a recent survey indicated that one fifth of the population expressed difficulty in paying a $120 health bill. Given that the average price for a dental visit is higher at around $200, it is no surprise that one third of the population cannot afford a dental visit. Again, it is the disadvantaged that experience the highest burden of oral disease. It is inexcusable to discount oral disease given its severity and its association with almost every chronic condition in the body. The risk factors associated with oral disease are identical to problems associated with systemic diseases such as cardiovascular disease or diabetes.

These factors have obvious implications in the way dental care is provided. Without government support, dentists are responsible for all capital and start-up costs in a health profession that is heavily procedural. The costs associated with establishing a dental clinic are among the highest of all health practices. Given that a significant portion of the population expressed difficulty in meeting the cost of a dental examination, there is doubt that these particular individuals could afford further treatment. This creates a cascade of problems not only for the individual but for the entire health system. Many individuals neglect their oral health until it becomes unbearable, making them present either to hospital or as an emergency visit to a dental clinic for palliative care. Once pain is reduced,
many of these individuals may not present until there is an acute need. This translates to cancelled or missed appointments in private clinics and increased demand in emergency hospitals. Even though governments acknowledge that dental problems affect general health, no political party has taken action to include dentistry as part of Medicare due to cost.\textsuperscript{17} Finance has also been considered by private practice dentists in the way they manage their practices. As business owners, dentists need to make the practice profitable. A survey of dental clinics in Australia has indicated that business skills are essential for survival.\textsuperscript{18} Interestingly, one trait of successful private clinics was that their priorities were internal rather than patient centric. \textsuperscript{18}

Within this landscape it is not surprising that the most experienced and productive dentists are situated in capital cities within the most economically affluent suburbs.\textsuperscript{19} The combination of low government support and the competitive business environment has created a misdistribution of practices which does not reflect disease burden but rather ability to pay. Rural and remote areas have poorer oral health with fewer opportunities to see a dentist where fees are higher.\textsuperscript{20} Indigenous Australians have on average twice the incidence of caries than non-Indigenous Australians.\textsuperscript{20} Wealther Australians experience lower rates of caries yet have disproportionately higher rates of wisdom tooth extractions.\textsuperscript{21} Lack of private health insurance is strongly correlated with remote areas and in less affluent suburbs.\textsuperscript{20} Indigenous children are less likely to have insurance than non-indigenous children with greater rates of facial cellulitis.\textsuperscript{20} This is a classic example of the “inverse care law” described by Tudor.\textsuperscript{22} Stated differently, the availability of services tends to vary inversely with the need of the population served. Former US Secretary of State for Health, Frank Dobson, once said ‘inequality in health is the worst inequality of all’.\textsuperscript{23}

Profitability is an important consideration when it comes to any business model. With no government support, dental practices need to find a means to attract and retain patients. With this in mind, it would make sense to focus on groups that have money and want expensive treatment. However, this has created a two tier system where it is increasingly difficult to determine if the provision of dentistry is based on health necessity or a cosmetic commodity. The emphasis on cosmetic and reconstruction dentistry can be seen with the growing level of advertising and
marketing. Advertising campaigns now promote the perception that oral health is achieved only when naturally looking teeth are present. This has seen the emergence of ‘white filling only practices’, cosmetic and aesthetic practices, ‘implant all on four clinics’ and ‘same day crown centres’. Despite its long history of success, it is unfortunate that amalgam restorations are continually downplayed not only by the public but also from certain groups in the profession. The push to replace mercury fillings due to concerns of toxicity are unjustified. The fabrication of crowns using porcelain represents a significant source of income.\textsuperscript{24} It is also no surprise that these expensive procedures are provided in the most affluent suburbs.\textsuperscript{19} This is simple economics at play; provide services that make the most profit from patients who are willing to pay. The financial incentives for reconstructive services are significantly greater compared to preventive services. This situation is compounded when affordability to regular dental visits are out of reach for too many people; resulting in deteriorating dentitions that eventually require more costly treatment. Despite this, the provision of reconstructive and aesthetic dentistry is not unreasonable because society may want these services. However, it is unreasonable that a large group of people cannot afford preventive or primary health services because some practices are too focused on cosmetic and aesthetic dentistry. This problem is not ideal when 85\% of the workforce is in the private sector with the highest density of practices in wealthy suburbs.\textsuperscript{6,19}

Considering who misses out on treatment represents the silent epidemic in dentistry. There is clear evidence to show that low income earners, indigenous, rural, medically compromised and elderly experience difficulty in accessing services.\textsuperscript{6} Government health policies and the public system to date have been woefully inadequate. Attention should also be paid to those who fall through the cracks. Working families and modest income earners who are ineligible for the public system safety net and do not have private health insurance represent a large proportion of people who lack care. These groups cannot afford treatment leaving them with few options; bear dental pain until it becomes too much, seek palliative care in emergency hospitals or go elsewhere for \textit{en masse} treatment. In the latter, dental tourism is becoming a popular option where patients travel overseas for comprehensive care. While the quality of treatment by overseas providers may or may not be comparable, the main problem is one of
maintenance. It is not uncommon for extensive treatment/rehabilitation to require equally as extensive post-operative care and maintenance. Major changes in occlusion and function are not always tolerated by patients. Can these patients afford regular travel to their overseas provider? If not, can they afford local treatment (retreatment/maintenance) when they couldn’t in the first instance? As working families and modest income earners are the principal drivers of the economy, what is the impact of oral disease on the economy and general health system? It has been reported that lost economic productivity due to oral disease is second only to cardiovascular disease.6

Successive governments are aware of the situation but have been reluctant to introduce major reform. For many years, repeated calls from welfare and professional groups for the inclusion of dentistry in Medicare have been unsuccessful. It was not until the early 2000’s that the Commonwealth government introduced unprecedented policy in the form of the Chronic Disease Dental Scheme (CDDS). The CDDS represented the first major oral health policy to attract Medicare rebates for patients with chronic or complex conditions. On the surface, the CDDS seemed to be formulated on solid principles that addressed many of the perceived problems in accessing oral health care. Targeting the most medically compromised people in the population, utilising the private sector which has the capacity to deliver a national agenda and financing services under an established model seemed reasonable. Providing the opportunity to access private practices would also reduce hospital admissions for dentally related illnesses. This would alleviate the workload and waiting lists in public clinics resulting in greater opportunities to focus on prevention rather than palliative care. Rural and remote patients would be able to access their local dentist rather than travelling great distances to their nearest government clinic. Governments would also avoid the impossible and expensive task of setting up public clinics in rural and remote areas that are currently not serviced.

Despite promise in the scheme, the outcomes and adverse effects of the CDDS leaved a lot to be desired. It was reported that the number of services provided declined further away from capital cities.25 Expensive treatments such as crowns were disproportionately more frequent in metropolitan suburbs.25 Overall, the provision of services was inconsistent with the distribution of disease with groups
such rural dwellers and the indigenous missing out. These outcomes call to question the effectiveness of policies targeting oral disease in the current model of service provision. As the majority of dental care is provided by small business driven by economic pressures, the results are not surprising. Would profitable businesses operating for many years without government support suddenly change their business model or would they make use of opportunities to enhance what they are already doing? This is an important concept that was unappreciated by policy makers and governments and hints that structural change in the profession is needed as a way forward.

There is little doubt that cost and affordability are major barriers to seeking dental care. However, the reasons for dental visits are complex and multi-factorial. Dental anxiety is a common cause for avoidance. It has been estimated that 80% of adults experience some form of anxiety from negative experiences. Although anxiety may be more common in the elderly from past practices, this disorder is not confined to this generation. Despite new materials, techniques and practices making dentistry more comfortable, there are still members of society that delay dentistry due to anxiety. One major cause of anxiety is a lack of trust which is often caused by misdiagnosis, continual pain after treatment or unmet expectations. These instances contribute to negative experiences and dental avoidance. Furthermore, with increasing demands on appearance and high cost in treatment, it is unsurprising that litigation is becoming a major part of dentistry. This highlights the importance of professionalism, trust and informed consent.

Regardless of the reasons for avoiding dentistry, there are certain situations that will make patients seek care. Dental trauma are sudden and unexpected injuries where costs to society in managing these conditions are substantial. Traumatic dental injuries also affect self-esteem and quality of life. Additionally, Head and Neck tumours are not only debilitating, they are life threatening. It is not uncommon to find the initial or only symptoms to these cancers in the oral cavity. Finally, regardless of the way patients feel about visiting health professionals, an acute toothache is one of the few medical conditions that would make even the most robust person seek care.
All these considerations lead to the most pivotal question – How to improve dental health and make oral health policy work? Clearly, the solution does not lie in addressing one aspect of dentistry. The problem is multi-factorial and hence one would expect the solution to address all the issues discussed so far. This thesis hypothesises that increasing public health expenditure, without structural changes to the profession, will not improve dental health. This can be tested by observing the CDDS in the current model of care in Australia. It is also expected that an analysis of this scheme will provide an insight into innovative methods to improve data collation and communication. This will lead to more collaborative outcomes between all health professionals. As such, a study of the CDDS forms a major component of this thesis. Notwithstanding, it is acknowledged that certain individuals avoid dentistry for reasons other than finance no matter how well policy is formulated or funded. These issues broadly fall under the topics of informed consent, communication and trust which will be explored using dental conditions that are considered most critical; toothaches, trauma and tumours. Additionally, modern dentistry cannot be practiced without consideration of the law as litigation is becoming more apparent. By encompassing and providing an insight into these areas, it is hoped that people will be empowered to visit the dentist based on policy that affords them to do so. This may be the way to improve oral health and to reduce the burden of oral disease.

These topics are consistent with the views of major organizations such as the American Association of Public Health Dentistry, American Public Health Association Institute of Medicine and the World Health Organization in improving oral health. Tomar and Cohen reviewed policy positions of these groups and have provided a framework outlining the ideal attributes of an oral health system (Table 1). 29 This thesis will base its findings and recommendations on this framework.
### Table 1: A framework for oral health policy

<table>
<thead>
<tr>
<th>Ideal Attributes of An Oral Health System</th>
<th>Current Australian Situation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Integrated</td>
<td>Dentistry is excluded from the universal insurance scheme Medicare. The majority of the workforce operate in private practices as small businesses. There is little collaboration between private practices which operate as separate business entities.</td>
</tr>
<tr>
<td>2 Emphasis on health promotion and disease prevention</td>
<td>A study of the CDDS will provide an insight into this area. Extractions and palliative care feature highly in public health clinics with limited opportunity for health promotion and prevention.</td>
</tr>
<tr>
<td>3 Monitors population oral health status and needs</td>
<td>The Australian Institute of Health and Welfare (AIHW) have limited datasets from surveys such as the Child Dental Health Survey and National Survey of Adult Oral Health. The sample size of these datasets are small and limited information is based around private practices where a majority of dental care is provided. These oral health datasets are not available to the public or non AIHW researchers for analysis. A study of the CDDS will provide an insight into this area.</td>
</tr>
<tr>
<td>4 Evidenced based</td>
<td>Since the CDDS was the first major dental program to be included under Medicare, it was formulated with little evidence base.</td>
</tr>
<tr>
<td>5 Cost Effective</td>
<td>A study of the CDDS will provide an insight into this area.</td>
</tr>
<tr>
<td>6 Sustainable</td>
<td>A study of the CDDS will provide an insight into this area.</td>
</tr>
<tr>
<td>7 Equitable</td>
<td>Marginalized groups such as rural dwellers, the indigenous and medically compromised continue to face difficulties in assessing appropriate dental care. Working families ineligible for the public dental care and do not have private health insurance face difficulties in paying for dental treatment.</td>
</tr>
<tr>
<td>8 Universal</td>
<td>A study of the CDDS will provide an insight into this area.</td>
</tr>
<tr>
<td>9 Comprehensive</td>
<td>A study of the CDDS will provide an insight into this area.</td>
</tr>
<tr>
<td>10 Ethical</td>
<td>A study of the CDDS, the Teen Dental Plan and dental cases in law will provide an insight.</td>
</tr>
<tr>
<td>11 Continuous quality assessment and assurance</td>
<td>There is no mechanism for continuous quality assessment and assurance. The AIHW periodically conducts surveys and questionnaires but this is infrequent and of small scale. There needs to be a better way to obtain large datasets of dental treatment. It would be ideal if every dentist contributed to data collation and research but there is no practical or affordable solution.</td>
</tr>
<tr>
<td>12 Culturally competent</td>
<td>A study of the CDDS, the Teen Dental Plan, dental trauma and dental cases in law will provide an insight.</td>
</tr>
<tr>
<td>13 Empowers individuals and communities</td>
<td>A study of the CDDS, the Teen Dental Plan, dental trauma and dental cases in law will provide an insight.</td>
</tr>
</tbody>
</table>
In summary, by presenting this thesis as a series of published papers, the major objective of this thesis is to answer the question – How to improve dental health and make oral health policy work? The answer will be placed in a proposed framework at the conclusion. This thesis argues that increased health expenditure does not directly relate to better health outcomes. Structural reform in key areas of the dental profession is needed. It is about the right policies, an appropriate workforce balance, evidenced based care, ethical standards, trust and communication. Each paper contains its own sub-objectives and methodology and is organized into one of three main sections. A preface will accompany each section to outline its contribution to the objectives of this thesis and the proposed framework for dental health.
References


Section One: Oral Health Policy in Practice

Preface
This section provides an analysis of oral health policies in practice. The Chronic Disease Dental Scheme (CDDS) and the Teen Dental Plan (TEEN) represented unprecedented policies in the Australian health care system. Previously, Commonwealth governments had reservations about the inclusion of dentistry as part of Medicare, citing concerns with cost. Analysis of actual policy allows these concerns to be quantified.

In order to understand policy, it is important to consider it from different perspectives. The first chapter provides a macroscopic overview of the CDDS in terms of cost and utilisation. This will provide some guidance as to whether oral health policy is affordable and sustainable. It is also important to place dentistry in the context of the other allied health professions, especially when dentistry is part of multi-disciplinary care where the global objective is to improve general health. Are the problems encountered with dentistry systemic or particular to the profession? Health administrators, policy makers and those in positions of power need a greater understanding of dentistry in order to ensure that services are not only sustainable but commensurate with their goals and those of taxpayers. An understanding of how each field of dentistry contributes to health not only enables governments to formulate appropriate policies but to also appreciate patterns of care.

Observations from the CDDS and TEEN provide an insight into real policy relevant effects in the Australian context. This section contributes to the thesis by identifying what works and what doesn’t from the policy front. It then provides a model of care that attempts to fulfil the criteria set out in the framework for an ideal oral health system.
CHAPTER 1: Experiences in the implementation of a national policy: A retrospective analysis of the Australian Chronic Disease Dental Scheme

Abstract

Background

The Chronic Disease Dental Scheme (CDDS) is the first public dental policy in Australia to attract Medicare benefits for dental services.

Aims

This study examines the utilisation of a new Federal method of funding dental care in Australia for people suffering from a chronic medical condition. This objective of this study is to quantify and discuss the utilisation of the CDDS from a policy perspective.

Method

A retrospective analysis of service data extracted from the open source Medicare Benefits Schedule database for years 2007-2009 formed the basis of this study.

Results

During the study period, approximately five million dental services were obtained from the Medicare database. There was a disproportionate use of services between jurisdictions. The highest proportion (66%) of services was provided in the state of New South Wales (NSW) with Victoria second (22%). The adjusted value of care provided as a proportion of comprehensive examinations (per patient) ranged from $1937 in the northern territory (NT) to $2900 in NSW. The value of care per dentist ranged from $80,000 down to less than $1000 and the value of care per adult of the population ranged between $53 and $1 across Australia. The highest was always in NSW and the lowest from NT. Fixed prosthodontics (crown and bridge) accounted for the significant costs associated with the program.

Conclusion

The scheme was utilised above its budget with prosthodontics accounting for the majority of expenses. Treatment plans differed between jurisdictions. The increase in utilisation of the scheme was coincident with periods of increased in subsidy and remuneration and has been postulated to be a main driver for its utilisation.
BACKGROUND

One hallmark of a developed country is a reasonable standard of living and health. There is a general expectation that governments have the responsibility of providing adequate health care services for its people. Australia is a federated system of government and is generally considered to be a developed country. Epidemiological studies have indicated that Australia has one of the healthiest populations in the world with an enviable life expectancy. However, an aging population brings additional complications to the health care system. It has been estimated that over one-third of problems in medicine are chronic, represent over 80% of disease burden and form a significant part of health expenditure.

Australia’s national health insurance scheme, Medicare, is funded by annual taxation and is designed to provide health services for its population. One defining feature of this system is bulk billing where the cost of treatment is funded by the government without the patient incurring a cost. Typically, the health provider itemises the treatment and bills the government agency responsible for managing Medicare (Australian Department of Human Resources). Despite government funding, health providers are able to set their own fees and this has resulted in circumstances where patients are required to contribute to the cost of treatment above the level of subsidy provided by the government. As such, bulk billing is not always guaranteed and in these instances, patients are required to make a co-contribution. Patient co-contributions have been postulated to impact acceptance of treatment plans, especially in dentistry where the majority of presentations are by asymptomatic patients. An increasing number of patients also seek dental care for aesthetic or cosmetic reasons. It has been estimated that around 76% of Medicare services are bulk billed.

Although Medicare was formulated on the principle of universality (universal eligibility) for health services, there are limits imposed on treatment. Contrary to the view expressed by the World Health Organization, oral health has been excluded from Medicare. Diseases in the mouth receive no government assistance while organs within this vicinity such as the ear, nose, and throat are fully recognised. Ironically, oral diseases in the form of caries and periodontal disease are the most prevalent in Australia and is the second most costly diet related disease behind heart disease. Without government funding, the majority of dental expenses are borne by the individual in the private sector on a fee per service basis. Less than half of the population (~46%) have private health insurance. A survey of dental fees in Australia indicated that private dental fees have increased substantially higher than the Consumer Price Index. This has affected the affordability of dentistry where it has been estimated that at least one third of the
population delayed or avoid seeking dental care due to cost.\textsuperscript{8}

The problem with access and affordability to dental services is not new. Historically, a number of parliamentary inquires have explored the prospect of including dentistry in Medicare such as the Layton inquiry in 1986 and two separate inquires in 1998 and 2003.\textsuperscript{9} Despite repeated calls by oral health interest groups, Commonwealth governments have been reluctant to include dentistry due to cost concerns. It must be noted that although dentistry was excluded under Medicare for the general population, funding was available to select groups such as cleft lip and palate patients and war veterans under the Department of Veterans Affairs program.

This changed in 2004 when the Coalition Liberal Government introduced Medicare benefits for a limited range of dental services for patients with chronic and complex conditions. The program was initially known as the Enhanced Primary Dental Care Scheme (EPDCS) and formed part of the much greater Enhanced Primary Care Scheme (EPC). The EPDCS represented a change in policy as it represented the first community-based dental program to attract Medicare benefits; providing patients with a benefit of $220 per calendar year. Dentistry was not the only health profession to receive government assistance. Other allied health professions such as podiatry, physiotherapy and audiology were part of the EPC; the new government initiative to manage chronic conditions multi-disciplinary.\textsuperscript{9} Under the EPC, eligibility for Medicare rebates required a management plan from a general medical practitioner (GMP) who served as the first point of contact for patients requiring allied health services. Eligibility for treatment was based solely on health need which was any condition lasting for six months or longer.

The establishment of the EPDCS represented the unprecedented opportunity to observe national policy in action. This allows an assessment of utilisation patterns and to observe the cost implications of including dental services under Medicare. Its analysis will also strengthen population level research in Australia as the first major oral health policy.

Utilisation of the EPDCS was initially low with a combined number of services from 2004-2007 totalling 16,000 services nationally.\textsuperscript{10} This was well below budget projections and the expected uptake of the scheme.\textsuperscript{10} With concerns that costs involved with administrating the program would outweigh any health benefit due to low utilisation, the scope of treatment and subsidy was increased on two occasions.\textsuperscript{10} Fixed prosthodontic services such as the provision of crown and bridges which were previously excluded were allowed under these new measures. This final subsidy of $4250 over two years and the extension of services to cover reconstructive services saw significant changes in
utilisation. With these changes, the program was rebranded as the Chronic Disease Dental Scheme (CDDS).

In making these changes, the government anticipated that this would cost taxpayers approximately $385 million over four years\textsuperscript{10}. However, claims in the first eighteen months as the CDDS saw expenditure exceed $1 billion AUD, making the policy the most expensive in Australian history. The number of services increased from 16,000 to over five million. This resulted in a new problem where cost containment, rather than low utilisation, became an issue. As a result, the Labor party attempted to cancel the scheme and aimed to redirect funding towards establishing a new Commonwealth Dental Health Plan. Under this plan, funding would be focused towards existing public services and infrastructure. However, attempts to close the CDDS were blocked in the senate by the Coalition and minor parties. This prompted other reactionary measures such as an audit by the Department of Human Resources where some practitioners were identified as having misused the scheme. The audit attracted important stakeholders including the political parties, the dental association and many oral health groups. With the support of the national association (Australian Dental Association) and the opposition health minister, a bill was introduced to parliament. Tabled as the ‘Senate Finance Administration Committee for Inquiry’, the bill provided an olive branch to dentists who failed to comply with the CDDS, as many practices indicated they would go bankrupt if required to repay the sums requested. Although dentists avoided these repayments, the inquiry provided the catalyst that resulted in the premature closure of the scheme in 2012.

Given these problems, a study of the CDDS would provide an invaluable insight for the development of future oral health policies in Australia. As such, the objective of this study is to quantify and discuss utilisation patterns of the CDDS. The scope of this study is dictated by the nature of the data which permits an analysis at the national and jurisdictional level.

**METHODS**

**Base activity data:**

All data were obtained from open sources and therefore no ethics approval was required.\textsuperscript{11} During the administration of the CDDS, dentists submitted item codes to the Department of Human Resources for processing. These codes were consistent with industry standard and in accordance to the Australian Schedule of Services and Glossary.\textsuperscript{12} According to the schedule, each item code described a particular dental service or procedure in detail. A database of these codes were segregated into
jurisdiction, age and gender and was publicly available from the department website. This study assumed accuracy in the compilation of this database.

Specifically, Medicare items related to dentistry (85011-87777) were extracted from the Medicare Benefits Schedule database (MBS) online, exported and analysed in Excel 97 (Microsoft Corp Redmont WA) for the calendar years 2007-2009. As data represented actual treatment, this study did not rely on sampling or statistical forecasting. Conclusions were derived from general observations from tables and figures derived from the data.

To enable comparisons with general practice dentistry, this study maintains the categories (nature of services) used in the schedule. As such, each dental service was categorised into 10 main fields of dentistry: (i) diagnostic, (ii) preventive, (iii) periodontics, (iv) oral surgery, (v) endodontic, (vi) restorative, (vii) prosthodontic, (dentures), (viii) crown and bridge, (ix) orthodontic, (x) general.

Population based comparisons were made based on data obtained from the 2009 Australian Bureau of Statistics. Dentist numbers for each jurisdiction were obtained from the Australian Institute of Health and Welfare. Value of care calculations (adjusted for population and the size of the dental workforce) were completed using the 2009 Department of Veteran based dental fees. Data were separated into the six States and two Territories: Australian Capital Territory (ACT), Victoria (Vic), New South Wales (NSW), Queensland (QLD), Northern Territory (NT), Western Australia (WA), South Australia (SA) and Tasmania (TAS).

**RESULTS**

**Uptake of EPDCS/CDDS**

Utilisation of the EPDCS in the first three years of implementation was significantly lower than expectation. The number of services provided during the period of 2004-2007 totalled 16,000. With a change in subsidy as rebranding the scheme as the CDDS, the number of services increased. During the operation of the CDDS, the number of services were 16,297 (2007), 1,503,854 (2008) and 3,426,815 (2009). The difference between the first three years of the EPDCS and the CDDS represented an increase of 30,625%. After adjusting for differences in population, NSW recorded the highest level of utilisation with over three million services (Table 1). Most patients using the scheme were geriatric in the age group 65-74 years. Using the number of comprehensive examinations in general practice clinics, there were approximately 250,000 patients seen over three years with 2009 recording the highest number of patients (163,626).
Table 1: Total number of items (service codes) of CDDS services provided during 2007-2009 by Jurisdiction

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>NSW</th>
<th>VIC</th>
<th>QLD</th>
<th>SA</th>
<th>WA</th>
<th>TAS</th>
<th>ACT</th>
<th>NT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population ('000,000) (%)</td>
<td>6.55 (33%)</td>
<td>4.93 (25%)</td>
<td>3.9 (20%)</td>
<td>1.51 (8%)</td>
<td>1.96 (10%)</td>
<td>0.48 (2%)</td>
<td>0.32 (2%)</td>
<td>0.19 (1%)</td>
</tr>
<tr>
<td>Median Age</td>
<td>37.2</td>
<td>36.9</td>
<td>36.2</td>
<td>39.2</td>
<td>36.2</td>
<td>39.9</td>
<td>34.6</td>
<td>31.2</td>
</tr>
<tr>
<td>% over 65 years of age</td>
<td>14</td>
<td>14</td>
<td>13</td>
<td>16</td>
<td>12</td>
<td>16</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>Surface Area (Rank) ('000 km)</td>
<td>800.6 (5)</td>
<td>227.4 (6)</td>
<td>1730.6 (2)</td>
<td>983.5 (4)</td>
<td>2529.9 (1)</td>
<td>68.4 (7)</td>
<td>2.4 (8)</td>
<td>1349.1 (3)</td>
</tr>
<tr>
<td>Dentist Ratio (/100,000)</td>
<td>52</td>
<td>48</td>
<td>50</td>
<td>53</td>
<td>52</td>
<td>35</td>
<td>65</td>
<td>37</td>
</tr>
<tr>
<td>Dental Services (Number, %)</td>
<td>Diagnostic: 685430 (68.17%)</td>
<td>189245 (18.82%)</td>
<td>60603 (6.03%)</td>
<td>58202 (5.79%)</td>
<td>4871 (0.48%)</td>
<td>2798 (0.28%)</td>
<td>3907 (0.39%)</td>
<td>344 (0.03%)</td>
</tr>
<tr>
<td>Preventive: 148285 (68.76%)</td>
<td>40472 (18.77%)</td>
<td>12790 (5.93%)</td>
<td>11922 (5.53%)</td>
<td>854 (0.4%)</td>
<td>574 (0.27%)</td>
<td>674 (0.31%)</td>
<td>80 (0.04%)</td>
<td></td>
</tr>
<tr>
<td>Periodontics: 286682 (65.34%)</td>
<td>92554 (21.1%)</td>
<td>27737 (6.32%)</td>
<td>27208 (6.2%)</td>
<td>1466 (0.33%)</td>
<td>1689 (0.38%)</td>
<td>1295 (0.3%)</td>
<td>113 (0.03%)</td>
<td></td>
</tr>
<tr>
<td>Oral Surgery: 190603 (61.20%)</td>
<td>71463 (22.95%)</td>
<td>25089 (8.06%)</td>
<td>17559 (5.67%)</td>
<td>3012 (0.97%)</td>
<td>1989 (0.64%)</td>
<td>1396 (0.45%)</td>
<td>230 (0.07%)</td>
<td></td>
</tr>
<tr>
<td>Endodontics: 105458 (67.56%)</td>
<td>35168 (22.53%)</td>
<td>8252 (5.29%)</td>
<td>5651 (3.62%)</td>
<td>614 (0.39%)</td>
<td>295 (0.19%)</td>
<td>576 (0.37%)</td>
<td>82 (0.05%)</td>
<td></td>
</tr>
<tr>
<td>Restorative: 674240 (62.02%)</td>
<td>239993 (22.08%)</td>
<td>85257 (7.84%)</td>
<td>73910 (6.8%)</td>
<td>5710 (0.53%)</td>
<td>3209 (0.3%)</td>
<td>4169 (0.38%)</td>
<td>585 (0.05%)</td>
<td></td>
</tr>
<tr>
<td>Prosthodontics: 654968 (67.44%)</td>
<td>202448 (20.85%)</td>
<td>44006 (4.53%)</td>
<td>58490 (6.02%)</td>
<td>4978 (0.51%)</td>
<td>3227 (0.33%)</td>
<td>2554 (0.26%)</td>
<td>491 (0.05%)</td>
<td></td>
</tr>
<tr>
<td>Crown and Bridge: 221540 (73.15%)</td>
<td>54206 (17.9%)</td>
<td>13166 (4.35%)</td>
<td>10738 (3.55%)</td>
<td>1566 (0.52%)</td>
<td>790 (0.26%)</td>
<td>800 (0.26%)</td>
<td>46 (0.02%)</td>
<td></td>
</tr>
<tr>
<td>Orthodontics: 1535 (77.64%)</td>
<td>355 (17.96%)</td>
<td>51 (2.58%)</td>
<td>24 (1.21%)</td>
<td>4 (0.2%)</td>
<td>6 (0.3%)</td>
<td>2 (0.1%)</td>
<td>0 (0.0%)</td>
<td></td>
</tr>
<tr>
<td>General: 24371 (57.73%)</td>
<td>11794 (27.94%)</td>
<td>3389 (8.03%)</td>
<td>2107 (4.99%)</td>
<td>253 (0.6%)</td>
<td>158 (0.37%)</td>
<td>136 (0.32%)</td>
<td>5 (0.01%)</td>
<td></td>
</tr>
<tr>
<td>Total: 2993112</td>
<td>937698</td>
<td>280340</td>
<td>265911</td>
<td>23328</td>
<td>14735</td>
<td>15509</td>
<td>1976</td>
<td></td>
</tr>
</tbody>
</table>
Time course: The number of dental services, coincident with the increase in benefit and scope of services, showed a marked increase from 2007 (Figure 1). The value of care under the scheme in 2009 was a 24,000% increase compared to 2007. The biggest increases were the number of fixed prosthodontic (crown and bridge) procedures, which accounted for over a third of total expenditure.

Jurisdictional breakdown: The highest proportion (66%) of services were provided in New South Wales with Victoria second (22%) and Queensland and South Australia following with 6% each (Table 1). In 2009, two-thirds of the total value of care was provided in New South Wales (Figure 2). A comparison of the types of treatment provided shows a significant disparity between jurisdictions on a per capita basis. Dentists in the Northern Territory tended to rely on extraction and dentures while the preferred option in NSW favoured crown, bridge and implant dentistry (Table 1, Figures 2–3). The adjusted value of care provided as a proportion of comprehensive examinations ranged from $1937 in the Northern Territory to $2900 in New South Wales. The value of care per dentist ranged from nearly $80,000 down to less than $1000 and the value of care per adult of the population ranged between $53 and $1 across Australia. The highest had always been New South Wales and the lowest always being the Northern Territory (Figure 4).
Figure 2: The proportion of value of care by item number for NSW and the rest of Australia (2009)

Figure 3: Cost of Value of care by type of service for NSW and rest of Australia (2009)
Figure 4: The average value of care per dentist (left axis - bars) and per adult (greater than 15 years of age) (right axis - diamonds) for each jurisdiction of Australia (CDDS 2009)

![Graph showing average value of care per dentist and per adult](image)

**Services by sex and age:** The predominant age group for services was 65-74 year olds followed closely by the 55-64 year old age group. As the impact of chronic and complex conditions tends to increase with age these findings were not surprising. An age demographic of the distribution of patients is shown in (Figure 5).

![Graph showing age and gender distribution of CDDS patients](image)

**Figure 5: Age and gender of CDDS patients**
DISCUSSION

Limitations

As this program was managed by a government department without specific links to the industry or particular practices other than in the administration of this scheme, it was assumed that published data were accurate (no conflict of interest).

Although a large dataset was available for analysis, the nature of the data only permitted a population based assessment. The dataset did not permit correlation with particular chronic diseases or particular individuals. As the data were open source and consisted entirely of numeric values, ethics approval was not necessary as the data were non identifiable. It was possible that the same patient visited the dental provider on multiple occasions for a repeat course of treatment. This source of discrepancy was reduced by limiting the period of investigation to a period of three years (2007-2009). During this time, it was unlikely that the same patient would need another course of reconstruction. Limiting the study to the end of 2009 also enabled an unbiased assessment of utilisation without the influence of the Medicare audit that began in early 2010. Another source of discrepancy involved the removal of specialist and prosthetic services. Some dentists may assume these services whilst others would refer. This will impact the number of services rendered in the general dental subset. Despite this discrepancy, this reflects the circumstances that dentists face routinely in their clinical practice. Despite these limitations, it is believed that the dataset is an accurate representation of the CDDS.

Utilisation of the CDDS

As the CDDS utilised the private sector, it was interesting to compare the provision of services against regular activity in this setting. A comparison has been made with published data relating to activity in general dental practice (Figure 6)\textsuperscript{18,19}. It has been observed that there was greater emphasis on reconstructive dentistry (prosthodonic services in crown, bridge and dentures) in the CDDS when subsidy permitted.
Figure 6: Proportion of items of service (grouped) provided in 2009 under the CDDS compared to previous published general practice mix of care

The emphasis towards reconstruction is not surprising in the CDDS as this represented medically compromised patients. These patients may have deteriorating conditions that required extensive treatment. However, the differences in the initial CDDS (2007) compared to the final CDDS (2009) where it received increased funding shows a marked difference in practice activity (Figure 6). As chronic conditions are long-standing and not expected to change significantly within two years, the results suggest that the level of remuneration influenced the intensity of treatment. When subsidy was low, it was postulated that patients avoided expensive procedures as this required a significant co-contribution. The effect of third party insurance such as government funding through the CDDS has a significant impact on service provision.

The focus on reconstruction was deliberate as this accounted for the majority of CDDS expenditure. It is necessary to consider the provision of crowns in relation to the objectives of the EPC. With this in mind, remuneration and the effect of third party insurance on service provision in private practice is an area that is worth further investigation. It would also be beneficial to compare how other allied health services compared under the EPC.

Regional Variation
A report by the Australian Institute of Health and Welfare indicated similar prevalence rates of common chronic diseases (cardiovascular, diabetes, cancer) amongst the
capital cities. In Australia, all capital cities reside near the coast with vast areas of rural dwellings and un-urbanised territory that are most prominent in WA, NT, QLD and SA (by area). Specific groups such as the indigenous population tended to be evenly distributed throughout the country and have the highest levels of chronic disease. Although some smaller variations in prevalence rates of chronic diseases may be present, it was expected that utilisation would be more evenly distributed at the gross population level. Despite this, utilisation of the CDDS does not seem to be consistent with the spread of chronic diseases in Australia.

A disproportionate use of the scheme was recorded in the state of NSW. The choice of treatment and number of services offered also differed between jurisdictions. The level of marketing, which was highest in NSW, was postulated to affect utilisation. During the implementation of the CDDS, a number of oral health groups from NSW actively promoted the scheme. Many clinicians have also been reported to actively engage with GMP’s for referrals. There were also instances of patients seeking dental practices willing to bulk bill CDDS services which was heavily promoted in NSW.

CONCLUSION
The CDDS experienced extreme swings in utilisation during the years 2004-2009. The predominant age group receiving services were in the 65-74 year group, confirming that the prevalence of chronic diseases are mainly in geriatrics. However, utilisation patterns of the scheme did not necessarily reflect the distribution of chronic disease across Australia. The state of NSW recorded a significantly higher rate of utilisation. Fixed prosthodontic services in the provision of crowns, when allowed and funded by policy, accounted for a significant part of expenditure. The adjusted value of care per patient ranged from $1937 in NT to $2900 in NSW. The value of care per dentist ranged from $80 000 down to less than $1000 and the value of care per adult of the population ranged between $53 and $1 across Australia. The highest was always in NSW and the lowest from NT where there were differences in the types of services provided. With chronic diseases patterns relatively stable over time, it was postulated that remuneration affected both service provision and intensity. Remuneration and the impact of third party (health policy) insurance is an area that requires further investigation. As the CDDS was the first major dental policy to attract dental benefits under Medicare, it provided an invaluable insight into the delivery of national dental policy.
References


CHAPTER 2: Role of the Chronic Disease Dental Scheme in Enhanced Primary Care: allied health or allied outlier?

Abstract
This study aims to compare the two streams of the Enhanced Primary Care Scheme, a recent Commonwealth Government initiative, to provide Medicare rebates to assist medically compromised patients. Although the objectives and eligibility criteria of the two streams were identical, the Chronic Disease Dental Scheme (CDDS) operated on a fee per service schedule while the other stream, the Allied Health Professions (AHP) was based on a fee per visit schedule. Comparing the CDDS and AHP will demonstrate the effect on different funding mechanisms on health expenditure. A retrospective analysis of data pertaining to Medicare items related to dentistry and allied health from 2007-2009 extracted from the Medicare database formed the basis of this study. The provision of services was disproportionate to the size of the jurisdictions with the highest usage in New South Wales. The cost to Primary Care from the CDDS was at least 40 times more expensive than the AHP. CDDS expenditure resulted in an increase of 13,350% in the year that subsidy was increased to allow for reconstructive dental services such as crowns. Expenditure in the AHP was more modest with higher proportion of females seen for a mix of care that was more therapeutic and preventative. Despite this, national policies focused exclusively on preventive dentistry are economically achievable. However, greater health expenditure does not necessarily improve health, as treatment may not always be focussed primary health; presenting a challenge for health planners.
Introduction
Dentistry occupies a unique position in the Australian health care system. Teeth and the oral cavity have traditionally been excluded from the rest of the body when it comes to government subsidy for treatment. This is despite many calls from interest groups over many years requesting the inclusion of dentistry under its major health policy. Despite this, Commonwealth governments have refused to place dentistry under the universal insurance scheme Medicare. Successive governments speculated that the cost of dentistry would be too high. Resultantly, the majority of the cost for dental treatment is met by the individual. Although dentistry is recognized as an essential allied health service, its involvement with the peak body, the Allied Health Professions Australia is limited. The impact of oral disease is the highest among all medical conditions with caries and periodontal disease the most prevalent. It has been estimated that these two diseases alone have an economic impact comparable to cardiovascular disease and diabetes.

With increasing evidence that general health is affected by local diseases, the importance of multi-disciplinary management is being realised by health authorities and governments worldwide. Mitchell has indicated that a multi-disciplinary approach to managing diseases has a tendency for better health outcomes. It has been estimated that over one-third of problems encountered in medicine are chronic, responsible for over 80% disease burden and form a significant part of health expenditure. In response to this growing problem, the Commonwealth Government established the Enhanced Primary Care Program (EPC). This was unprecedented policy and provided government subsidy for many allied health services that were previously excluded from Medicare.

The stated aim of the EPC was to improve the health of patients with complex and chronic conditions. The program consisted of two major streams overseen by the general medical practitioner (GP). Eligibility to the program was based entirely on clinical need and consisted of any condition endorsed by the GP as being chronic or complex. Stated differently, eligibility for subsided treatment was based on the severity of disease rather than the patient’s ability to pay. These conditions varied widely as a chronic condition was loosely considered as any medical problem lasting 6 months or longer.
A referral from the GP entitled patients to subsidised treatment under the EPC streams. The first stream involved a group of 13 allied health professions (AHP) and the other stream was exclusive to dentistry as the Enhanced Primary Dental Care Scheme (EPDCS). The AHP included professions identified as complementary to medicine under section 8 of the Medicare Benefits Schedule.\textsuperscript{7,8} This included professions such as podiatry, physiotherapy, audiology and dietetics to name a few. During the first few months of the program, the dental component of the EPC received increases in subsidy and an extension of services to include reconstruction dentistry (crowns and dentures).\textsuperscript{1} This was in response to low utilization and concerns that the program was not making progress towards improving oral health.\textsuperscript{1} Accompanying these changes, the dental component was renamed as the Chronic Disease Dental Scheme (CDDS).

Although both steams operated under the EPC, they were financed differently. The AHP program operated under a \textit{fee per visit} schedule entitling a patient up to five visits to see any combination of AHP professionals at a subsidy of \textasciitilde$60 per visit. In contrast, the CDDS utilised a \textit{fee per service} schedule for dental treatment up to a monetary limit of \textasciitilde$4250 per two calendar years.

As the only difference between the two streams was the way in which services were subsidised, it is possible to observe how health expenditure is affected by different funding mechanisms. As such, this study aims to compare the APH and CDDS programs as they relate to the EPC. It is expected that the policy relevant effects and insights of this study would provide valuable information for the development of future policies. Additionally, observations of the CDDS will provide a cost insight into the delivery of a national oral health policy. This was previously based on speculation as this represented the first dental policy to attract Medicare benefits. Rather than focusing on particular chronic conditions or individuals, the scope of this study is confined to a macroscopic assessment of treatment at the population level.

\textbf{Methods}

All data were obtained from open sources (Department of Health and Aging) and therefore no ethics approval was required.\textsuperscript{7,8,9} Data pertaining to Medicare items
related to dentistry (85011–87777) by general dentists were extracted from the Medicare Benefits Schedule online database for the calendar years 2007–09. Data (item codes) consisted entirely of numeric numbers which preserved patient and practice confidentiality. These item codes were consistent with industry practice of itemising treatment in accordance with the Australian Schedule of Dental Services and Glossary 2009. Data up to the calendar year of 2009 was chosen because this was the last year before an aggressive auditing campaign was initiated by the government. The audit involved a vocal campaign to target individual dentists and practices for inappropriate claims. As this may present a bias towards subsequent service provision, data after 2009 was not considered. Data for the allied health professions were extracted from the Medicare Benefits Schedule during the same period collating the item numbers 10950–10970.

In this study, as the data represented actual treatment (census data), there was no need for statistical inferences. As each practitioner was required to submit these item numbers to the Department of Health for processing before receiving payment, this study assumes that the pool of item numbers available online represented all treatment under the EPC.

All population data were based on the Australian Bureau of Statistics census data. All data analysis used Excel 97 (Microsoft Corp., Redmont, WA, USA).

**Results**

**Number of patients**

In dentistry, it is standard practice for each new patient to receive a comprehensive examination. An estimate of the number of patients seen in the CDDS can therefore be deduced from the item number relating to this service. In contrast, patients in the AHP scheme were entitled to up to five visits to see any allied health professional. Therefore the number of patients seen is at least one fifth of the overall number of services. In 2009, ~164 000 dental patients were seen in contrast to a range of 437,000–2,200,000 AHP patients. This represents a greater number of patients seen by AHP by a factor of ~3–13 bearing in mind that the AHP group consists of 13 different professions.
Jurisdictional breakdown

For all EPC services (AHP and CDDS), the highest proportion of treatment was provided in New South Wales (Table 1). Although New South Wales had increased utilisation of all services (AHP and CDDS), the use of dental services was significantly higher (Fig.1a.b). Dental services in this state accounted for 62% of CDDS services compared with 38% of AHP (Fig. 1 and Fig.2).

Table 1. Total number of items of all services provided by each health profession (2009)

<table>
<thead>
<tr>
<th>Allied health service</th>
<th>NSW</th>
<th>Vic.</th>
<th>Qld</th>
<th>SA</th>
<th>WA</th>
<th>Tas.</th>
<th>ACT</th>
<th>NT</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aboriginal health worker</td>
<td>62</td>
<td>7</td>
<td>71</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>16</td>
<td>156</td>
<td></td>
</tr>
<tr>
<td>Diabetes education</td>
<td>8453</td>
<td>20541</td>
<td>8249</td>
<td>3041</td>
<td>1910</td>
<td>1597</td>
<td>46</td>
<td>758</td>
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<tr>
<td>Audiology</td>
<td>275</td>
<td>214</td>
<td>76</td>
<td>63</td>
<td>130</td>
<td>15</td>
<td>6</td>
<td>779</td>
<td></td>
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<tr>
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<td>23452</td>
<td>8824</td>
<td>14903</td>
<td>6485</td>
<td>10679</td>
<td>1551</td>
<td>366</td>
<td>203</td>
<td>66463</td>
</tr>
<tr>
<td>Dietetics</td>
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<td>42454</td>
<td>38668</td>
<td>11407</td>
<td>14067</td>
<td>1510</td>
<td>650</td>
<td>563</td>
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<td>Mental health</td>
<td>1075</td>
<td>843</td>
<td>490</td>
<td>110</td>
<td>98</td>
<td>20</td>
<td>3</td>
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<td>2641</td>
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<tr>
<td>Occupational therapy</td>
<td>9425</td>
<td>6748</td>
<td>3368</td>
<td>1052</td>
<td>1922</td>
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<td>201</td>
<td>36</td>
<td>22896</td>
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<td>Physiotherapy</td>
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<td>196888</td>
<td>119157</td>
<td>42064</td>
<td>40045</td>
<td>5921</td>
<td>2932</td>
<td>902</td>
<td>699887</td>
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<tr>
<td>Podiatry</td>
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<td>272512</td>
<td>129537</td>
<td>100910</td>
<td>70082</td>
<td>20928</td>
<td>2026</td>
<td>1887</td>
<td>914715</td>
</tr>
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<td>32521</td>
<td>11555</td>
<td>5521</td>
<td>2858</td>
<td>1060</td>
<td>608</td>
<td>31</td>
<td>105829</td>
</tr>
<tr>
<td>Osteopathy</td>
<td>18904</td>
<td>27964</td>
<td>5289</td>
<td>133</td>
<td>433</td>
<td>1104</td>
<td>234</td>
<td>25</td>
<td>54086</td>
</tr>
<tr>
<td>Psychology</td>
<td>30390</td>
<td>1824</td>
<td>1491</td>
<td>236</td>
<td>340</td>
<td>106</td>
<td>82</td>
<td>26</td>
<td>7144</td>
</tr>
<tr>
<td>Speech pathology</td>
<td>39967</td>
<td>22069</td>
<td>12048</td>
<td>3035</td>
<td>5823</td>
<td>630</td>
<td>117</td>
<td>167</td>
<td>83856</td>
</tr>
<tr>
<td>Total allied health services</td>
<td>839747</td>
<td>635509</td>
<td>344902</td>
<td>174057</td>
<td>148387</td>
<td>34586</td>
<td>7277</td>
<td>4616</td>
<td>2187075</td>
</tr>
<tr>
<td>Dentistry</td>
<td>1933476</td>
<td>696209</td>
<td>222539</td>
<td>226128</td>
<td>17105</td>
<td>11782</td>
<td>12873</td>
<td>1512</td>
<td>3121624</td>
</tr>
</tbody>
</table>

Figure 1a. Number of services per capita by state in 2009

![Number of services per capita (per 100,00 population)](image_url)
Figure 1b. Total number of services expressed as percentage in 2009

<table>
<thead>
<tr>
<th></th>
<th>NSW</th>
<th>VIC</th>
<th>QLD</th>
<th>SA</th>
<th>WA</th>
<th>TAS</th>
<th>ACT</th>
<th>NT</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHP</td>
<td>38.4%</td>
<td>29.0%</td>
<td>15.8%</td>
<td>8.0%</td>
<td>6.8%</td>
<td>1.6%</td>
<td>0.3%</td>
<td>0.2%</td>
</tr>
<tr>
<td>CDSS</td>
<td>61.9%</td>
<td>22.3%</td>
<td>7.1%</td>
<td>7.2%</td>
<td>0.5%</td>
<td>0.4%</td>
<td>0.4%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

Figure 2. Proportion of allied health activity expressed as percentage of total by state in 2009

Proportion of Allied Health Activity as percentage of total by state

- Dentistry
- Speech Pathology
- Psychology
- Osteopathy
- Chiropractic
- Podiatry
- Physiotherapy
- Occupational Therapy
- Mental Health
- Dietetics
- Exercise Physiology
- Audiology
- Diabetes Education
- Aboriginal Health Worker

Legend:
- NSW
- VIC
- QLD
- SA
- WA
- TAS
- ACT
- NT
Across the EPC, the jurisdictions of New South Wales, Northern Territory, Australian Capital Territory and Western Australia recorded utilisation rates beyond their anticipated rates when adjusted for population differences (Table 2). New South Wales had uniformly exceeded its population size-expected services across most professions whilst Northern Territory, Australian Capital Territory and Western Australia underutilised the schemes.

Table 2. Net proportion (%) of allied health activity adjusted for population to assess degree of utilisation by jurisdiction

<table>
<thead>
<tr>
<th>Allied health service</th>
<th>NSW</th>
<th>Vic.</th>
<th>Qld</th>
<th>SA</th>
<th>WA</th>
<th>Tas.</th>
<th>ACT</th>
<th>NT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aboriginal health worker</td>
<td>7.3</td>
<td>-20.3</td>
<td>25.3</td>
<td>-7.4</td>
<td>-10.2</td>
<td>-2.3</td>
<td>-1.6</td>
<td>9.2</td>
</tr>
<tr>
<td>Diabetes education</td>
<td>-13.5</td>
<td>21.2</td>
<td>-1.7</td>
<td>-0.6</td>
<td>-6.0</td>
<td>1.3</td>
<td>-1.5</td>
<td>0.7</td>
</tr>
<tr>
<td>Audiology</td>
<td>2.8</td>
<td>2.7</td>
<td>-10.4</td>
<td>0.7</td>
<td>6.4</td>
<td>-0.4</td>
<td>-0.8</td>
<td>-1.0</td>
</tr>
<tr>
<td>Exercise physiology</td>
<td>2.8</td>
<td>-11.5</td>
<td>2.2</td>
<td>2.4</td>
<td>5.8</td>
<td>0.1</td>
<td>-1.1</td>
<td>-0.7</td>
</tr>
<tr>
<td>Dietetics</td>
<td>8.1</td>
<td>-1.7</td>
<td>0.8</td>
<td>-1.2</td>
<td>-2.6</td>
<td>-1.5</td>
<td>-1.2</td>
<td>-0.7</td>
</tr>
<tr>
<td>Mental health</td>
<td>8.2</td>
<td>7.1</td>
<td>-1.6</td>
<td>-3.2</td>
<td>-6.5</td>
<td>-1.5</td>
<td>-1.5</td>
<td>-1.0</td>
</tr>
<tr>
<td>Occupational therapy</td>
<td>8.7</td>
<td>4.7</td>
<td>-5.5</td>
<td>-2.8</td>
<td>-1.9</td>
<td>-1.7</td>
<td>-0.7</td>
<td>-0.9</td>
</tr>
<tr>
<td>Physiotherapy</td>
<td>9.2</td>
<td>3.3</td>
<td>-3.2</td>
<td>-1.4</td>
<td>-4.5</td>
<td>-1.4</td>
<td>-1.2</td>
<td>-0.9</td>
</tr>
<tr>
<td>Podiatry</td>
<td>2.2</td>
<td>5.0</td>
<td>-6.0</td>
<td>3.7</td>
<td>-2.6</td>
<td>0.0</td>
<td>-1.4</td>
<td>-0.8</td>
</tr>
<tr>
<td>Chiropractic</td>
<td>16.4</td>
<td>5.9</td>
<td>-9.3</td>
<td>-2.2</td>
<td>-7.5</td>
<td>-1.3</td>
<td>-1.0</td>
<td>-1.0</td>
</tr>
<tr>
<td>Osteopathy</td>
<td>2.5</td>
<td>26.9</td>
<td>-10.4</td>
<td>-7.1</td>
<td>-9.4</td>
<td>-0.2</td>
<td>-1.2</td>
<td>-1.0</td>
</tr>
<tr>
<td>Psychology</td>
<td>10.1</td>
<td>0.7</td>
<td>0.7</td>
<td>-4.1</td>
<td>-5.5</td>
<td>-0.8</td>
<td>-0.5</td>
<td>-0.7</td>
</tr>
<tr>
<td>Speech pathology</td>
<td>15.2</td>
<td>1.5</td>
<td>-5.8</td>
<td>-3.8</td>
<td>-3.3</td>
<td>-1.5</td>
<td>-1.5</td>
<td>-0.8</td>
</tr>
<tr>
<td>Dentistry</td>
<td>29.5</td>
<td>-2.5</td>
<td>-13.1</td>
<td>-0.1</td>
<td>-9.7</td>
<td>-1.9</td>
<td>-1.2</td>
<td>-1.0</td>
</tr>
</tbody>
</table>

Value of care per patient

The value of care per patient in dentistry was significantly higher when compared to AHP. Estimated value of care per patient in dentistry ranged from $1900 in the Northern Territory to $2900 in New South Wales. In contrast, the cost to see an AHP per patient ranged from $59 to $279. The cost of dentistry in enhanced primary care was ~40 times more expensive compared to AHP under the EPC funding schedule.
Cost of enhanced primary care per profession

The cost of treatment for patients with complex or chronic needs based on the utilisation of a particular allied health profession is shown in Fig. 3. Costs of dental services to enhanced primary care were over three times more expensive than all AHP services combined. Most of the costs associated with dental care involved prosthodontic (reconstructive) services such as crown, bridges, implants and dentures. These intensely procedural services to rehabilitate or replace missing teeth accounted for over two thirds of CDDS expenditure. This form of treatment is different to the type of care provided by the majority of AHPs, which tended to be more manipulative, educative and palliative. For example, the predominant itemised activities in physiotherapy focused on the therapeutic manipulation of the muscles, or in podiatry where wound care and debridement of feet affected by diabetes was common.

Figure 3. Total estimated cost of enhanced primary care per allied health profession

<table>
<thead>
<tr>
<th>Cost of Enhanced Primary Care per Allied Health Profession (2009)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aboriginal Health...</td>
</tr>
<tr>
<td>Audiology</td>
</tr>
<tr>
<td>Mental Health</td>
</tr>
<tr>
<td>Psychology</td>
</tr>
<tr>
<td>Occupational Therapy</td>
</tr>
<tr>
<td>Diabetes Education</td>
</tr>
<tr>
<td>Osteopathy</td>
</tr>
<tr>
<td>Exercise Physiology</td>
</tr>
<tr>
<td>Speech Pathology</td>
</tr>
<tr>
<td>Chiropractic</td>
</tr>
<tr>
<td>Dietetics</td>
</tr>
<tr>
<td>Physiotherapy</td>
</tr>
<tr>
<td>Podiatry</td>
</tr>
<tr>
<td>Dentistry (GP only)</td>
</tr>
</tbody>
</table>

Non-surgical comparison

The cost involved with preventive dentistry in isolation seems to be comparable to AHP expenditure (Figure 4). Preventive dentistry includes examining the oral
cavity, providing specific oral hygiene instructions, placing fluoride, sealing teeth and removing (debridement) plaque to prevent caries and periodontal disease. This type of treatment is similar to treating a foot ulcer in podiatry, where emphasis is towards plaque removal, debridement, wound care and diabetes education. This comparison shows that the cost associated with preventing and managing disease, the stated aim of the EPC, to be comparable despite differences in funding mechanisms.

Figure 4. Cost of preventive dentistry against the most prominently featured AHPs

![Comparison of Preventive Dentistry with selected AHPs](chart)

Services by sex and age
In all EPC services, dentistry recorded the narrowest distinction between genders across all age groups (Fig 5a.b). The allied professions of podiatry, physiotherapy and dietetics accounted for over 80% of AHP services and had a gender discrepancy favouring females by a ratio of 64% to 36%. In contrast, dentistry which had the majority of expenditure in reconstruction, had a gender utilisation slightly favouring females (54% to 46%). Common to all professions, the predominant age group utilising the EPC consisted of patients over 55 years of
age. This confirms that chronic diseases are predominantly diseases in the elderly, accounting for over two thirds of EPC expenditure.

Figure 5a. Gender and Age Demographic of CDDS patients (2009)

![Gender and Age Demographic of CDDS patients (2009)](image1)

Figure 5b. Age comparison and use of services (2009)

![Age comparison and use of services (2009)](image2)
Cost of enhanced primary care over time

Utilisation of the dental component did not meet expectations when it was introduced to the EPC. Initially, the EPC provided a dental subsidy of $220/year/patient compared to a total of $160/year/patient shared among the 13 allied health professions.\textsuperscript{1,12} The number of dental services totalled 16,400 (total number of item codes) which was significantly below government expectations.\textsuperscript{1} Although the government argued that reconstructive services were not necessary as this was a “health initiative” rather than a dental scheme, their stance changed.\textsuperscript{13} Responding to calls from dental groups and concerns that the scheme would not improve chronic conditions from the low level of utilisation; reconstructive services were allowed as well as a significant increase in subsidy. This resulted in the provision of crowns, dentures, implants and bridges with an increase in dental subsidy to $4250 per two consecutive calendar years. During this time, the AHP’s only received modest CPI increases to ~$63 per visit.

These changes resulted in an increase of over 13350\% in expenditure for dental services with the cost for general dentistry ~$227 million in 2008. Reconstructive services accounted for over two thirds of total CDDS expenditure in 2008 where it was previously less than half in the preceding years. Most of these reconstructive dental services were disproportionately provided in New South Wales, accounting for over half of total CDDS expenditure. Changes to CDDS subsidy made a significant difference to EPC expenditure between the two streams.

Discussion

The objective of this study was to examine the effects of health expenditure and the provision of certain services under different funding mechanisms. As both the CDDS and AHP were part of the over-riding EPC scheme that targeted medically compromised individuals referred by GPs, this study provided an insight into how different ways of financing services affected health expenditure and budgeting. The CDDS was based on a fee per service schedule as opposed a fee per visit schedule for AHP.
Limitations
In comparing these funding schedules, it must be noted that the EPC did not prohibit clinicians from charging beyond the level of subsidy for each stream. In these circumstances, patients incurred an out of pocket expense (co-contribution). These expenses were not recorded in the Medicare database and varied between each practice. Therefore, the true cost of EPC is higher than these reported values. Despite this, this would not affect the focus of this study because emphasis was on how the government’s commitment and budget was affected by their pre-determined levels of subsidy. However, any consideration on clinical outcomes and cost-benefit from the EPC (beyond the scope of this study) would need to be mindful of an unquantifiable level of co-contribution from patients.

Furthermore, it must be acknowledged that item codes from the database were retrospective and represented treatment completed rather than the circumstances for such treatment. As it stands, these item codes provide no clues to success rates or how conditions improved over time. With this in mind, data linkage or linking clinical outcomes to item codes is an area that needs further investigation.

Even if these item codes were related to clinical outcomes, it was unlikely that any meaningful conclusions could be drawn at this time because the EPC represented new policy to tackle conditions that were longstanding and progressive (short timeframe of study; 2007-2009).

As the dataset consisted of numeric codes, the study was unable to quantify which chronic conditions were referred by GP’s. As such, the study assumed no new disease emerged during the study period that would change visiting patterns to health professionals. Information obtained from state and national health authorities show that cardiovascular, oral, pulmonary, diabetic and renal diseases feature consistently as the most predominant diseases in Australia.5, 14 These conditions account for a significant portion of national health expenditure.5, 14 There was also no evidence to suggest that chronic disease patterns in the state of New South Wales differed significantly to the other jurisdictions despite having the greatest utilisation.
This study also assumes that the dataset was collated accurately by the third party (Department of Health, Medicare Australia).

Patterns of care
It is interesting to observe that dentistry exhibited the narrowest gender disparity in the EPC where costs in reconstructive dentistry were high. This supports the premise that males were less likely to be proactive in seeking care, resulting in deteriorating dentitions that required extensive treatment. Despite this, preventive dental services such as saliva testing remained low among both genders indicating that there may be other factors influencing service provision.

An important observation was that when preventive services were isolated from other dental services, CDDS expenditure was comparable to AHPs. This indicates that a Fee per Service schedule can be sustainable if it has a preventive focus. This observation also provides clarity to governments that dentistry can be sustainable under Medicare if services were more primary health focused. This calls to question the excessive costs in providing aesthetic dental crowns especially when there is no strong evidence to suggest any significant improvement in health. Other than reinforcing weakened teeth, crowns have little impact towards minimising the prevalence of caries and periodontal disease.

Utilisation of the EPC showed a consistent pattern between jurisdictions. Adjusting for population differences (per capita), it seems that the EPC was either overutilised or underutilised across jurisdictions. This trend was also observed when per capita values for the professions (value charged per health provider) were compared. The size of the workforce and the amount of health service infrastructure may have resulted in fewer services in rural and remote regions of Western Australia and Northern Territory. Although subsidy was provided for treatment, access to EPC services was still reliant the availability of health professionals. No EPC funding was allocated to incentivise health professionals to relocate to areas of greater need. In other jurisdictions, reports suggested that practitioners were actively asking patients to obtain GP referrals. Palferman and Zoellner noted that dental practices and local associations in New South Wales were very active in promoting and marketing the CDDS.
Sydney recorded the highest utilisation of the scheme, especially in the provision of reconstructive services.\textsuperscript{18} This highlights an important policy relevant observation. Managing diseases do not necessarily reflect the density of services (infrastructure and professionals) available to treat them. The availability of services tends to vary inversely with the need of the population served.

Although the AHP stream did not experience a surge in cost and utilisation, it was not without criticism. Many of the allied health professions argued that the limited number of visits, which totalled five, were inadequate to provide adequate care for essentially illnesses that were deteriorative and progressive.\textsuperscript{12} This prompted calls to extend the number of visits, especially when patients were seeing more than one allied health professional.

These observations raise a very interesting question. Why is dentistry different as an allied health profession? It has been shown that preventive dentistry is comparable in cost to the AHP stream despite differences in funding mechanisms (\textit{fixed fee per visit} versus \textit{fee per service}). Although the initial subsidy for dental services ($220/year) was comparable to the AHP rate, dentistry did not experience the same level of utilisation. This is remarkable given that preventable oral disease in caries and periodontal disease are the two most prevalent diseases in the community.\textsuperscript{3}

\textbf{The influence of remuneration on service provision}

Given that chronic diseases remain progressive over time, the significant increase in CDDS expenditure in the narrow study period of 2007-2009 suggests other factors driving utilisation. These outcomes may be related to how dental services are funded, who is responsible for paying and the level of remuneration to service providers. The provision of crowns has the potential to make up a significant part of a dentists’ income and therefore represents a financial incentive to provide this service.\textsuperscript{19,20}

The expanded measures in the CDDS saw a significant change in the mix of care compared to the initial EPCDS. With the initial EPCDS subsidy at $220/year, many patients were unable to afford or accept the \textit{out of pocket} expenses for crowns and other reconstructive services. As a guide, a survey indicated that one
in five adults expressed difficulty in paying a $120 health bill. With the average cost for a crown at approximately $1300, it is unsurprising that few crowns were fabricated prior to the CDDS. This changed when the increase in subsidy provided greater opportunity to fabricate crowns which coincided with more active promotion by dentists to utilise the scheme. By shifting the burden of payment to health policy, more expensive treatment options were presented by dentists that were more readily accepted by patients. This resulted in the reported increases in CDDS expenditure which eventually became unsustainable. This is an important observation because many private dental practices operate with high autonomy and the freedom to pursue certain forms of dentistry. It is not surprising in a free market economy for private dental practices to focus on aspects of dentistry which are more rewarding. This highlights the adverse effects of health policy in the current private practice environment.

These circumstances pose a major challenge to governments and policy makers in improving access to dentistry. Historically, the majority of the workforce have operated in the private sector with little government assistance. Most dental practices over time have become restoratively focused because this represents a major source of income. It is therefore unsurprising that without financial incentives, private practices may be unwilling to change their service delivery.

While AHP’s also have clinical freedom, their expenditure was more modest and sustainable. This is attributable to a fee per visit rather than a fee per service schedule. The former represented a level of capped level of service while the latter provided an incentive to provide more services as this directly correlated to revenue. The problems with cost containment and the selection of high end services in the CDDS is an example of the economic principle “moral hazard” and “adverse selection” described by various health economists. Observations from this study suggest that simply increasing the level of health funding does not necessarily result in services that improve health.
Conclusion
A comparative analysis of the two EPC streams in the CDDS and the AHP demonstrates the effect of different funding mechanisms on health expenditure. A fee per service schedule in the CDDS had greater problems with cost containment. Where there is a financial incentive for treatment, there may be a tendency to focus on particular forms of treatment. This was observed with the provision of dental crowns which accounted for the majority of CDDS expenditure, confirming previous government reservations that dentistry may be too expensive for Medicare. Allocating more money into health policy does not necessarily improve health as treatment may not always be focussed on prevention and disease control. When there is a financial incentive to provide certain types of treatment and by shifting the burden of payment from the patient to a third party, there is a risk that costs may be uncontrollable. This is an important policy relevant effect to consider in future policies. Although not without criticism, the fee per visit schedule in the AHP schedule was more modest and sustainable. Its mix of care was more therapeutic and preventative rather than reconstructive/procedural with a higher proportion of females seen. Despite the differences in the CDDS, the cost in preventive dentistry alone has shown to be comparable to allied health services. This indicates that reducing the burden of oral disease at the population level is economically viable. However, the problem with dentistry is of two extremes. When initial subsidy in the EPCDS was modest, its utilisation was low in private practice. When crowns became allowable, the program became too expensive and unsustainable. Why is dentistry different and how to make dental policy work?
References


18. Palfreeman V, Zoellner H. Description of comprehensive dental services supported by the Medicare Chronic Disease Dental Scheme in the first 23 months of operation. Aust N Z J Public Health 2012; 36: 69-75.


CHAPTER 3: Dental demystification: A retrospective analysis of patterns of care under the Chronic Disease Dental Scheme.

Abstract

Objective: The first aim of this study is to provide a review of dental services in general dentistry and how each discipline contributes to oral health. This will provide a context for health managers to appreciate patterns of care and expenditure under the Chronic Disease Dental Scheme (CDDS).

Methods: A retrospective analysis of data pertaining to Medicare items related to the general dentistry (85011-87777) were extracted from the Medicare Benefits Schedule database (MBS) online for years 2007-2012, and formed the basis for this study. A similar search was repeated for item codes 88000, belonging to another Medicare program known as the Teen Dental Plan (TEEN).

Results: Approximately 420,000 patients were seen under the CDDS representing ~2% of the Australian Population and costing over $1.2 billion AUD during 2007-2010. Based on number of services, the most frequent services were restorative, diagnostic, and prosthodontic. Females tended to be more proactive with higher return visits and tended to place greater emphasis on aesthetics. Males tended to have more teeth extracted and had more metallic restorations. Almost all fillings (96%) were white aesthetic fillings compared to metallic amalgams. The types of restorative and reconstructive services varied between jurisdictions. Other interventional procedures such as orthodontics showed a steady increase in services. Preventive procedures such as saliva testing were infrequent compared to the provision of aesthetic crowns and bridges.

Conclusion: Despite its stated aim towards prevention and disease control, the patterns of care and expenditure in the CDDS tended to be restoratively focused. Although the TEEN Dental plan offered free preventive services, the number of visits declined. Oral health policies need additional measures to ensure that patterns of care are appropriate and sustainable. There is a need for greater emphasis on prevention but the challenge is in the private practice environment where financial incentive appears to be a driver for service provision.
Introduction

It has been estimated that over one third of problems encountered in medicine are chronic, responsible for over 80% of the total disease burden and form a significant part of health expenditure.\textsuperscript{1,2} Among these conditions, oral diseases in the form of caries and periodontal disease are the most prevalent.\textsuperscript{3,4} These two diseases combined have placed a significant strain on the entire health system with an economic burden second only to cardiovascular disease.\textsuperscript{3,5} An acute toothache has also been described as one of the most painful medical conditions that one can experience. It is one of few conditions that will make even the most hardened and reluctant individual seek professional care.\textsuperscript{4} As such, there is little doubt that the key to improving general health lies in tackling the issues with oral disease.

In response to this growing problem, the Commonwealth Government established an initiative known as the Enhanced Primary Care Scheme (EPC) to manage chronic diseases. The EPC represented unprecedented policy as it provided Medicare rebates for many health services that were previously excluded. Among these services, dentistry was included as a branch of the EPC and eventually became known as the Chronic Disease Dental Scheme (CDDS). The government stated that the \textit{primary purpose of the CDDS is to improve oral health and function, not for paid dental services that were cosmetic in nature}.\textsuperscript{6} Eligibility to the scheme was entirely clinically based which required a doctor (GP) to endorse a condition as being chronic or complex. Shortly after the CDDS, the Commonwealth Government implemented another policy known as the Medicare Teen Dental Plan (TEEN). Unlike the CDDS, the TEEN had automatic eligibility for teenagers (12-16 years of age) who met financial criteria. The scheme was limited to diagnostic and preventative services. With renewed interest in the importance of oral health, unprecedented moves to include dentistry under Medicare, and a focus towards prevention and disease control, it seems that the government, on the policy side, was determined to deal with oral disease.

A preliminary analysis of the CDDS by Lam \textit{et al} at the population level identified many issues with utilization and cost.\textsuperscript{7} It was reported that the CDDS was unsustainable with a 13350% increase in cost after initial problems with low utilization.\textsuperscript{7} This problem appeared to be confined to dentistry as other allied
health professions were within budget. Unexpectedly, the CDDS became the most expensive dental initiative in Australian history with spending exceeding $1 billion dollars in less than two years when it was budgeted for $385 million over four years. This led to a series of reactionary measures to control costs including an aggressive auditing campaign by the Department of Health to recoup funds from practitioners identified to have misused the scheme. There were also several unsuccessful attempts to close the scheme in the upper house of parliament. These problems drew many stakeholders and professional associations but unfortunately negotiations stalled at a stalemate. There was no consensus as to how national oral health policy should be introduced and in what form. A senate inquiry was eventually launched by the Government to investigate the adverse effects and the problem of cost containment in the CDDS.

A key finding of the inquiry was that there was a misunderstanding between health managers and the dental profession in the way oral health policy should be structured. The Australian Dental Association, representing 90% of the workforce with the majority in private practice, criticized policy makers for not involving them with developing CDDS policy. On the flip side, the inquiry highlighted that policy makers did not understand the factors influencing the provision of dental services. With newer technologies, more engaging marketing strategies and the increasing social value of appearance, it is more difficult to discern the difference in dentistry as a primary health service as opposed to a cosmetic commodity. This makes it difficult to draft policies focused on primary health which has no doubt contributed to problems in the CDDS. Within three years of operation, the scheme saw extremes in the level of utilization and kneejerk changes to subsidy and scope of services. Despite these efforts, the CDDS eventually came to closure in 2013 at an unprecedented cost and left many existing patients without a dedicated oral health policy.

Given these concerns, the primary objective of this study is demystify dentistry to health managers and policy makers by reviewing the disciplines of general dentistry and how they contribute to the aims of the CDDS. These observations would be relevant to any future policies focused on prevention and primary dental care. By appreciating how these disciplines contribute to health policy, the secondary objective, which is to report on patterns of care, can be appreciated
from a more informed position. As the most expensive Australian dental initiative, a retrospective analysis of the CDDS is necessary not only for accountability, but to ensure that future policies can be better formulated. Stated differently, what dental services were provided under the CDDS and how did this contribute to the ultimate objectives of the EPC in managing patients with complex and chronic conditions?

Methods
The first section is a review using search words relating to the main disciplines of dentistry. According to The Australian Schedule of Dental Services and Glossary, this consisted of (i) diagnostic, (ii) preventive, (iii) periodontics, (iv) oral surgery, (v) endodontic, (vi) restorative, (vii) prosthodontic (reconstructive) (ix) orthodontic and (x) general. The study cross referenced these disciplines with the search words “quality of life”, “disease management”, “stabilization”, “prevention”, “perceived benefit” and “clinical outcomes” in major electronic databases such as Medline (PubMed), Cochrane and the SSCI (Social Citation Index). This provided a perspective (cost-benefit) of how each area potentially contributed to the aims of the CDDS.

The remainder and main emphasis of this study involved a quantitative analysis of services funded under the CDDS to provide an insight into patterns of care.

All data were obtained from open sources. The data consisted of item codes that corresponded to a single act of treatment according to ‘The Australian Schedule of Dental Services and Glossary’. The use of item codes according to this schedule was consistent with industry practice. As these item codes were entirely numeric, there were no issues with privacy or confidentiality. As the Department of Health collates these item codes into categories, it was not possible to correlate these codes to a particular individual or practice location. Typically, a course of treatment averages 2-3 item codes per visit. As such, data pertaining to Medicare item codes related to dentistry (85011-8777) by general dentists (excluding specialists and prosthodontists) were extracted from the Medicare Benefits Schedule Database (MBS Online) for the calendar years 2007-2012. A similar search was repeated for item codes 88000, belonging to another Medicare program known as the TEEN Dental Plan during the same period. The search
yielded approximately 9 million item codes that formed the basis of the study. It must be noted that these item codes represented all treatment provided under the CDDS (census data). As such, there was no requirement for statistical inferences or sampling. Comparisons between jurisdictions were made based on data obtained from the 2009 Australian Bureau of Statistics. Dentist numbers for each jurisdiction were obtained from the Australian Institute of Health and Welfare. Cost calculations were completed using the 2009 Department of Veteran Affairs-based dental fees. The data were extracted, exported and analysed in Excel 97 (Microsoft Corp Redmont WA). Figure 1 relating to net utilisation of the CDDS was formulated based on considering the weighted average (by population) of each jurisdiction compared to the national average based on gross population.

**Rationale for Dental Services- How the main areas of general dentistry in the CDDS contribute to primary health care**

For as long as records existed, the concept of a tooth worm, which according to popular and superstitious belief, caused caries and periodontal disease, has existed across many diverse cultures and ages. The discovery of the microscope was a pivotal moment in health care as it stimulated scientific rigor that led to studies implicating plaque as the cause of most dental diseases. Dental plaque is a structured and gelatinous consortium of bacteria that adhere to the soft and hard tissues of the oral cavity using chemical receptors present in saliva (pellicle). Certain groups of bacteria, such as the *Streptococcus Mutans* group, become part of a biofilm (organized ecosystem of bacteria) and produce acids during their metabolism. These acids under certain pH conditions are capable of dissolving and weakening teeth, thereby causing a cavity. A classical study by Kakehashi et al also implicated bacteria as causing nerve pain (pulpitis) as these biofilms become more complex as they progress within the tooth and beyond the confines of the oral cavity. These mechanisms are similar in periodontal disease where plaque attaches to the gums, matures and triggers a host of chemicals in the body to cause bystander (self induced) damage to the periodontum (bone and gums). Together, these conditions account for the majority of oral diseases, which are the most common illnesses affecting the community.
Preventive dentistry is considered as the cornerstone of primary health dentistry by the World Health Association. This view is consistent with the Australian Department of Health which considers primary health care as the first point of contact for consumers to manage their needs to stay as healthy as possible. This field of dentistry involves a comprehensive examination of the oral cavity, educating and formulating a custom oral hygiene plan and professionally removing plaque from the teeth and gums. Instrumental studies by Loe and Featherstone have demonstrated that caries and periodontal disease can be prevented, treated and cured. This has changed the practice of dentistry where extractions of teeth were more common in the past. Regular attendance to a dental professional to remove plaque (scale and clean) has shown a reversal of gingivitis, the precursor for periodontal disease, to a condition of health within days. In a Cochrane Review by Darby, up to sixty percent of plaque may be left behind by individuals during their daily brushing. However, plaque maturity is often slow, enabling the dentist to remove plaque before it can reach a threshold where irreversible changes occur. In other words, the process by which biofilms become organized and complex is a slow chronic process and is amenable to mechanical disruption. This highlights the importance of regularly visiting the dentist. Similarly, teeth with initial carious lesions can be replenished without the need for drilling and placing a filling. Many of these modern methods can be attributed to the greater understanding and appreciation of saliva and its role in remineralisation. Remineralisation is the process whereby minerals are deposited on tooth surfaces via a concentration and pH gradient. Many new topical products containing fluoride, hydrogen peroxide and complexes of calcium and phosphate have been demonstrated to assist in this process through the medium of saliva. With its ability to buffer acids and be supra-saturated with minerals, saliva is the most important ingredient in preventing caries and maintaining of oral function. Assessing the condition of saliva is therefore an essential component of preventive dentistry as its quality is influenced by systemic conditions (ie-diabetes) and poly-pharmacy (medication induced dry mouth).

With this in mind, it is clear that the emphasis of any oral health policy should be towards regular attendance with a primary health focus (preventive dentistry). Remarkably, this is all that is needed to reduce the high burden of oral disease in
the community. These benefits not only translate to improved oral health but an increasing number of studies have linked an association between dental plaque and many systemic diseases. The currently accepted view is that oral plaque is a significant modifier (stressor) to many systemic illnesses throughout the body.

Despite the benefits of preventive dentistry, the majority of practice activity is focused around restorative care. This is the branch of dentistry involved with restoring/repairing cavities in decayed teeth. As caries is progressive and slow, the point where teeth require fillings is a late stage of the disease process. However, it must be noted that an increasing number of teeth are also filled for cosmetic reasons in the absence of disease. Although placing a filling into a cavity restores form and function, it does not address the disease process which has caused the problem. As an isolated procedure without a preventive focus, once a tooth receives a filling, it enters a predictable cycle of restorative dentistry. In this cycle, fillings get progressively larger to the point where there may be nerve pain (toothache/pulpitis) requiring more expensive and extensive dentistry such as endodontics (root canal therapy treating the tooth nerve). Small to medium size filings (subjective to each dentist) are often called direct restorations because the filling is placed directly into the prepared cavity of the tooth. Among these fillings, amalgam (metal) fillings have demonstrated the longest history of use and longevity over white fillings (composite resins) and are less prone to fracture.

The cycle of restorative dentistry typically leads to a situation where there is insufficient tooth structure remaining to support a direct restoration. This leads to more extensive treatment in the field of prosthodontics (reconstructive dentistry) where indirect restorations (large fillings made outside of the mouth and inserted into the cavity) are used to replace missing teeth. The most common indirect restoration is a dental crown, which is like a 360 degree circumferential and encompassing filling that acts like a cap or ‘helmet’ over the remaining tooth. It is cemented and fixed to the tooth unlike a denture (removable prosthesis) which can be taken out of the mouth. One purpose of a crown is to protect weakened teeth due to its encompassment. However, an increasing number of crowns are also fabricated for aesthetic reasons as complete coverage over the tooth allows for greater changes (shape, contour and colour of tooth) to improve aesthetics. Dental crowns can either be metal (gold), ceramic or a hybrid (porcelain fused to
metal). Gold crowns have demonstrated the longest longevity because they do not require as much tooth removal during its preparation and the material is less prone to fracture.\textsuperscript{33} Despite these benefits, there is no conclusive evidence to demonstrate that crowns improve oral health and the improvement in quality of life is questionable.\textsuperscript{34,35} Crowns also have the potential to increase plaque retention as they are normally cemented with its margin around the gumline; an area that is usually difficult to clean. Selwitz noted that restorative procedures do not target or arrest the disease process and without plaque control, the longevity of crowns are compromised.\textsuperscript{36} There is also a biological cost in placing a crown. Saunders and Saunders indicated that one fifth of teeth prepared for crowns (from extensive drilling) develop necrotic nerves within five years, increasing the chances of infection and requiring further treatment such as root canal therapy.\textsuperscript{37} This has been identified as a major problem in recent cases involved in litigation as aesthetic smile makeover cases involving the crowning of multiple teeth may result, on the balance of probabilities, in unexpected complications. Other prosthodontic services such as bridges (multiple crowns fused together on either side of the space left by a missing tooth) or implants (titanium screws into the jawbone with a crown) also restores function by providing a substitute for missing teeth. Despite being the most dominant activity in general practice and its high cost, restorative dentistry has little contribution to improving health.\textsuperscript{30,36}

Orthodontics is the area of dentistry concerned with correcting malocclusions (irregularities) of the teeth and jaws using pressure placing devices on teeth such as braces. The mean time for wearing braces is typically around 12 to 18 months. The literature reports an increased prevalence of malocclusion in people with mental, physical and developmental disabilities.\textsuperscript{38} Despite this, malocclusion is not a disease or life threatening condition.\textsuperscript{39} Even without orthodontic treatment, malocclusions remain relatively stable during life.\textsuperscript{40} It has long been recognized that patients seek this form of treatment not because of anatomic irregularities or disease prevention, but rather due to the social consequences of aesthetic impairment caused by malocclusion.\textsuperscript{39} There is no conclusive evidence to suggest an association between orthodontic treatment and common systemic illnesses such as cardiovascular disease or diabetes.\textsuperscript{39} Controversy exists about the relationship between orthodontics and quality of life.
Results
Based on standard practice where each new patient receives a comprehensive examination (item code 011), the number of CDDS patients during 2007-2010 was estimated at approximately 460,000 (2% Australian Population) with a gender discrepancy favoring females (54%) compared to males (46%). As 7 million Australians are estimated to have one or more chronic conditions, the CDDS represented ~6% of the medically compromised cohort. Over 9 million dental services (sum of item codes) at ~$1.2 billion during this 4 year period were provided with the predominant number of services being restorative (25%), diagnostic (23%) and prosthodontic (19%).

Based on population adjusted statistics, discrepancies in utilisation were compared between jurisdictions. It appears that services in New South Wales were overutilised whilst all other jurisdictions were underutilised (Figure 1). This was also reflected in cost, with the majority of expenses claimed in NSW (62%). Of these expenses, restorative and prosthodontic services (crowns) accounted for approximately two thirds of NSW expenditure. Crowns also represented the majority of CDDS expenditure at the national level.
Figure 1: Utilisation based on jurisdiction

<table>
<thead>
<tr>
<th>State</th>
<th>Net Utilisation of CDSS 2007-2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSW</td>
<td>28.4%</td>
</tr>
<tr>
<td>VIC</td>
<td>-2.5%</td>
</tr>
<tr>
<td>QLD</td>
<td>-11.1%</td>
</tr>
<tr>
<td>SA</td>
<td>-1.2%</td>
</tr>
<tr>
<td>WA</td>
<td>-9.5%</td>
</tr>
<tr>
<td>TAS</td>
<td>-1.9%</td>
</tr>
<tr>
<td>ACT</td>
<td>-1.2%</td>
</tr>
<tr>
<td>NT</td>
<td>-1.0%</td>
</tr>
</tbody>
</table>

Notes:
1) The number of services in each jurisdiction adjusted for differences in population
2) + : overutilization based on relative population of jurisdiction
   - : underutilization based on relative population of jurisdiction

Using the standard ADA schedule for classifying services and adjusting for differences in population, Table 1 demonstrates how treatment patterns varied between jurisdictions. A higher number of teeth in New South Wales were restored with full coverage crowns. Treatment in this state saw a higher number of endodontic (root canal) and prosthodontic options with fewer extractions of teeth (oral surgery). As such, a higher number of heavily restored or questionable teeth tended to receive attempts at reconstruction rather than extraction. Queensland had the highest rates of restorative services (fillings) but many of these teeth were not crowned. Preventive services were low by comparison in Western Australia and Northern Territory with higher rates of extractions. Dentures featured highly in Northern Territory indicating that many questionable teeth tended to be removed rather than attempting extensive dentistry to rehabilitate teeth.
<table>
<thead>
<tr>
<th>Treatment Category</th>
<th>NSW</th>
<th>VIC</th>
<th>QLD</th>
<th>SA</th>
<th>WA</th>
<th>TAS</th>
<th>ACT</th>
<th>NT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic Services</td>
<td>1.6%</td>
<td>-0.9%</td>
<td>0.3%</td>
<td>0.2%</td>
<td>0.0%</td>
<td>-2.3%</td>
<td>4.0%</td>
<td>-2.8%</td>
</tr>
<tr>
<td>Preventive Services</td>
<td>0.4%</td>
<td>0.4%</td>
<td>0.9%</td>
<td>1.4%</td>
<td>-3.6%</td>
<td>2.3%</td>
<td>-0.6%</td>
<td>-1.4%</td>
</tr>
<tr>
<td>Periodontics</td>
<td>0.6%</td>
<td>0.8%</td>
<td>-0.2%</td>
<td>-0.8%</td>
<td>-0.2%</td>
<td>-1.7%</td>
<td>0.9%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Oral Surgery</td>
<td>-3.3%</td>
<td>-2.0%</td>
<td>-1.3%</td>
<td>-3.1%</td>
<td>3.3%</td>
<td>4.3%</td>
<td>-0.2%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Endodontics</td>
<td>0.7%</td>
<td>0.1%</td>
<td>0.3%</td>
<td>0.1%</td>
<td>-0.3%</td>
<td>-0.6%</td>
<td>-0.1%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Restorative Services</td>
<td>-2.8%</td>
<td>0.0%</td>
<td>4.1%</td>
<td>1.3%</td>
<td>-1.3%</td>
<td>-3.1%</td>
<td>0.6%</td>
<td>1.2%</td>
</tr>
<tr>
<td>Crown and Bridge</td>
<td>2.2%</td>
<td>0.5%</td>
<td>0.0%</td>
<td>-0.8%</td>
<td>0.5%</td>
<td>-0.1%</td>
<td>0.3%</td>
<td>-2.6%</td>
</tr>
<tr>
<td>Prosthodontics</td>
<td>0.7%</td>
<td>0.9%</td>
<td>-4.1%</td>
<td>2.2%</td>
<td>1.6%</td>
<td>1.4%</td>
<td>-4.8%</td>
<td>2.1%</td>
</tr>
<tr>
<td>Orthodontics</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>General Services</td>
<td>-0.2%</td>
<td>0.1%</td>
<td>0.0%</td>
<td>-0.3%</td>
<td>0.0%</td>
<td>-0.1%</td>
<td>0.0%</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

Notes
1. Each service was segregated into main category according to the Australian Schedule of Services (eg. Diagnostic, Restorative etc)
2. Each category was then further grouped according to jurisdiction
3. Per capital values (adjusting for population differences) was obtained and expressed as a percentage and compared with the national average
4. For example, 23.5% of activity in New South Wales belonged to the diagnostic where the national average was 21.9% (Giving a value of +1.6% as shown)
5. The net values can be used to assess the utilisation (+ve: overutilisation, -ve: underutilisation)
6. Over 9 million dental services were considered in formulating the table

<table>
<thead>
<tr>
<th>CDSS 2007-2010</th>
<th>NSW</th>
<th>VIC</th>
<th>QLD</th>
<th>SA</th>
<th>WA</th>
<th>TAS</th>
<th>ACT</th>
<th>NT</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic</td>
<td>$41,707,129</td>
<td>$13,799,187</td>
<td>$6,480,727</td>
<td>$4,787,383</td>
<td>$499,945</td>
<td>$251,094</td>
<td>$33,888</td>
<td>$312,744</td>
<td>$67,872,098</td>
</tr>
<tr>
<td>Preventive</td>
<td>$26,489,920</td>
<td>$9,992,972</td>
<td>$4,499,343</td>
<td>$3,742,501</td>
<td>$226,804</td>
<td>$224,508</td>
<td>$168,428</td>
<td>$23,893</td>
<td>$45,368,369</td>
</tr>
<tr>
<td>Periodontics</td>
<td>$19,734,071</td>
<td>$7,440,862</td>
<td>$2,473,520</td>
<td>$1,448,530</td>
<td>$192,461</td>
<td>$57,900</td>
<td>$131,229</td>
<td>$16,859</td>
<td>$31,495,432</td>
</tr>
<tr>
<td>Oral Surgery</td>
<td>$36,208,718</td>
<td>$15,787,100</td>
<td>$7,662,877</td>
<td>$4,241,636</td>
<td>$910,063</td>
<td>$513,154</td>
<td>$353,049</td>
<td>$60,374</td>
<td>$65,736,971</td>
</tr>
<tr>
<td>Endodontics</td>
<td>$31,553,344</td>
<td>$9,817,026</td>
<td>$4,542,926</td>
<td>$3,334,985</td>
<td>$298,021</td>
<td>$160,341</td>
<td>$152,422</td>
<td>$25,080</td>
<td>$49,883,965</td>
</tr>
<tr>
<td>Restorative</td>
<td>$139,394,282</td>
<td>$55,430,161</td>
<td>$28,954,884</td>
<td>$19,793,698</td>
<td>$1,767,810</td>
<td>$945,300</td>
<td>$1,004,592</td>
<td>$150,269</td>
<td>$320,539,231</td>
</tr>
<tr>
<td>Crown and Bridge</td>
<td>$269,724,819</td>
<td>$69,731,593</td>
<td>$30,062,674</td>
<td>$19,299,740</td>
<td>$2,485,644</td>
<td>$1,428,213</td>
<td>$1,358,116</td>
<td>$74,640</td>
<td>$394,165,439</td>
</tr>
<tr>
<td>Prosthodontics</td>
<td>$198,754,431</td>
<td>$71,212,397</td>
<td>$22,412,662</td>
<td>$23,318,554</td>
<td>$2,382,414</td>
<td>$1,363,113</td>
<td>$943,539</td>
<td>$152,121</td>
<td>$320,539,231</td>
</tr>
<tr>
<td>Orthodontics</td>
<td>$3,203,862</td>
<td>$1,050,186</td>
<td>$243,534</td>
<td>$44,182</td>
<td>$6,647</td>
<td>$6,485</td>
<td>$4,656</td>
<td>$671</td>
<td>$4,560,223</td>
</tr>
<tr>
<td>General Services</td>
<td>$6,228,770</td>
<td>$2,793,516</td>
<td>$1,036,814</td>
<td>$827,524</td>
<td>$76,718</td>
<td>$63,144</td>
<td>$46,793</td>
<td>$5,758</td>
<td>$11,079,038</td>
</tr>
<tr>
<td>General Dental Practitioner Costs to CDSS</td>
<td>$1,238,141,762</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Gender disparities were observed in the CDDS. Females were generally more proactive with higher number of return examinations and a greater number of oral hygiene services. The average female to male proportion of the Australian population during the study was 50.3% and 49.7% respectively with 54% of the CDDS cohort females. As shown in table 2, regular visits correlated to less invasive procedures. Females required fewer extractions compared to males despite outnumbering males. This was universal to almost all age groups, inclusive of the dominant age groups from 45 -84 years.

A higher number of direct restorations were aesthetic (adhesive composite) compared to metallic (amalgam) (96% vs. 4%). Males had higher rates of metallic restorations across all age groups (Table 2). Of the indirect restorations placed, an overwhelming number were tooth coloured/aesthetic instead of completely metallic (85% vs. 15%). In extensive cavities, rates of cusp capping (extension of a filling over a tooth cusp) to protect remaining tooth structure for large direct restorations were amongst the lowest in New South Wales. This is an important observation because cusp capping of large restorations is an alternative to crowning, offered when finances are limited. Instead, many teeth in New South Wales were restored with ‘Porcelain Fused to Metal’ (PFM) crowns (a type of aesthetic crown). As indirect metallic crowns (gold) are more conservative with higher longevity, it is interesting to compare the disparities between genders. Given a higher number of metallic crowns in the smaller male cohort (46%), this indicates that males tended to care less about aesthetics as long as the restoration lasted longer. Given that the CDDS comprised of medically compromised patients, it was expected that periodontal treatment would feature more prominently as this condition shares the same risk factors with many systemic illnesses. Despite this, periodontal treatment remains low under the CDDS and was comparable to the low level in general practice dentistry (3.5% vs 1%).
### Table 2: Treatment Items of Interest

<table>
<thead>
<tr>
<th>CDDS Items of Interest</th>
<th>Male</th>
<th></th>
<th>Female</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>%</td>
<td>Number</td>
<td>%</td>
</tr>
<tr>
<td>Total Australian Population</td>
<td>10,110,800</td>
<td>49.7%</td>
<td>10,217,800</td>
<td>50.3%</td>
</tr>
<tr>
<td>Total Proportion of CDDS Population</td>
<td>210,034</td>
<td>46%</td>
<td>248,976</td>
<td>54%</td>
</tr>
<tr>
<td>Number of Extractions (all types)</td>
<td>158,048</td>
<td>53%</td>
<td>140,689</td>
<td>47%</td>
</tr>
<tr>
<td>Metallic Restorations</td>
<td>39,586</td>
<td>51%</td>
<td>37,807</td>
<td>49%</td>
</tr>
<tr>
<td>Metallic Crowns</td>
<td>4379</td>
<td>54%</td>
<td>3684</td>
<td>46%</td>
</tr>
<tr>
<td>Periodic Examinations</td>
<td>70,568</td>
<td>43%</td>
<td>93543</td>
<td>57%</td>
</tr>
</tbody>
</table>

The largest proportion of cost was in the 55-64 and 65-74 age groups confirming that chronic diseases were predominantly in geriatric patients (Figure 2). There were also atypical cases where treatment was provided that typically did not fit the age category for patients. For example, the youngest age group of 0-4 years received claims for full coverage PFM crowns and deep periodontal therapy. These services are generally reserved for heavily restored teeth with an extensive dental history. The youngest age group for a PFM bridge was in the 5-14 year old group. There were 65 claims of full maxillary complete dentures in the 15-24 year group with one solitary case in the 0-4 year group. All these atypical cases belonged to the reconstructive side of general dentistry.
It is interesting to note the differences in service provision between preventative and restorative dentistry. A total of 1142 saliva tests were performed as a diagnostic test in contrast to 323,942 crowns fabricated during the study period. This equates to an average of 1 in every 400 medically compromised patients receiving a saliva test compared to fabricating two crowns for every 3 patients. Based on standard fees and average clinical times, fabricating a crown is more expensive (with a correspondingly higher financial reward) compared to saliva testing by a factor of 20:1.\textsuperscript{16,19,42} The most common crowns were PFM and its numbers rose from 325 (2007) to 59,134 (2008) and 86,506 (2009). This represented a 266 fold increase in provision of crowns which was the most significant expenditure in the CDDS.

Another interesting observation was noted between preventive dentistry and CDDS orthodontics. During the study period 2008-2012, approximately 6.5 million vouchers (~1.3 million vouchers per year to ~65% of the Australian population aged 12-17 years) were issued to eligible teenagers.\textsuperscript{43} Despite this, a
maximum of 25% of teenagers used these vouchers with numbers declining with each year. In contrast, the number of orthodontic services and expenditure saw a noticeable increase (Figure 3). The cohort of CDDS patients receiving orthodontic services was predominately in the same age range as TEEN, with the dominant age groups being 5-14 years and 15-24 (Figure 4a, 4b). Over the five year study period, approximately 1.9 million teenagers used these preventative vouchers compared to ~6500 CDDS orthodontic patients. The value of care per TEEN patient was ~$165 per patient (maximum level of entitlement) compared to $5700 per orthodontic patient with total health expenditure of approximately $300M (TEEN) and $45M (CDDS Ortho). A majority of orthodontic expenses (~67%) were in the provision of fixed appliances (braces) with most services performed in GP clinics in New South Wales. Orthodontic costs in New South Wales alone accounted for ~70% of expenditure in this discipline.

Figure 3: Cost of Preventive and Orthodontic Services over time

![Comparison of Expenditure between Prevention and Orthodontic Services during 2007-2012](image-url)
Discussion
The first objective of this study was to demystify aspects of dentistry to those involved with integrated health planning such as health managers and policy makers. This was to address one of the concerns from the inquiry that health managers did not fully understand the various disciplines of dentistry and its contribution to primary health. By providing a brief of the various disciplines of
dentistry, the discussion of patterns of care could be reported from a more informed position.

Limitations
Although the Medicare database of item codes compiled by the Department of Health represented actual treatment, there were limitations in the data. There was no linkage of data to determine which specific chronic conditions were referred to the scheme. A macroscopic level analysis (national and jurisdictional) was only possible because the database consisted of a tally of each item code without reference to the number of contributing patients. As such, a patient level analysis and reporting of clinical outcomes was not possible. As the data consisted solely of item codes, it was not possible to determine how many patients with chronic conditions presented to GP’s that resulted in referrals to the scheme. When considering patterns of care with gender, it can only be assumed that referrals were not influenced by gender but rather the type of condition presenting to GPs. This study also assumes that the item codes complied by the third party (Department of Health) are accurate and complete. As a patient analysis was not permissible, it was difficult to ascertain whether orthodontic patients paid a contribution above the level of subsidy or that wearing braces was prolonged into the next cycle of subsidy.

Whilst the CDDS provided a broad range of services over the entire field of general dentistry, this study focused on reconstructive services. This was intentional as the authors believe that the scheme became problematic because of its high expenditure. This was consistent with one of the major findings from the inquiry that the CDDS was closed because it became economically unsustainable.

Patterns of Care
Observations from the CDDS suggesting that females were more proactive with their health were consistent with other studies.\textsuperscript{44,45} The higher number of periodic (return) examinations supports the report by Ellershaw and Stewart that females presented more frequently for dental services.\textsuperscript{46} Females were also more inclined to place a greater emphasis over aesthetics rather than function as indicated by
the preference for white fillings and crowns. As with other areas of health, it may be beneficial to consider health promotional programs targeted towards males.

Restorative and reconstructive dentistry accounted for the majority of expenditure and clinical time in the CDDS. Despite the focus on medically compromised patients, these areas were also the predominant activity in private dental practices for the general population. Restorative and reconstructive dentistry accounted for the majority of expenditure and clinical time in the CDDS. Despite the focus on medically compromised patients, these areas were also the predominant activity in private dental practices for the general population. As this form of dentistry represented a major source of income, it is unsurprising that preventive services remained relatively low. Although the emphasis on restorative dentistry in the CDDS population may be the result of more teeth affected by advanced diseases, the number of diagnostic and preventive services, especially when funded and promoted by policy, was expected to be higher. This indicates that private practices may have other considerations driving service provision which is worth further investigation. The discrepancy between the number of crowns and saliva tests in a medically compromised group of predominately geriatric patients in the CDDS is concerning.

The lack of preventive emphasis was also noted at the other end of the age spectrum. The TEEN dental plan provided a majority of the Australian teenage population with vouchers for dental treatment focused on prevention. Reports indicated that over 90% of services were provided in private clinics with most patients not having to contribute to the cost of the visit (bulk bill). Despite this, utilization of the TEEN saw a gradual decline shortly after its introduction in 2007. One speculation may be that patients were unwilling to return for further visits in the TEEN because they could not afford subsequent treatment that was likely restorative. At the same time, an increasing number of orthodontic services were provided to a much smaller CDDS cohort within this age range. Even when public health policy funded free or heavily subsidized preventive services in private practice, utilization rates relative to other services were low and in decline. This is an interesting observation because caries and periodontal diseases are plaque related diseases that are preventable. Based on these findings, it is worth investigation the private practice environment and its impact on service provision.

Another interesting finding is the provision of services that do not fit the class or character of patients receiving them. These atypical services tended to be
focused around restorative dentistry where there are financial services to provide such services. Financial issues aside, there is also a biological risk in providing restorative treatment in young patients. The provision of aesthetic porcelain crowns requires extensive tooth removal which can be problematic in young teeth as the nerves cover a greater part of the tooth and there is increase susceptibility to damage (pulpitis). Fabricating PFM bridges in pre-pubertal patients has the tendency to affect the bite and also the eruption, impediment and movement of permanent teeth. Interceptive orthodontics in young children is also another controversial area, which should be referred to a specialist rather than treated in general practice. One can only assume that financial incentive influenced the provision of these services. These observations highlight the need for health managers to understand dentistry and its role in prevention and disease control. Fortunately, this is possible with the use of item codes. Item codes in the Australian schedule are not only used for claims and administration, they are also very prescriptive and describe an act of dentistry in great detail. As such, it is recommended that health managers become conversant with these codes to enable claims under the CDDS to be monitored from an informed position. It may also be beneficial to have an oral health advisory committee in the Medicare department to scrutinise claims and its relevance to policy before final processing.

Although the Commonwealth provided rebates for dental services, it must be noted that no specific funding in the CDDS was dedicated to improving the availability of dental services. Patients in rural and remote areas and those of lower socio-economic status were still likely to face difficulties with regular attendance or paying a co-contribution for extensive treatment beyond the level of subsidy. The relative lack of specialists in the Northern Territory, Tasmania and rural Western Australia may explain the lower level of reconstructive dentistry (crowns, bridges, implants and orthodontics).46

Given the relative high rate of utilisation and expenditure in New South Wales, it is difficult to discount the influence of remuneration on service provision. Although NSW has the highest population, its workforce relative to its population is similar to other jurisdictions. Estimations indicate that there are ~52 dentists per 100,000 of the population in NSW which is similar to the national average (50/10000).47 State health reports indicate that cardiovascular disease and
diabetes feature prominently in all Australian capital cities and many Western cities worldwide.\textsuperscript{48,49} There is no evidence suggesting that the burden of chronic disease is higher in NSW, especially when other jurisdictions were more geographically larger or remote.\textsuperscript{48,49} The higher density of specialists, coordinated GP clinics (corporate and shareholder owned clinics) and more active promotion may contribute to the high level of crowns provided in NSW.\textsuperscript{7} This is an important observation as no other allied health profession engages in a mix of primary health and cosmetic/aesthetic services as variable as dentistry. With over 85% of dental services provided in the private sector in a free market economy where dentists set their own agenda, there may be issues with implementing public policy. This is a critical issue for oral health policy and requires further investigation. How to make public policy work in private dentistry?

**Contribution of Enhanced Primary Care**

As the most expensive dental initiative in Australian history, it is necessary to ask the responsible question. What was the benefit to enhanced primary care from the CDDS?

This is a very difficult question to answer because CDDS data were not amenable to a patient level analysis. However, it is well known that many geriatric patients, especially the medically compromised, exhibited multiple chronic conditions that are essentially longstanding, progressive and non-curable.\textsuperscript{49} With this in mind, the cessation of the scheme 5 years since its introduction is unlikely to provide a long term benefit to these patients. With no alternative policy, many existing CDDS patients were left with no government support following the closure of the scheme.

The focus on expensive and procedural dentistry in the form of restorative and reconstructive dentistry is a concern. It is well documented that restorative dentistry without disease control leads to a predictable cycle of more expensive and extensive restorations. It is difficult to predict the burden of oral disease and quality of life when CDDS patients, now without a dedicated policy, require maintenance on extensive work provided under this scheme. This may become a problem for the profession as there is a correlation between cost and litigation. At least one quarter of complaints are in the field of reconstruction (fixed
prosthodontics). This may undermine confidence in the profession and potentially negate the effectiveness of any future policy, no matter how well it is formulated or funded.

Contrary to belief, having more teeth/crowns in the dentition does not necessarily improve quality of life. Although there is mixed views, one major review by Radford concluded “no perceived improvement in general health when patients received crowns or dentures”\(^{34(p373)}\) There is also evidence to suggest that many patients find it more comfortable to eat and function without a denture or a prosthetic replacement for their back teeth. Witter et al shows merit in the Shortened Dental Arch concept.\(^ {50}\) Given that aesthetic crowns accounted a significant portion of expenditure, there is a need to provide stricter guidelines in policy for these services.

**Conclusion**

The CDDS was unprecedented policy as the first major dental initiative to attract Medicare rebates for dental services. This provided the opportunity to assess how well national policy could be delivered in the Australian context. Unfortunately, there were many issues encountered with this scheme with cost and sustainability identified by an inquiry as being critical. The inquiry also recommended that health managers and policy makers needed a greater understanding of dentistry and its contribution to primary health. As such, this study aimed to demystify the major disciplines of dentistry and its relation to the core objectives of the CDDS in improving patients with chronic and complex conditions. The study then analyzed large data from the Medicare database of item codes to report on patterns of care. The CDDS provided dental services to approximately 2% Australians with the majority being female and geriatric. Females tended to be more proactive with higher return visits and tended to place greater emphasis on aesthetics. Males tended to have more teeth extracted and had more metallic restorations. Despite its stated aim towards prevention and disease control, the patterns of care and expenditure were restoratively focused. Even with free preventive services in the Teen Dental Plan, the number of preventive visits was in decline. The types of restorative services varied between jurisdictions. It was important to note that New South Wales recorded a disproportionate number of crowns, which accounted for a majority of all CDDS
expenditure. These results suggest the need to provide additional precautions to ensure that policy is both sustainable and that the emphasis of treatment is appropriate. It is unlikely that the high expenses in restorative dentistry and the closure of the CDDS would have long term positive impact on medically compromised patients. With this in mind, there is merit in establishing an advisory committee to help understand item codes and to ensure that claims are appropriate. There is a need for greater emphasis on prevention but the challenge is emphasizing this in private practice where financial incentive appears to be a driver for service provision.
References


CHAPTER 4: Conundrums in merging public policy into private dentistry: experiences from Australia’s recent past

Abstract

Although caries and periodontal disease are preventable, they remain the most prevalent medical condition. This is despite unprecedented levels of funding in two Medicare policies aligned with principles endorsed by major health organisations in the Chronic Disease Dental Scheme (CDDS) and Teen Dental Plan (TEEN). While addressing many barriers to treatment such as access and affordability to private practices, these programs experienced many unintended consequences. The provision of restorative services resulted in cost containment problems while the low priority of preventive services raised questions to the effectiveness of policies in reducing oral disease. Drawing upon publicly available data, the view that private practice and its factors that influence service provision is a barrier towards implementing ideal oral health policies is presented. It has been demonstrated that when dentists have substantial influence over the course of care, patients being exempt from payment and financial responsibility assumed by a third party, there is a tendency to over-service. Under the current system, it cannot be assured that the practice of dentistry represents a prioritised approach to combat disease patterns based on scientific evidence in primary health. The focus needs to shift from an increasingly unaffordable reconstructive model to a cost-effective evidence-based preventive model. Restructuring the role of the dental professionals and reforming the oral healthcare system may be required for more effective oral health policies.
Introduction
Oral diseases include disorders such as ulcers, cysts, cancers, cleft palates and malaligned and impacted teeth. Although there are a large range of disorders, oral disease in the form of caries and periodontal disease are the most prevalent.\textsuperscript{1-3} These two conditions not only affect appearance, quality of life and self-esteem, more studies are reporting its association with almost every illness in the human body.\textsuperscript{4} Quite often, the first clues to a weakened immune system are related to many signs and symptoms reported in the oral cavity. Oral infections are also a source of systemic infection that are critical in medically compromised individuals.\textsuperscript{4}

Despite advancements in dental technologies and unprecedented funding from recent governments, the burden of oral disease remains high. There are persistent high levels of oral disease among working Australians with one in every two teeth in 35-44 year olds having experienced caries.\textsuperscript{5} Rural and remote dwellers continue to face difficulties with accessing dental services and tend to have poorer oral health.\textsuperscript{3} Overall, at least one third of the population cannot afford to visit a private dentist with many expressing difficulty paying a $120 health bill.\textsuperscript{3,6} It is worse for working families on a modest income as they are ineligible for the public dental system. These issues have significant ramifications on the general health system, the economy and standard of living. Dental infections constitute the largest number of preventable conditions presenting to emergency departments.\textsuperscript{7, 8} The economic impact and lost productivity from dental infections is comparable to diabetes and cardiovascular disease.\textsuperscript{3,9} Without a dedicated oral health policy, individuals are responsible for financing treatment where there are issues with affordability. Personal financing of dental services is the second highest expense behind medications.\textsuperscript{10}

Epidemiological research in Australia is consistent with other industrialised countries in the reporting of oral disease. It is well known that caries and periodontal disease are skewed diseases with the highest burden in the medically compromised, financially disadvantaged and in rural and remote dwellers.\textsuperscript{3,4} The understanding of dental science has made tremendous strides over the last few decades. It is now conclusive that caries and periodontal disease are amendable to prevention (and reversal) using simple and cost effective methods.\textsuperscript{4} It has been
demonstrated that with proper preventive care, at least half of cavities present do not require fillings or surgical intervention.\textsuperscript{11,12}

The Chronic Disease Dental Scheme (CDDS) represented the first major oral health policy to be included under Medicare. It was formulated with a preventive focus and addressed many of the concerns identified in the literature.\textsuperscript{13} The scheme targeted vulnerable individuals (medically compromised) and enabled rural dwellers and working families within this cohort to access treatment. Respecting that these groups may have greater needs, subsidy was adequate for repeat visits as well as entitlements to the full scope of general dentistry. Notwithstanding, the CDDS experienced serious issues with utilisation and cost containment which led to its controversial closure.\textsuperscript{14,15}

The adverse outcomes of the CDDS raise serious questions. Why did the scheme fail when it was formulated on what appeared to be sound principles? Why does the burden of caries and periodontal disease remain high when it is entirely preventable? How did the scheme reach such a level of expenditure when preventive services are the most cost effective procedures in dentistry?

Drawing on publicly available data in the Chronic Disease Dental Scheme (CDDS) and the Medicare Teen Dental Plan (TEEN), this study argues that the current state of private practice is not is an ideal position to deliver public polices based on primary health.\textsuperscript{16} There are additional considerations in private practice that impact service provision such the influence of remuneration and effect of third party insurance. This study argues that without structural reform in the dental profession, there will continue to be barriers towards implementing effective oral health policies.

What does the scientific evidence say about Oral Disease and how does this impact function?

One pivotal moment in dentistry that has changed clinical management is the understanding that caries is preventable and the role of fluoride. It has been demonstrated that community water fluoridation has been the principal driver in reducing caries experience.\textsuperscript{3,4} The success of water fluoridation has prompted other strategies of caries control such as its use in toothpastes and topical
varnishes. Many of the benefits can be attributed to fluoride’s ability to exist in an aqueous phase in saliva and plaque.\textsuperscript{17} Fluoride in this medium enhances resistance to demineralization by strengthening the crystals in teeth to improve acid resistance. Fluoride has also been shown to inhibit the metabolism (glycolysis) of fermentable carbohydrates in cariogenic bacteria\textsuperscript{17}. Featherstone has studied the dynamic nature of caries and has underscored the importance of saliva.\textsuperscript{18} Saliva is the medium in which ionic exchanges occur as is governed by a pH and logarithmic equation described by Hedersson and Hasselbalch.\textsuperscript{18} Under favourable conditions, aqueous fluoride in saliva deposits into dental hard tissues by a process known as remineralisation.

It is the understanding of remineralisation that has changed the practice of dentistry. Initial carious lesions can be reversed without the need for restorative intervention (ie-placing a filling).\textsuperscript{18-21} This is the basis for a range of products in the market such as tooth mousse (amorphous calcium and phosphate), peroxides (hydrogen peroxide), and fluoride containing pastes and gels.\textsuperscript{22} These products are aimed at improving saliva, either by saturating it with soluble minerals or increasing its pH; thereby making dental hard tissues more acid resistant.\textsuperscript{21-22} Removing plaque regularly by personal and professional cleaning ensures immaturity of the plaque biofilm which is less favourable for bacteria that metabolise strong acids. This prevents the oral cavity from reaching a critical pH threshold capable of dissolving the minerals in teeth (demineralisation). As such, caries can be reversed and cured by simple and cost effective methods. These simple methods can reduce the need for restorations by up to fifty percent through a focus on customised preventive care.\textsuperscript{12}

Similarly, periodontal disease is also caused by specific bacteria in mature plaque. By simple chemical and mechanical procedures, the removal of plaque has demonstrated a reversal of gingivitis, the precursor of periodontal disease.\textsuperscript{23} The importance of regular attendance for a professional clean is highlighted by a study by Darby.\textsuperscript{24} As much as 60\% of plaque may be left behind in some people after daily brushing.\textsuperscript{24} Residual plaque can mature and form a more complex biofilm which attracts more aggressive bacteria that can trigger the host responses to resorb the bone around teeth. Lang et al reported that individuals
with regular attendance to a dental professional for a scale and clean reported lower plaque scores and better periodontal health.\textsuperscript{25}

Even when teeth are irreversibly affected by caries or when dentitions have experienced periodontal tooth loss, preventive dentistry is still an important part of management. Studies have shown that plaque is the major cause for restoration failure\textsuperscript{26, 27}. Without adequate oral hygiene, the lifespan of fillings, crowns, partial dentures, implants and bridges are significantly diminished.\textsuperscript{27} Replacement of failing restorations requires more expensive and extensive treatment. Although there are instances where crowns are necessary, such as teeth requiring coronal protection, questions have been raised about its routine use in oral rehabilitation. The ‘shortened dental arch’ concept is consistent with the World Health Organization’s objectives of a functional, aesthetic and natural dentition.\textsuperscript{28,29} In its policy paper, it stated a goal to retain no less than 20 teeth and not requiring a fixed or removable prosthesis as a treatment objective.\textsuperscript{29} It is based on the philosophy that not all missing teeth require replacement. Studies have shown that many people do not report difficulties in function or reduced quality of life when posterior teeth are not replaced. Reissmann et al indicated that less than 3% of patients report any improvement in general health after receiving crowns.\textsuperscript{30,31} As such, individuals can do without extensive treatment which may influence the decision making process on whether to commence oral reconstruction. This is particularly relevant in medically compromised patients who the lack manual dexterity to clean, have a reduced immune system, experience dry mouth and have poorer quality saliva. Adopting this concept should be a priority for oral health policies as this does not impact quality of life but significantly reduces cost.

Despite the prevalence of oral disease in the form of caries and periodontal disease, both conditions are amenable to prevention using safe, proven and cost effective methods.\textsuperscript{4} The use of fluoride and novel products such as tooth mouse has the potential to make dentistry less invasive.\textsuperscript{21} Restorative dentistry should not be the emphasis in combating oral disease even when it may be warranted in missing teeth. The key to prevention lies in improving the quality of saliva, underscoring the importance of customised saliva testing and oral hygiene education.
How do health authorities and organizations see oral disease?

The World Health Organization and the World Dental Federation see oral health as important and have identified key performance objectives towards 2020 (Table 1). These core goals have a primary health focus based on diagnosing, preventing and managing disease with cost-effective and sustainable policies. Similarly, the Australian Primary Health Care Research Institute considers primary health as the first point of contact in health care that gives ‘priority to those most in need with care focused on prevention, treatment and care of the sick at a cost that is maintainable’. These principles have been the backbone of Australia’s universal health insurance scheme, Medicare.

Table 1. Global oral health objectives

<table>
<thead>
<tr>
<th>Federation Dentaire International 2003; WHO, World Health Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>FDI and WHO global oral health objectives for 2020</td>
</tr>
<tr>
<td>1. Reduce mortality from oral diseases</td>
</tr>
<tr>
<td>2. Reduce morbidity from oral disease, thereby improving quality life</td>
</tr>
<tr>
<td>3. Promote sustainable, priority-driven policies that are scientifically based</td>
</tr>
<tr>
<td>4. Develop cost-effective oral health systems for prevention and disease control</td>
</tr>
<tr>
<td>5. Integrate oral health promotion with other health providers</td>
</tr>
<tr>
<td>6. Develop oral health programs that empower people to control determinants of health</td>
</tr>
<tr>
<td>7. Strengthen systems and methods for oral health surveillance</td>
</tr>
<tr>
<td>8. Promote social responsibility and ethical practices of health providers</td>
</tr>
<tr>
<td>9. Reduce disparities in oral health between different socioeconomic groups</td>
</tr>
<tr>
<td>10. Increase the number of healthcare providers who are trained in dental public health</td>
</tr>
</tbody>
</table>

The CDDS was the first major dental initiative to be included under Medicare with the objective of improving the health of patients with complex and chronic conditions. Formulated as a health measure with a focus on prevention and disease control, it seems that its principles are aligned the views of major health authorities. By targeting the most vulnerable individuals based on clinical need rather than ability to pay, and providing generous subsidy for regular visits, the fundamentals of the scheme had the capacity to address the objective stated by WHO. Similarly, the TEEN dental plan was another initiative that provided annual vouchers to eligible teenagers to access annual preventive services.
On the policy front, it seems like Commonwealth Governments are appreciating the importance of oral health to general health.

**Are these principles reflected in private practice?**

When the CDDS was first introduced as the Enhanced Primary Dental Care Scheme (EPDCS), it was restricted to diagnostic, preventative and simple restorative (fillings) services with an annual limit of $220 per year. With many issues surrounding access and affordability to dentistry, it was a surprise to policy makers that utilisation in private practices was extremely low. Many patients complained about the high out of pocket expenses making subsequent visits unaffordable. Although the government was initially firm on its commitment to primary health, policy makers eventually responded to calls from the profession to increase the level of subsidy and scope of services. This resulted in rebranding the scheme as the CDDS.

During the first year of operation as the CDDS in 2008, over 5 million services were processed with claims in excess of $1 billion AUD. This equated to a 13, 350% increase in expenditure, exceeding budget and making the scheme the most expensive dental initiative in Australian history (Table 2). Interestingly, over two thirds of expenditure was involved with restorative/reconstruction dentistry, where the provision of aesthetic crowns accounted for the majority of the cost. There was also a noticeable increase in orthodontic services to treat crowded teeth. Preventive services in contrast remained low compared to other services. Since the CDDS serviced medically compromised patients with the majority in the geriatric age, it was surprising to note that saliva tests were not considered in private practice. Over 99% of replacement restorations were aesthetic and on average, every second patient in the CDDS received a crown in contrast to one in 400 receiving a saliva test for a customized preventive plan.
Similarly, the TEEN Dental plan was a primary health initiative where the government provided ~1.2 million vouchers (65% of teenage population) to eligible teenagers aged between 12 and 17 years in families meeting financial criteria.  

Unlike the CDDS, the scope of services was restricted to diagnostic and preventative services and subsidy fixed at $160 per annum. Over 90% of vouchers were used in private practices where most patients were bulk billed (no out of pocket expense). Despite patients not having to contribute to the cost of the visit, there was a yearly decline in the number of patients returning back to private practices where they received treatment (Figure 1). Of concern, the two most effective methods in caries prevention in fissure sealants and fluoride treatment were reported to be only received by a minority of patients.

### Table 2. Key CDDS Statistics

<table>
<thead>
<tr>
<th>Year</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Patients (Estimated by comprehensive exams)</td>
<td>1623</td>
<td>80919</td>
<td>163626</td>
</tr>
<tr>
<td>Total Number of dental services</td>
<td>15348</td>
<td>1395637</td>
<td>3121624</td>
</tr>
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<td>Cost of CDDS</td>
<td>$1,738,443</td>
<td>$226,812,757</td>
<td>$430,483,014</td>
</tr>
<tr>
<td>% of Cost in Reconstruction (Prosthodontics)</td>
<td>48%</td>
<td>67%</td>
<td>59%</td>
</tr>
<tr>
<td>Frequency of PFM type Crowns (1 crown per &quot;X&quot; patients)</td>
<td>5</td>
<td>1.4</td>
<td>1.9</td>
</tr>
<tr>
<td>Frequency of Saliva Testing (1 saliva test per &quot;X&quot; patients)</td>
<td>1623</td>
<td>337</td>
<td>395</td>
</tr>
</tbody>
</table>

**Increase in dental subsidization from 2008 to $4250 per two years**

#### Notes

1) Number of patients estimated from item code relating to comprehensive examination (011), which is the standard of practice in Australia
2) Number of services relates to the number of individual acts of dental treatment according to the ADA Schedule of Services
3) Data beyond 2009 was not considered due to an auditing campaign that may have affected utilisation of this scheme
Rate of utilisation of the Chronic Disease Dental Scheme (CDDS) and the Teen Dental Plan (TEEN). (i) Although both programs were introduced with a primary health focus they had different funding schedules. (ii) The TEEN was restricted to one visit per year with a subsidy around $160 for dental services classified by the ADA schedule as preventive services. The CDDS (initially EPDCS) started with a subsidy of $220 per year which increased to $4250/2years in 2008 and included preventive and reconstructive services. (iii) CDDS cost estimations were based on the item codes and their monetary value based on fees presented in the Department of Veterans Affairs Fee Schedule 2008. (iv) Percentages on the y-axis relate to the proportion of activity during the calendar year compared with the period in consideration to observe the level of utilisation. (v) The period 2007–09 was chosen for the CDDS because this was prior to an audit campaign which may have influenced service provision after 2009.

Utilisation of these policies indicate that preventive dentistry does not seem to be the focus in private practices. Even when generous subsidy was provided for regular attendance in the CDDS or a free preventive visit in the TEEN, utilisation of preventive services is not commensurate with its evidence base in reducing the high prevalence of oral disease. Based on expenditure and activity, private practice dentistry has a predisposition towards clinical intervention, aesthetic and restorative dentistry. Restorative dentistry in the replacement of restorations occupies at least half of dentists’ time and represents substantial expenditure.26
What is unique about the private dental practice environment and how does this affect public policies based on prevention?

Clinicians that deliver the majority of dental services operate as small private practices which are also happen to be their businesses. The exclusion of dental services from Medicare has resulted in little to no government support for many decades. As such, dentists differ to medical and other health professionals given that they assume all financial risk for establishing their business, receiving little to no start-up cost and receive no funding to develop their capital infrastructure. The cost associated with setting up a dental practice is one of the highest among all health professions. Training as a dentist is second only to medicine in terms of student fees and duration. The number of scholarships in dentistry is comparatively low compared to medical students in Australia. Public dentistry is unlike public medicine in career opportunity and remuneration. Medical students have government incentives with decent remuneration and opportunities to work in tertiary hospitals which happen to be the locust of the specialists and centres of excellence. The majority of dental specialists operate in private practices with no engagement with the public sector. With the highest student debt and little support, dentists choose to operate in the private sector which may explain why there is a large imbalance in the workforce with 85% in private. However, to succeed in this environment, dentists must be acutely sensitive to financial incentives within their remuneration system as this represents their principal source of income. An Australian survey of successful dentists indicated that business skills were essential in maintaining a private practice. In nominating the features of a successful practice, many of the points listed by dentists were inward rather than patient centric.

As such, it is unsurprising that changes to remuneration systems impact clinical practice. Unlike medicine, the bulk of service delivery in private dental practice, in volume of activity, is based around the regular attendance of asymptomatic patients. To be more profitable, dentists have expanded their scope of services which are not necessarily health related such as the creation of aesthetic makeover practices, ‘all in four’ implant clinics, ‘same day’ crown centres and ‘white filling only’ practices. Bleaching teeth, veneers, tooth coloured restorations, implants, crowns and computer-milled ceramics to improve aesthetics are increasingly in demand by patients who have been motivated by marketing and
the media. Aesthetic crowns placed in general practice make up a significant portion of most dentist's income. This has produced distortions in health need, demand and supply; accounting for the atypical high cost associated with dentistry.

While these are legitimate services because dentists are meeting a demand from society, this can create disparities in health. An unintended effect of the CDDS was the provision of expensive reconstructive services which had little impact on improving health or managing chronic conditions. As a result, the closure of the scheme left many patients without a dedicated policy to access primary dental services. When dentists have substantial influence over the course of care, there are strong incentives to over treat. From a business perspective, it makes greater financial sense to focus on procedures that are more profitable. In the normal course of care, the type and intensity of dental treatment is often limited by the patients' ability to pay. However, the problem of cost containment becomes significant when patients are exempt from payment when services are funded by a third party such as health policy (i.e. CDDS). Although it may be argued that dentists were providing patients with best treatment, the issue is its contribution to the objectives of the policy and its sustainment. The premature closure of the CDDS due to cost does not bode well with managing medically compromised patients with ongoing needs. This is a significant problem for governments trying to push preventive policies in a workforce which is in predominately in private practice. Private practices have unique circumstances as small businesses and may differ in their objectives when providing dental services.

These unique circumstances have shaped the pattern of care and the delivery of services. Most CPD activity undertaken by dentists in Australia has a restorative emphasis and this is reflected in practice activity. The location of private practices are at its highest density in capital cities and affluent suburbs where patients' have more disposable income and are more likely to have private health insurance. Unfortunately, this distribution does not coincide with where disease burden is at its highest such as in poorer socio-economic and rural and remote locations. This represents the classical ‘inverse care law’ described by health economists. When the financial barrier between dentist and patient is lifted, the choice of care tends to be more intensive. This has been termed 'moral
hazard’ and ‘adverse selection’ relating to excessive expenditure for health services due to the eligibility to third party (ie- insurance) benefits.\textsuperscript{49,50}

As Medicare funded programs for dentistry are new, it must be noted that many established and successful practices have operated without any government assistance. In this environment, practices focused on restorative care has proven to be successful business models.\textsuperscript{41,42} As such, there may be a level of uncertainty in practices changing their activity to a preventative focus.\textsuperscript{51} As an example, after adjusting for time and material cost, the financial incentive for fabricating a crown over a preventive saliva test is greater by a factor of ~25:1.\textsuperscript{15} A decrease in clinical intervention with a commensurate rise in patient focused prevention could potentially threaten a proven income stream. As restorative dentistry is continually chosen by dentists as their preferred area of professional development, it may be difficult to change the mindset and habits of established professionals. Governments see dentistry entirely as a health service while private practices have additional considerations such as offering particular services to maintain profitability.

Care must be taken to understand the complex nature of private dental practices and factors that influences their activity when planning policy initiatives. As it currently stands, the private practice environment is not suited to deliver public policies based on prevention as evidenced by the CDDS and TEEN. Structural reform in the profession is necessary.

**What are the recommendations?**

The practice of dentistry should not automatically be assumed to be a direct response to oral disease. This is an important consideration when allocating taxpayer money to fund public policies. The low emphasis of preventive dentistry and the focus on restorative procedures with aesthetic considerations raises questions about whether dentistry is a health service or a cosmetic commodity.\textsuperscript{14,15,35} Although both services are necessary to meet demand from society, it is undesirable when treatment is not aligned to the policy that funded its services. Given that the burden of caries and periodontal disease remains high, it is unfortunate that the improved understanding and management of these conditions is not reflected in practice activity. General practices continue to have
a restorative emphasis where financial incentives are greatest in private practice. Without a focus on disease control, restorative dentistry will continue in a cycle of more invasive and expensive restorations that will prematurely fail. This constitutes a deficient method of treating caries.\textsuperscript{52} As a result, restorative approaches tend to work against improvements in oral health.\textsuperscript{52} Cynical as this may sound, private business models are not hampered by these circumstances as profitability is related to productivity; especially when treatment is provided by an additional source of funding from a third party such as health policy. How can health policy based on prevention operate in such an environment?

Structural change is required in the profession and the way dental services are delivered. There is a need to reconsider the contribution of all dental professionals and their role in meeting the health needs of the population. It is not ideal that the majority of leaders, teachers and specialists (\textasciitilde90\%) belong to highly technical and rehabilitative specialities of orthodontics, prosthodontics, endodontics (root canal), oral surgery and implantology.\textsuperscript{39} Public health specialists in Australia make up less than 5\% of the specialist workforce.\textsuperscript{39} There needs to be greater emphasis in the areas of diagnosis, disease control and prevention. Expanding the role of allied dental professionals such as therapists and hygienists may fulfil this need. There is also a need to rebalance the mix of professionals which can be achieved by changing the number of training places in universities.

Other measures include limiting reconstructive services and establishing better guidelines for allocating subsidy. Oral health policies need measures to protect against over servicing. Prosthetically (reconstruction) driven treatment does not directly improve health and should not be the focus of treatment. In the long term, there is a need to re-establish the imbalance between the public and private sector. This will enable governments to exercise greater control in the provision of care and the delivery of policies. Importantly, there needs to be mechanisms to monitor policy performance at real time, especially when cost concerns become apparent. These areas are worth further investigation to improve the delivery of oral health care and to ensure the effectiveness of policy.
Conclusion

Although scientific evidence has demonstrated that caries and periodontal disease can be prevented with safe and effective measures, they continue to be the most prevalent of all medical conditions. This is despite unprecedented funding from Commonwealth governments in the form of the CDDS and TEEN. Representing the first dental policies under Medicare, they have been implemented with principles that are aligned with health organisations as being pivotal in reducing the burden of oral disease. However, the implementation of this scheme resulted in many unintended consequences. The problem with cost containment, an emphasis towards reconstructive services and the low priority of preventive dentistry as observed in the CDDS and TEEN is a concern. Many of these problems have been attributed to the private practice environment and factors that influence its provision of services. Successful private practices have strong business models with a focus towards restorative dentistry as this has historically been proven profitable. As such, it is unsurprising that the CDDS became a vehicle to supplement existing business models. Within this environment, more money into health does not necessarily relate to better health outcomes. When dentists have substantial influence over the course of care, patient being exempt from payment and financial responsibility assumed by a third party, there is a tendency to over-service. Although this may represent best treatment, the issue is its contribution to health and the sustainment of policy. Under the current system, it cannot be assured that the practice of dentistry represents a prioritised approach to combat disease patterns based on scientific evidence in primary health. The focus needs to shift from an increasingly unaffordable reconstructive model to a cost-effective evidence-based preventive model. This is a significant problem for governments trying to promote prevention in the only workforce that has the capacity to handle a national agenda. The view that structural reform is required so that preventive policies can be better implemented is presented.
References


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CHAPTER 5: JERM model of care: an in-principle model for dental health policy

Abstract
Despite the prevalence of oral disease and its impact on general health, Commonwealth governments have been reluctant to place dentistry under the universal insurance scheme, Medicare. This changed in 2004 when the Howard Coalition government introduced the Chronic Disease Dental Scheme (CDDS). Unfortunately, the scheme was short lived and experienced many problems relating to cost and the provision of services. Concerns with high expenditure and long term sustainability resulted in its controversial closure. Although the scheme was considered a failure, it provided many valuable insights for future policies. By analysing CDDS item codes from previous research, this commentary proposes a set of principles for oral health policy. It has been proposed that oral health policy should be based around four main themes; a justified, economical and research based model of care (JERM). This model argues that a universal dental scheme focused on primary dental services is economically viable. The use of item codes represents an opportunity to improve policy research and surveillance. There is also a need to rebalance the public and private sector and to reorganize the dental profession with the potential to expand the roles of allied dental professionals.
Introduction

Oral health is an integral part of general health affecting quality of life, the broader health system and the economy. Despite its importance, Commonwealth Governments have been reluctant to include dental services as part of its universal health insurance scheme, Medicare. As such, the cost of dentistry which is approaching $10 billion per annum is largely financed by individuals.\textsuperscript{1,2} Around 40% of the population have private health insurance while the financially disadvantaged have access to the much smaller public sector where waiting lists have been unacceptable.\textsuperscript{2,3} Without Medicare rebates for dental services, at least one third of the Australian population are unable to visit the dentist due to cost.\textsuperscript{4}

Oral disease in the form of caries and periodontal disease has affected more people than any other known disease with an economic impact second only to cardiovascular disease.\textsuperscript{2,5} With increasing evidence associating oral disease with almost every other condition in the body, governments could no longer ignore its importance. This has resulted in unprecedented moves to introduce Medicare rebates for dentistry in an initiative known as the Chronic Disease Dental Scheme (CDDS).

Fundamentally, the principles of the CDDS were sound and addressed many of the known barriers to oral health. Rather than spending significant money on public infrastructure, the scheme made use of the existing and much broader private sector that has the capacity and workforce to deliver a national agenda. Although contradictory to the principles of Medicare, the scheme was not universal but rather targeted medically compromised individuals. As such, the reduced scope of eligibility acted as a measure to contain cost. The maximum allowable subsidy allowed for an extensive range of services in dentistry to manage patients with complex and chronic needs. Rural and remote dwellers have the opportunity to visit their local dentist without having to travel great distances to the nearest public clinic. In turn, it was predicted that these measures would alleviate pressures faced in public dental clinics and emergency departments. Ultimately, the CDDS seemed like a bold, positive and timely move to reduce the burden of oral disease.
Although the design of the CDDS addressed many areas of concern, there were problems during implementation. Despite having the highest initial subsidy among all allied health professions by a factor of ~3.5 ($220 vs $60), utilisation of dental services was comparatively low.\(^6\) Responding to calls from oral health groups, the level of subsidy and allowable services increased on two occasions to $4250/2 years. This created another problem at the other extreme. Utilisation of the scheme saw an unsustainable increase with expenditure growing by ~13,350% within 12 months (Table 1).\(^6, 7\) Of significant concern is that the majority of expenses were in the provision of aesthetic crowns where restorative and reconstruction dentistry accounted for two thirds of total expenditure.\(^7\) The provision of these services did not match the national distribution of chronic diseases, with one jurisdiction alone accounting for almost ~70% of all expenditure.\(^7\) Despite targeting medically compromised patients for preventable oral diseases, the number of preventive and disease control procedures was disproportionately low.\(^8\) It seems that it is difficult to promote prevention and disease control in private practices that have been operating for many years with a restorative focus.\(^6, 8\) The premature closure of the CDDS left many patients without a dedicated policy to address their oral health needs.

Table 1. Chronic Disease Dental Scheme (CDDS) activity by general dentists during 2007–09

<table>
<thead>
<tr>
<th>Year</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients (by examinations 011)</td>
<td>1623</td>
<td>80,919</td>
<td>163,626</td>
</tr>
<tr>
<td>Total number of services</td>
<td>15,348</td>
<td>1,395,637</td>
<td>3,121,624</td>
</tr>
<tr>
<td>Cost of CDDS</td>
<td>$1,738,443</td>
<td>$226,812,757</td>
<td>$430,483,014</td>
</tr>
<tr>
<td>% of cost in reconstruction (prosthodontics)</td>
<td>48</td>
<td>67</td>
<td>59</td>
</tr>
<tr>
<td>Number of crowns per 100 patients</td>
<td>20</td>
<td>73</td>
<td>53</td>
</tr>
</tbody>
</table>

Despite the practical shortcomings of the CDDS, there are many important lessons to be learnt. As such, this study involves a reflection of the CDDS with a view of proposing a set of principles to make oral health policy work. These recommendations have been made from previous research focused on observing/analysing CDDS item codes submitted to Department of Health.\(^6-9\) This commentary has identified four key principles that are the topics of discussion; a
justified, economical and research-based model of care (JERM). This model argues that it is possible to have an effective and sustainable dental program under Medicare under certain conditions.

**Background to the CDDS**

During the years of the Howard Coalition Government (Liberal and National Party), Medicare benefits for certain dental services to treat patients with chronic conditions were introduced in July 2004. This was part of a suite of reforms known as MedicarePlus, in response to the growing appreciation that allied health services played a key role in general health management. The dental component had various names such as the ‘Allied Health and Dental Health Care Initiative’ to the ‘Enhanced Primary Care Dental Scheme’. Subsidy was limited to $220 per year where reconstructive services such as dentures, bridges, crowns, orthodontics and implants were not covered.

These initiatives were unprecedented and represented the first major oral health policy under Medicare. Prior to this, direct Commonwealth involvement was restricted to schemes for war veterans and special conditions such as cleft lip and palate. It must be noted that Commonwealth governments traditionally had a more indirect role, providing funding to the states and territories to manage their own public system through the Commonwealth Dental Health Program.

Utilisation of the CDDS was unexpectedly low prompting concerns that the scheme did not have any impact towards improving oral health. Many patients experienced high out of pocket expenses and could not afford the co-payment. In some cases this amounted to over $700 for a single visit. This promoted calls from welfare and oral health groups to increase dental benefits. As a result, the level of subsidy was increased to $4250 per 2 years with an extension in the allowable services to include all types of dental procedures in 2007. The scheme subsequently became known as the CDDS. The government budgeted these measures at $385 million over 4 years.

Within a short period of time, the expansion of services and increased funding made the CDDS the most expensive dental policy in Australian history. In less than 18 months, expenditure had exceeded $1 billion AUD in 2008.
incumbent Labor Government had concerns that costs were uncontrollable and attempted to abolish the scheme. Many attempts to close the scheme were met with staunch opposition in the Coalition controlled senate with support from the minor parties such as the Greens and Family First. One major concern highlighted by the Greens was that there was no viable plan to deal with patients already receiving treatment. Clearly, there was no contingency plan as policy makers did not intend the CDDS to be short term.

Resistance in the senate stalled plans by the Labor party to redirect funding toward the tried and tested Commonwealth Dental Health Program. Unable to close the CDDS, there were ongoing concerns that costs would spiral. This resulted in a series of reactionary measures including an aggressive auditing campaign by the Department of Health. The audit identified misuse of the scheme and proceeded to reclaim significant sums from certain dentists. In some instances, repayments were of the scale that offending dentists claimed would make their practices insolvent.\textsuperscript{13,14} This predicament drew the Australian Dental Association to lobby on behalf of these dentists and accused policy makers for not involving the profession with developing CDDS policy. With the support of the Liberal Opposition Health Spokesperson, a bill was introduced to parliament. This bill was referred to as the Senate Finance Administration Inquiry (Dental Services) 2012.\textsuperscript{13} An olive branch was provided to dentists identified during the audit that failed with administrative requirements of the scheme.\textsuperscript{14} The bill also identified problems with implementing the CDDS and noted that policy makers needed to have a greater understanding of dentistry.\textsuperscript{13}

Shortly after the inquiry, the Gillard Labor Government successfully negotiated a deal with the Greens to close the CDDS. At a joint press conference, the Labor Government and the Greens announced plans to redirect funding towards a dental benefits scheme for children (Child Benefit Scheme) as well as more funding for the states and territories to manage their public services (re-establishing Commonwealth Dental Health Program). Unfortunately, the majority of patients (adults and elderly) in the CDDS miss out on government assistance as they are left without a specific oral health policy following closure of the scheme. It remains to be seen whether another policy will be introduced and in
what form. Until then, many working Australians ineligible for the public sector safety net are responsible for fully meeting the cost of dentistry themselves.

**Dental statistics in perspective: What do the numbers mean?**

It has been estimated by the Australian Institute of Health and Welfare (AIHW) that dental expenditure in 2014 was approximately $8 billion dollars, representing approximately 5% of total health expenditure ($155 billion). The majority of dental costs were met by individuals (~60%) with about 40% having private health insurance. A report by Ellershaw and Spencer indicated that less than 40% of adults had favourable visiting patterns. One third of the population avoided the dentist because of cost. Best estimations indicate that somewhere between 25 to 50% of the Australian population have visited the dentist at least once a year. This estimation does not include ~70,000 annual emergency admissions to hospitals due to preventable dental diseases; which is the fourth most common presentation.

The question as to whether dentistry should be included in Medicare has been asked many times. Many arguments against the inclusion cite cost as a barrier. On the surface, this appears warranted as dental expenditure is approaching $10 billion per annum. This figure is equivalent to the entire medical taxation levy. Considering a worst case scenario where only 25% of the population have visited a dentist to reach this spending, it would daunting to consider costs if visiting patterns triple or even quadruple to 75-100% of the population. Correspondingly, this may increase dental expenditure well into the vicinity of $40 billion per annum representing about 25% of total health expenditure. Given that caries and periodontal disease are the most prevalent conditions with an economic impact second only to cardiovascular disease, there may be grounds for justification. On the flip side, the increase in cost to families makes this prospect one that may not be politically palatable. The current expenditure of approximately $10 billion dollars in an Australian population of 25 million equates to $400 per annum for each person; costing an average family of two $1600 per year. Hypothesizing that visiting patterns reach full subscription, costs would increase to $6400 per annum for the same family. These cost concerns have attributed to the Commonwealth governments reluctance to include dental services under Medicare. After decades of shunning calls from welfare groups, the
Commonwealth government introduced the first dental program under Medicare in the form of the CDDS. Although eligibility to the CDDS was restricted to less than 10% of the population with a budget of $100 million per year, it was cancelled due to unsustainable expenditure. Given these problems, the prospect of a universal dental program for all Australians seems less likely.

Despite this, the goal of funding a universal dental scheme to reduce the burden of oral disease is achievable. With the improved understanding of oral disease, it is well known that caries and periodontal disease can be prevented and cured with simple and cost effective dentistry. Although there were adverse outcomes in the CDDS, it demonstrated that preventive dentistry is affordable. Approximately 70% of CDDS expenditure, which is similar to general practice dentistry, is restoratively driven.\textsuperscript{6,7} The provision of fillings, crowns, bridges, implants, veneers and orthodontics relate to repairing lost form and function of teeth or improving aesthetics but do not address the disease process. Comparing essential CDDS services (diagnosis and prevention) against other allied health services indicate that dentistry, with the right focus, is comparable in cost (Figure 1).\textsuperscript{7} As such, there is potential for dentistry to be less than a third of its current cost; giving hope that a universal dental scheme is possible. Health services to manage disease in the mouth should be no different to managing disease in other parts of the body. For this to be possible, there is a need to justify dental services when allocating subsidy based on its contribution to health.
The nature of clinical care is often reflected in the size and mix of the workforce available to provide services. It has frequently been asked why dentistry cannot simply be part of medicine. The imbalance in the workforce may explain why dentistry is different. Medical nurses in Australia are tertiary trained to provide restricted clinical care which includes patient education, wound care, health promotion, prevention, immunisation, baseline diagnostics, disease control and administering medicines.\textsuperscript{17} These primary health services closely resembles the role of allied dental professionals such as hygienists. It must be noted that dental nurses in Australia do not require tertiary qualifications and do not provide clinical care but rather assists dentists or hygienists. Comparing the number of registered health professionals, there are \(~10\) nurses for every medical GP compared to one dental hygienist for every \(~10\) dentists (35,000 GPs, 330,000 Registered Nurses, 19,000 Dentists, 1800 hygienists/therapists).\textsuperscript{18,19} Approximately \(85\%)\ of dentists are in the private practice where there is a strong restorative focus (in terms of number of services).\textsuperscript{2,20} Approximately \(90\%)\ of dental specialists are involved with complex restorative and surgical procedures; orthodontics, oral surgeons, endodontists and prosthodontists.\textsuperscript{21} It has been estimated by Britt et al that less than \(20\%)\ of general practice medicine is procedural/surgical based.\textsuperscript{22} With this...
in mind, any oral health policy focused on primary health services may need to consider rebalancing the dental workforce to reflect a focus on oral disease prevention.

**DEVELOPING A NEW MODEL**

**Justification**

In formulating policy, the emphasis of any initiative should be based around two overarching objectives; minimising the burden of oral disease and ensuring adequate access to preventive services. As demonstrated by the CDDS, the provision of services in the area of general dentistry can be wide and varied. As with funding, more expensive procedures do not necessarily translate to better health outcomes.

This model proposes segregating the Australian Dental Association Glossary and Schedule of Services (used in the CDDS and the dental industry) into two main categories (Table 2).

The first group, “Primary Oral Health Care”, includes services relating to diagnosis, palliative care, fluoride therapy, disease control, plaque removal, education and prevention. The second group, “Rehabilitative and Reconstructive”, includes the provision of fillings, crowns, bridges, implants, dentures, orthodontics, and more complex reconstructive dentistry.

The aim of Group 1 is to focus on the core principles of oral health policy. It has a focus towards disease control and prevention rather than repairing the effects of disease. In restorative dentistry, placing a filling into a cavity restores form and function to a tooth but does not address the disease process that has caused the problem. Temporary restorations are included group 1 as they can serve as caries control restorations where teeth are given the opportunity to form a hard tissue barrier (reparative dentine). Temporary materials such as glass ionomers (fluoride releasing properties) and sedative pastes (zinc oxide eugenol and corticosterior/antibiotic liners) can arrest disease and provide pain relief. Unlike more permanent restorations, these restorations have therapeutic properties and require less clinical time, precision and surgical preparation compared to a conventional restorations (composite, gold or metallic amalgam). Although the
primary focus is on prevention and disease control, treatment in this group can be considered ‘pre-restorative’, that is, obtaining a controlled and disease free environment where a patient can electively proceed (subject to personal or approved finance) to group 2.

Importantly, a comparative study by Lam et al demonstrated that the costs involved with Group 1 dentistry are comparable to the other allied health professions involved in the Enhanced Primary Care Scheme (EPC). This addresses one of the major concerns with the CDDS in that it was inappropriate and unsustainable. Segregating dental services in this manner provides stronger justification to consider dentistry as a primary health care profession that requires dedicated funding. It could be better argued that these procedures are no different to treating disease in other parts of the body.

The CDDS became unsustainable because of the high cost of Group 2 services. Funding should be restricted in the prosthodontics (crown and bridge) component of this group. Interestingly, there is an increasing body of evidence that perceived quality of life and function are not diminished with the absence of teeth (shortened dental arch concept). It is recommended that approval should be obtained to provide these services. Ideally, an oral health expert (such as a Public Health Dentistry Specialist) should be employed to establish a committee to deal with the administrative aspects of dentistry under Medicare. This addresses another issue raised in the inquiry in that policy makers did not fully understand dentistry.

The confusion between dentistry as an essential health service as opposed to a cosmetic commodity can be resolved by a concerted effort to segregate services into the groups proposed. This would enable policy makers to better fund services based on its contribution to health and what the community is willing to pay for a particular type of service.
### Table 2. Segregation of dental services (Justification)

A sample of services has been selected in each category to highlight the nature of services.

<table>
<thead>
<tr>
<th>Nature of service</th>
<th>Description of service</th>
<th>Item number</th>
<th>Nature of service</th>
<th>Description of service</th>
<th>Item number</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group 1: Primary Oral Health Care</strong></td>
<td></td>
<td></td>
<td><strong>Group 2: Rehabilitative and Reconstructive</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Diagnostic</strong></td>
<td>Comprehensive examination</td>
<td>011</td>
<td>Cosmetic</td>
<td>Tooth whitening (bleaching)</td>
<td>117–119</td>
</tr>
<tr>
<td></td>
<td>Periodic examination</td>
<td>012</td>
<td>Periodontic</td>
<td>Crown lengthening for restorative</td>
<td>213–245</td>
</tr>
<tr>
<td></td>
<td>Limited examination</td>
<td>013</td>
<td></td>
<td>Grafting for implant placement</td>
<td>213–245</td>
</tr>
<tr>
<td></td>
<td>Consultation</td>
<td>014</td>
<td></td>
<td>Osseous surgery</td>
<td>213–245</td>
</tr>
<tr>
<td></td>
<td>Letter of referrals</td>
<td>019</td>
<td>Oral surgery</td>
<td>Pre-prosthetic surgery</td>
<td>331–345</td>
</tr>
<tr>
<td></td>
<td>Intra-oral radiographs</td>
<td>022</td>
<td></td>
<td>Augmentation</td>
<td>331–345</td>
</tr>
<tr>
<td><strong>Preventive</strong></td>
<td>Removal of plaque and stain</td>
<td>114</td>
<td></td>
<td>Orthognathic surgery</td>
<td>331–345</td>
</tr>
<tr>
<td></td>
<td>Re-contouring existing restoration</td>
<td>113</td>
<td>Endodontic</td>
<td>Root canal rehabilitation</td>
<td>414–458</td>
</tr>
<tr>
<td></td>
<td>Removal of calculus</td>
<td>114</td>
<td>Restorative</td>
<td>Metallic restorations</td>
<td>511–515</td>
</tr>
<tr>
<td></td>
<td>Fluoride application</td>
<td>121</td>
<td></td>
<td>White coloured restorations</td>
<td>521–525, 531–535</td>
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<tr>
<td></td>
<td>Dietary advice</td>
<td>131</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Saliva testing</td>
<td>047</td>
<td></td>
<td>Veneers</td>
<td>582–583</td>
</tr>
<tr>
<td></td>
<td>Fissure sealing</td>
<td>161</td>
<td></td>
<td>Post</td>
<td>597</td>
</tr>
<tr>
<td><strong>Periodontic</strong></td>
<td>Treatment of acute periodontal infection</td>
<td>213</td>
<td>Prosthetics</td>
<td>Dentures</td>
<td>611–779</td>
</tr>
<tr>
<td></td>
<td>Root debridement</td>
<td>222</td>
<td></td>
<td>Crowns</td>
<td>611–779</td>
</tr>
<tr>
<td><strong>Oral surgery</strong></td>
<td>Removal of infected teeth (simple)</td>
<td>311</td>
<td></td>
<td>Bridges</td>
<td>611–779</td>
</tr>
<tr>
<td><strong>Endodontic</strong></td>
<td>Sedative dressing for relief</td>
<td>411</td>
<td></td>
<td>Implants</td>
<td>611–779</td>
</tr>
<tr>
<td></td>
<td>Emergency pulp extirpation</td>
<td>419</td>
<td>Orthodontic</td>
<td>Fixed and removable appliances</td>
<td>811–881</td>
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<tr>
<td><strong>Restorative</strong></td>
<td>Dressing of root canals for disinfection</td>
<td>455</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>General services</strong></td>
<td>Caries control and temporary restorations</td>
<td>572</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Palliative care</td>
<td>911</td>
<td></td>
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</tbody>
</table>
Economical
An essential requirement of health policy is that it must be cost effective and sustainable as a majority of medical conditions are chronic and form a significant part of health expenditure.\textsuperscript{25} Many of these illnesses such as diabetes, cancers, asthma, arthritis, and certain cardiovascular and neurological conditions are incurable and progressively deteriorative. As such, these illnesses can only be managed rather than cured, underscoring the importance of a sustainable health policy. This was one of the major objectives of the EPC and CDDS.

Although it can be argued that the CDDS wasn’t adequately costed, its eligibility criteria in Medicare was more cost conservative compared to other services. Unlike medical services which had universal eligibility, the CDDS was based on clinical need and restricted to medically compromised patients. Interestingly, it has been demonstrated that CDDS expenditure based on primary health (essentially Group 1 services) is comparable to the many other health services in Medicare.\textsuperscript{6} Accordingly, it may seem a simple and logical solution to consider a dental examination as if it were a medical examination and treat both as a Medicare service. This is one of the reasons for justifying dental services because the CDDS failed because of the unsustainable expenses in Group 2 (restorative services).

Implementing a preventive proposal in a free market economy where private practices are remunerated for more procedural/intensive services may be difficult.\textsuperscript{26} Policy makers underestimated the influence of private practice enterprise.\textsuperscript{26} However, it must be appreciated that in some instances, extensive treatment was necessary, especially in a medically compromised cohort. Just as a percentage of patients seeing a general medical practitioner may subsequently require major surgery/treatment, the situation is no different in dentistry. As such, this model argues for the principle of universality and equity in access. Former US Senator Frank Dobson once said, “Inequality in health is the worst inequality of all”.\textsuperscript{27} Every Australian should be entitled, at the very least, to essential primary dental services. Those requiring extensive dental treatment should be given some consideration and financial assistance from Medicare. Accordingly, an appropriate and economical solution for funding policy should consist of a combination of universal eligibility (Traditional Medicare) for the general
population with a subgroup receiving further assistance based on clinical need as assessed by a government oral health committee (EPC criteria).

Although much blame had been attributed to CDDS expenditure, there is no doubt that in certain instances, patients were provided the best option which may not have been otherwise available due to cost. Rather than a blanket fund with a generous upper limit ($4250/2 years) for every patient as in the CDDS, there should be clear guidelines and more appropriate distribution of subsidy for patients. Subsidy should be based on the severity of disease rather than just having a disease and meeting minimum eligibility criteria. Eligible patients should not automatically receive maximum entitlement. This not only provides cost containment measures, but also ensures that patients receive treatment commensurate with their needs. Such an assessment should not be subjected to means (financial) testing; respecting that even those with modest incomes, such as working families, may not be able to afford ongoing/complex treatment.

With this in mind, there is a need to establish clearer guidelines for GP referrals. Rather than acknowledging that a patient has a chronic condition, the severity should be quantified. Although this may be difficult without clear guidelines and also the subjective nature of medical examinations, the use of existing diagnostic tests is a good starting point where baseline records can be developed over time. Many GP’s routinely assess the functional status of the patient during their course of care. Indexes such as the ‘activities of daily living’ and measurements for hypertension, HB1Ac levels in diabetic patients, renal function, and spirometry respiratory tests are useful indicators to assess health status. These tests normally have a range of values which can be considered to be low, normal, high or critical. This may be a useful starting point to assess the severity of each patient.

Developing these guidelines not only ensures consistency and sustainability of policy, it is also complementary to the principles of multi-disciplinary care. Establishing baseline records over time would not only allow for more consistent referrals and appropriate funding, it allows the health professions to assess clinical outcomes over time. There is also the opportunity for health data linkage between the professions.
While the appropriate level of funding needs to be established based on what the public considers fair and is willing to pay through tax, it is believed that an economic principle based on a combination of universality for essential services and clinical need for more extensive treatment is an appropriate model.

Research base
The healthcare system is complex and dynamic requiring significant taxpayer funding and is essential to ensure a reasonable standard of living. There is a general expectation that governments have the responsibility of making sure its citizens are able to access basic necessities such as health care. Although the CDDS had unintended consequences, it must be noted that it was unprecedented policy as the first major dental initiative in Medicare. Observations of the policy in practice has given a unique perspective of how policies fare in the Australian context. Despite this, there is still no general consensus on how to best approach oral health policy.

The CDDS highlighted the need for policies to be established with an evidence base. There were no mechanisms in the EPC/CDDS to assess how many patients reported back to their GPs or whether their medical needs improved over time. Funding was provided on the premise that multidisciplinary care had better outcomes without a means of quantification (there was no feedback mechanism).

There needs to be mechanisms to monitor the level of spending, types of services provided, health needs, and outcomes over time. Continuous assessment of policy ensures funding concerns are flagged when they become apparent. With particular reference to the EPC, there is a need for health data linkage across all disciples involved with multidisciplinary care. This will not only quantify care, but provide more consistent guidelines for referrals. For example, it would be beneficial if GP referrals, based on assessing health status (activities of daily index, diabetic levels or hypertensive status etc), were correlated with a history of allied and dental health problems and their outcomes. There is much information that can be gained if dental and allied health outcomes were integrated with GP assessments. This may create a unique opportunity to
quantify, both at the patient and population level, how allied and dental health impacts general health and therefore justify spending.

An area worth investigating is the use of item codes in the field of e-health (electronic research) and dental informatics. E-health has the advantage in that its evidence base will develop over time and allows for automated assessment of policy. The biggest advantage is that analysis of these codes requires nothing new as collation of these codes is an indirect result of processing claims as in the CDDS. These item codes, according to the Australian Glossary and Schedule, are used consistently in Australia and are detailed and prescriptive. Each item code describes one act of dentistry accurately. Collectively, these item codes gives clues to patterns of care and spending. Much of the research thus far has been a result of considering these item codes.  

Analysis of item codes is one area where the employment of an oral health expert (or committee) as part of Medicare would be beneficial. With an understanding of how item codes are used in dentistry, they would be in an ideal position to monitor policy as well as considering cases for extended subsidy (Group 2 services). They will also act as the conduit between the profession and government; addressing one of the main recommendations from the inquiry.

The JERM model also highlights potential in using item codes to improve dental research. By attaching clinically relevant data to existing item codes, there is the opportunity for health data linkage, assessing patient and population level outcomes, and for personal and professional development. For example, the item code 011 relates to a new patient presenting to the clinic for an examination. If this code were to be expanded by adding suffixes to denote location (geocoding and socio-economic status) and health status (diabetic levels, blood pressure, hospital admissions, mortality and birth rates etc), many useful health indicators can be automatically obtained as part of the normal course of care. An individual dentist can compare their pool of item codes with their peers for self-assessment and a public health dentist can compare item codes from all practitioners for population assessment and research. The biggest advantage of using item codes for research is that large and complete data (census) is easily obtainable without big investment in sampling or data collation. A real-time database would also
reflect changing patterns in health and provide clues to health outcomes from clinician intervention. Further details of this emerging field is another topic of discussion.

**Model of care**

How to improve dental health and make oral health policy work? This is a simple question but the answer is far more complicated. Analysis of the CDDS has shown that dental services based on prevention is affordable. With a concerted effort to segregate services based on its contribution to health, there is potential for dentistry to be economically viable under Medicare with universal eligibility.\(^6\) Primary care dentistry should be treated no differently to general health and medicine. Regular attendance with a preventive focus can reverse the effects of caries and periodontal disease and ultimately reduce the burden of oral disease.\(^2\) Despite this, private practices which account for 85% of the dental workforce is restoratively driven.\(^8,26\) In a free market economy where remuneration is attached to more intensive procedures and when financial barriers from the patient are lifted by third parties, there is a tendency to over-service.\(^26\) Best treatment in dentistry is subjective and does not necessary correlate with health given the high costs associated with aesthetic services and their complications. Aesthetic crowns account for a large proportion of a dentist's income.\(^28\) Society is placing an increasing emphasis towards appearance making it difficult to distinguish dentistry as a health service or cosmetic commodity. The public system does not have the infrastructure or workforce to service a national policy. With a national public wait list of around 300,000 in an underserviced sector (~15% of workforce), other than unlimited funding, there is no short term solution to rebalance and develop the public sector. Furthermore, if public waiting lists were somehow able to quantify the number of people presenting to emergency hospitals or those that did not register (rural, cultural or language barriers), reported figures are an underestimation of the oral health problem that actually exists. A band aid solution for the public system is to outsource treatment to the private sector. However, based on 'value per care' figures, it is more expensive to outsource public patients for temporary treatment in the private sector.\(^7\) This is unsurprising, given that private practices have the freedom to set fees and have an emphasis towards restorative care.\(^26\) Additionally, there are long held beliefs in the profession that may take generations to change. There is a reason why the most experienced
dentists and almost all specialists work privately in capital cities.\textsuperscript{26} These clinicians cite lifestyle, autonomy, remuneration and the opportunity to do complex work as highlights of their job; none of these benefits exist in the public sector.\textsuperscript{26,29} For associate dentists, the ability to learn from these experienced clinicians, receive higher income to service student debt and the opportunity to purchase the business later are career defining goals. A proven business model in the private sector is to establish a clinic, employ dentists and expand the business for passive/additional income. In recent years, this model has been taken to the extreme with clinics now forming large corporations that can obtain dental materials for cheaper. Almost all CPD activity is focused around restorative dentistry.\textsuperscript{26} Potential students are acutely aware of these opportunities when considering dentistry.\textsuperscript{26} Even if more money was allocated to developing public infrastructure, would the current crop of professionals move?

There is a need for a model of care that is different. Structural change in the profession and the way oral health is funded requires attention. Without these, the situation will get worse in an aging population where more people are keeping their teeth yet have poorer oral health. The JERM principle recommendations change in certain key areas.

In the short term, the only practical solution would be to place dentistry as part of Medicare for group 1 services. With most specialists, experienced dentists and 85\% of the workforce in private practice, this is the only sector with the capacity to handle a national oral health agenda. Consolidating public dentistry is a long term prospect and it is also impractical and economically unviable to set up government clinics to attempt to cover the vast geography of rural and remote Australia. A mobile dental van or a flying dental service may be effective for palliative care, but does nothing to establish patient rapport or continuity of care with a trusted professional.\textsuperscript{30} Providing incentives for dentists to inject their own capital to establish clinics in areas of need is far more feasible. Subscribing to universal eligibility is not only equitable and consistent with the rest of Medicare, it encourages opportunity and affordability. New practices have immediate access to a pool of eligible patients that can afford to visit a dentist while a fixed subsidy will place pressure on existing practices wanting to charge higher fees.
When a large gap exists (patient co-contribution), patients have the option to go elsewhere.

Although these changes are needed, the problem with service provision in the private sector remains as a major barrier. Private practices may continue to focus on restorative dentistry. This is a much more complicated problem and is the reason why the CDDS failed. The TEEN demonstrated that the number of patients visiting private practices for preventive services declined even though they were free (bulk billed). Structural changes is needed in the dental profession. One criticism of the CDDS was that it provided opportunities for all dental professionals to use the scheme (all the specialists, general dentists and prothesists) except hygienists and therapists. Ironically, the scheme excluded the only professionals trained entirely in primary health with a scope of practice consistent with the principles of the CDDS (and EPC).

The JERM model highlights the importance of allied dental professionals (ADP) (currently hygienists and therapists). Although most ADP courses in Australia are two years in duration, many of these programs are currently undergoing changes to their curriculum. As such, there is the opportunity to expand their skill set in Group 1 services such as diagnosis and referring. Expansion of ADP skills is the key to reforming the dental profession. Practice activity in dentistry needs to be more aligned to the medical model. In general medicine, only 20% of the volume of activity is procedural/surgical based. This is different in dentistry where operative, restorative and prosthodontics accounts for the majority of clinical time and cost. If dentistry were to be classed on equal footing with medicine, its mix of activity needs to be similar. Examining most undergraduate dental curriculums in Australia, the last two years of a five year course is mainly procedural based. Practicing restorative procedures (drilling cavities, taking impressions, cutting crowns/bridges and root canal therapy) consumes a considerable amount of time, teaching resources and materials. Omitting the procedural component of the course and focusing an extra year on examination, diagnosis and referring, is likely to extend most ADP programs to a three/four year degree (consistent with the average duration of most degrees). However, the extra time in developing ADP students would result in another class of professional upon graduation that is not only trained exclusively and competently in primary health, but with
important skills in diagnosis, treatment planning, palliative care, and referring (essentially general practice medicine).

With these core skills, the JERM model supports the argument that ADP’s should be granted rights for independent practice. Currently, these professionals can only work in private practice under the supervision and guidance of a dentist. However, with extra training and consolidated with appropriate continual professional development, ADPs can be as competent as dentists in diagnosis, primary care treatment and referring. Again, this is consistent with general medical practitioners as most refer their surgery to medical specialists rather than undertaking the procedure themselves. However, unlike medicine where there are gaps in knowledge to cure diseases, the understanding of caries and periodontal disease is at the level where they can be eliminated.

Governments can support these measures by committing more funding to training ADP’s. By offering more Commonwealth supported university places, lowering tuition fees, providing scholarships/incentives and classifying it as a qualification of need (as with general nursing courses), dentistry will benefit from another class of professionals. Importantly, this will address the substantial imbalance between medicine and dentistry with regards to the type of professionals trained to provide clinical care. ADP’s can provide an invaluable service not too dissimilar to medical nurses within their scope of practice; and more importantly, in a more appropriate workforce proportion to do so.

Prior to rights for independent practice, it is recommended that ADP’s undergo an “exit” examination. This is consistent with the US model where graduate dentists are required to sit a board examination before practice. This provides an extra layer of assurance to the community that standards are met. After meeting these requirements, the opportunity for ADPs to establish independently has numerous benefits. This not only provides more opportunities for the community to access dental care, it removes a conflict of interest as these professionals are trained exclusively in primary health (Group 1). Oral health policies with a preventive focus directed to these professionals is a medium term solution to ensure that the mix of care is consistent to its funding. This removes the grey
area between dentistry as a health service and a cosmetic commodity which has been a problem in the CDDS.

These views are similar to a more recent study by Macey et al who argued that regularly attending adult patients are increasingly asymptomatic and do not need treatment when attending for a routine examination.\textsuperscript{31,32} Based on screening 1899 patients, sensitivity and specificity values for caries and periodontal disease were similar between ADPs and general dentists (based on the current ADP curriculum).\textsuperscript{31,32} They concluded that ADPs could be used to screen for caries and periodontal disease.\textsuperscript{31,32}

These short and medium measures provide firm foundations for improving the public system in the long term. There is time to change perceptions about public dentistry and the role of dentistry as a health care profession. Although it remains to be seen, the anticipated reduction in public wait lists, increased access and affordability to private clinics, and less emergency related dental admissions in hospitals would ultimately reduce the burden (and cost to society) of oral disease. Unquantifiable benefits such as improved quality of life and health may translate to improved economic productivity and significant cost savings. Through these cost savings, Commonwealth governments have the opportunity to inject large capital to significantly prop up the public system. This will go a long way towards rebalancing the current private/public sector mix (85%:15%). Through increase capital spending, remuneration and benefits for dental specialists should also match their medical counterparts. Public dentistry may one day be the locus of the specialists as it is for medicine; translating the public system from one that is under-resourced and focused on palliative care to centres of excellence in dealing with chronic and complex conditions.
Conclusion

As the first major oral health policy to attract Medicare benefits, the CDDS provided an unprecedented insight into the operation of oral health policy in the Australian context. Although the outcomes were less than desired, four key principles have been recommended from analysis of the scheme. This commentary advocates that policy should be based around a justified, economical and research-based model of care (JERM). There is a need to justify dental services to reflect a more preventive approach and to also enable governments to fund services based on its contribution to health and what the community is willing to pay. By placing greater emphasis on allocating subsidy based on need, the inclusion of dentistry under Medicare were every individual receives at least some form of basic care is economically achievable. The consideration of item codes provides an invaluable opportunity to monitor policies and form a research base. Finally, there is a need for a model of care that focuses on re-balancing the private/public mix of care as well as opportunities to restructure the dental profession to focus more on primary health.
References


Section Two: e-Health Research

Preface

Major health authorities have identified that an ideal oral health system is one that is evidence based, cost effective, able to monitor the needs of the population and has mechanisms for continuous assessment and quality assurance of policy. This section introduces e-Health and informatics as a means to achieve these objectives.

The first chapter of this section provides an introduction to e-Health and informatics. It firstly outlines the challenges in dental research before providing a definition and scope of these terms. The focus then shifts towards how the application of this technique can improve research. The second chapter focuses on its use in epidemiology and population level research using the CDDS as an example. Finally, by focusing on item codes in the Australian Schedule of Services, chapter eight outlines how each dentist benefits from a more extensive and relevant evidence base and how they can seamlessly contribute to the body of science.
CHAPTER 6: How e-Health strategies may enhance dental research

Abstract
Although *evidenced based dentistry* has been the accepted protocol in guiding clinical decisions, there are challenges with establishing an adequate research base. This is most obvious in modern dentistry which has seen a rapid increase in the number of dental products and techniques. Unfortunately, this has created a gap between science and clinical practice which can cause uncertainty in treatment planning. Clinicians not only desire information on success rates and adverse effects of treatments, they also want to ensure that research is relevant to their needs. Policy makers and public health dentists look beyond the patient and require effective mechanisms to monitor the health status of the population. While traditional research methods continue to serve the profession well, it is an opportune time to explore the benefits of computer technology in the field of e-Health. Using the recent Chronic Disease Dental Scheme and the Australian Schedule of Services and Glossary, the proposal that e-Health and informatics can provide a seamless method to obtain valuable research data is presented.
Introduction

One disadvantage of the remarkable achievements in modern dentistry is that treatment options have never been more varied or confusing. For example, there are hundreds of implant systems, eight generations of bonding agents and an ever expanding range of products and procedures. This can present challenges for the dentist in choosing the right treatment for their patients. Fortunately, the literature has provided clues for dentists to assist in their clinical practice. The concept where clinical decisions are guided by the best available evidence has recently been referred to as Evidenced Based Dentistry (EBD). Although these principles have been endorsed by professional associations worldwide, there are problems with establishing a research base.\textsuperscript{1,2}

At the clinical level, dentists demand information on key parameters such as success rates, adverse effects, restorability and prognosis of various treatments. These metrics have been a key decider in treatment planning. However, it is well known that clinical treatment can be technique sensitive where results can vary between clinicians.\textsuperscript{3,4} This is unsurprising as very few studies are identical and there can be significant differences in methodologies. The setting, duration, clinical experience, qualifications of clinicians, patient characteristics and also the parameters of success, which are all subjective, can impact the reporting of results. This raises some very important questions for dentists. With their unique circumstances, can dentists rely on the literature and how relevant is the evidence to them? Would the longevity of a class II posterior composite restoration be different if it was placed by a specialist prosthodontist in a university setting as opposed to a graduate dentist in a busy private practice with a waiting room full of patients?

Another problem with modern techniques or rare diseases is that there are either gaps in knowledge or a lack of consensus in approaching a clinical problem. In oral medicine, patients suffering from osteonecrosis of the jaws from bisphosphonates have been reported to be low at 0.05%.\textsuperscript{5} While this is a fortunate outcome, there are few studies that are able to provide conclusive evidence due to limited data.\textsuperscript{5} A widely discussed topic is the ‘ultra-conservative stepwise’ technique in operative dentistry. There is still considerable debate in whether it is best protocol to leave deep carious lesions in-situ to avoid a pulp
In a Cochrane review by Burrow, it was reported that “the trials selected for review were not ideal and there is a need for more clinically based evidence to assist in the decision making process”\(^6\)\(^{(p275)}\). In orthodontics, the use of bone plates in the retro-molar region for anchorage after removal of wisdom teeth has shown stability, less invasive surgery and good clinical outcomes over mini-implants in other areas.\(^7\) However, orthodontists cited the common reasons for its limited use owing to a lack of clinical information and evidenced based success rates.\(^8\) These problems are common in all areas of clinical dentistry. The problem is twofold; how reliable and comprehensive is the evidence base and how applicable are the results to each dentist?

Public health dentists face similar challenges in obtaining sufficient data for population research. While traditional epidemiological studies have made significant advances in public health, they are resource and time intensive. They are susceptible to low response rates, exclusion bias, statistical inferences and errors with large data collation. These concerns were reported by the National Advisory Council on Dental Health who noted that “dental public health does not receive sufficient emphasis and resourcing and there is limited ability to positively influence policy development. There is a need for sustained data collection activity as there are gaps in population level data”\(^9\)\(^{(p63)}\). Additionally, it is difficult to compare epidemiological studies between countries and jurisdictions as there may be significant cultural or environmental differences. In the field of dental trauma, this has seen large variations in the prevalence of trauma with a wide range of reported aetiologies.\(^10\) Very few studies report the incidence of dental trauma as this requires ongoing coordination among clinicians to record these accidental injuries over a sufficient period of time.\(^11,12\) As a result, only a limited number of incidence studies have been available for systematic reviews.

With advancements in computer technology and the increasing importance of EBD, it is an opportune time to explore alternative methods to enhance dental research.
What are the ideal requirements of EBD?

Although EBD has been the accepted protocol to guide clinical decisions, it has been identified that there are many problems with establishing an evidence base. Before the benefits of e-Health as a method of data collation can be fully appreciated, it is necessary to consider the ideal requirements of research.

At the population level, many desirable properties of an ideal oral health system have been identified by the American Association of Public Health Dentistry and the World Health Organisation. Among these requirements is the need to monitor the health status of the population to assess the performance and sustainability of policy. Formulating oral health policy from an evidence base has also been identified as essential. Therefore, it would be ideal if data for population research is complete (census data) and represents actual treatment without the need for sampling or relying on statistical inferences. Data that is real time, automated, accurate and continuously updated would provide reliable information that is sensitive to health changes over time. Real time data would also enable health administrators to identify cost concerns as soon as they become apparent. Exclusion of data from certain demographics would represent actual problems in accessing health care services rather than problems with data collation. Data that is standardised enables consistent comparisons between jurisdictions. This would provide an insight into the effectiveness of different health policies. It would also be desirable if data were seamlessly obtained without the clinician having to do anything different from what they would normally do as part of treatment.

At a clinical level, dentists need to know what works for them and how their treatment compares with their peers. Scientific articles in peer reviewed journals are seen as the gold standard for EBD but its relevance to each dentist is questionable given that each case is different. If each dentist can compare their treatment against an established body of evidence, this not only provides guidance to treatment but also invaluable information for personal development. Ideal research would also be comprehensive where each dentist, regardless of location or place of training, would contribute to an ever increasing body of evidence. Contributing to the literature without additional resources or expenditure but as part of routine administration associated with providing
treatment ensures that every dentist would be able benefit from EBD without sacrificing clinical time.

With these considerations, it is an opportune time to explore the benefits of e-Health in meeting these requirements.

**What is a potential solution?**

The view that e-Health can enhance research and is a possible solution to address many of the aforementioned problems with EBD is discussed. The World Health Organization has developed a broad definition of e-Health to include the “the use of computer and information technologies for health related benefits in supporting administrative functions and its supportive role in gathering scientific information for professionals”. In Australia, the national e-Health strategy has envisioned a “safer and more sustainable health system” through this technology. A subset of this area is the field of dental informatics which is considered as the application of computer and information science to improve dental practice, research and education management. Although this is an emerging field that has yet to gain widespread acceptance, dental informatics has been touted as a novel method to improve patient outcomes and the delivery of dental care.

The author believes that e-Health and informatics is the ideal vehicle to improve research because it provides a means to collate and capture every act of dentistry seamlessly. Complete capture of data without the need for sampling, statistical forecasting or designing a study is possible because of the way dentists record their clinical activity. The standard practice of allocating item codes as part of treatment represents valuable clinical data for research. These item codes are non-identifiable and are amenable to electronic processing and collation. By establishing a central processing facility with the cooperation of the dental profession, it is possible to obtain electronic data at a macroscopic level with little friction and cost.
The Chronic Disease Dental Scheme (CDDS) represented the first major dental policy to attract Medicare benefits. Under this universal healthcare scheme, the Commonwealth government contributed to the cost of treatment for a range of health services. Administration of the CDDS was consistent with the dental industry in the use of item codes. These codes were in accordance with the Australian Glossary and Schedule of Services. The glossary is both encyclopaedic and prescriptive and covers all aspects of general and specialist treatment. It is divided into ten main categories; (i) diagnostic, (ii) preventive, (iii) periodontics, (iv) oral surgery, (v) endodontic, (vi) restorative, (vii) prosthodontic, (dentures), (viii) crown and bridge, (ix) orthodontic, (x) general. Dentists currently use these item codes to supplement their clinical notes and for invoicing treatment.

During the CDDS, dentists submitted these item codes to the Department of Health for processing. As a single department responsible for the scheme, it was possible to obtain a complete database of item codes as a result of processing claims. By limiting the responsibility of the scheme to one government department and the scrutiny by individual practices awaiting payment for services provided, there was reasonable confidence that the database of item codes were accurate and complete. As these item codes were entirely numeric and non-identifiable, publishing the database publicly online allows for independent analysis of policy. As a result, over 22 million item codes (large census population data) were available for analysis without the need for dedicated resources or labour to collect data (Table 1). Most of the analysis of the CDDS in the literature has been a result of analysing these codes.
Table 1: Database of Item Codes for Analysis of CDDS policy

<table>
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<th>Number Item</th>
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<td>Preventive</td>
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<td>Orthodontic</td>
<td>7,979</td>
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<tr>
<td>TOTAL</td>
<td>11,839,967</td>
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With an increasing number of practices using computers to record clinical notes, an untapped opportunity exists to obtain valuable research data. As they currently exist, item codes describe a single act of dentistry in extensive detail. For example, in the Australian Schedule of Services and Glossary, the code 011 corresponds to a comprehensive examination of a new patient; 531 corresponds to a one surface adhesive restoration on a posterior tooth; and 311 corresponds to an extraction of a tooth. Although these codes describe each procedure in detail, they provide no circumstantial information. Why was a tooth extracted? What demographic was the new patient? What circumstances warranted a restoration and how long did the previous restoration last? Answers to these important questions can be obtained by adding suffixes to item codes. This can be achieved by modifying existing software. When the clinician routinely enters item codes, it is proposed that a series of checkboxes appear next to each code. Once entered, these checkboxes become numeric suffixes after each code to allow for circumstantial evidence. For example, the item code 531-X1-X2-X3, may correspond to a posterior restoration on a virgin tooth (X1) due to caries (X2) with the depth extending to the inner 2/3rd of dentine (X3).

Modifying item codes using electronic software allows each clinician to assess their personal circumstances at many levels. Clinicians can compare results against their peers in the same practice, against published results or beyond borders with the greater profession at large. It provides the opportunity for self-development as a real time database of relevant information provides an opportunity for critical analysis and a review of their protocols. For the public health dentist or government policy makers, cooperation with local dentists to gather their database of item codes enables comprehensive large data for population analysis with little effort. With computer technology, there is the opportunity for each and every dentist, regardless of location throughout the world, to benefit and contribute to research. This may well be the solution to addressing many of the problems identified with the current evidence base.
Conclusion

Although Evidenced Based Dentistry has been endorsed by the profession as the standard in which to base clinical decisions, there are many difficulties in establishing a research base. While not a substitute to traditional research methods, there are many untapped opportunities to enhance research through e-Health and dental informatics. Using the Chronic Disease Dental Scheme and the Australian Glossary and Schedule of Services as the point of discussion, an outline of how e-Health may enhance research is presented. The focus on item codes, which is already used in the administrative part of treatment, combined with customised computer software can be a seamless way to obtain valuable research data. This data is complete, cumulative and real time that is relevant to the treating clinician as well as public health dentists and to the existing body of research.
References


CHAPTER 7: A critical discussion of the benefits of e-Health in population level dental research

Abstract
Population level research is an essential area of health with the potential to affect quality of life and the broader economy. Although there are excellent epidemiological studies that have improved health services, traditional research requires considerable investment. While relatively new in the field of health and clinical practice, electronic technology has changed the operation of many industries. One area of this technology is termed e-Health and is defined by the World Health Organisation as the use of information technology to support healthcare information and administration. However, not all professionals are convinced of its mainstream use. This paper presents one way in which e-Health can benefit population level research. Using the Chronic Disease Dental Scheme (CDDS) as a point for discussion, e-Health has been an invaluable tool for epidemiological research in collating data for monitoring policy performance, health linkage and assessing patterns of care.
Background
Epidemiology is the study of patterns, causes and effects of health related diseases and/or the effects of health intervention at the population level. These studies are one of the most resource intensive and encompassing fields of research. With the potential to cost taxpayers significant money and affecting quality of life, the broader health system and economy, the importance of accurate research cannot be understated. There are a number of excellent epidemiological studies that have improved lives but common to these traditional studies is the need for considerable investment. Due to the magnitude of these studies, it is always challenging to collect large data. As such, many studies are subjected to low response rates, biased sampling, exclusion bias, difficulties with surveying and statistical errors with forecasting.

Over the past decade, computer technology has changed the operation of many industries. This is no different in the field of health where there are opportunities to improve services. These changes have been acknowledged by the World Health Organization and have defined e-Health to include “the use of computer and information technologies for health related benefits in supporting administrative functions and its supportive role in gathering scientific information for professionals”. Similarly, Australian Health Ministers’ Advisory Council has called for more sustainable health systems through the use of this technology. Despite this, not all professionals are convinced about the application of this technology in healthcare. Concerns with self-diagnosis, misdiagnosis, self-treatment and confidentiality are among the most common cited problems. However, there are certain situations which e-Health may play a pivotal role.

Despite many technological advances in dentistry, the burden of oral disease remains high. Caries and periodontal disease continues to be the most prevalent medical condition in Australia. Many have attributed this problem to be due to a lack of a national oral health policy. As a result, a large number of Australians continue to face difficulties with accessing essential dental services with least one in three people avoiding the dentist due to cost. In response to this growing concern, the Commonwealth government recently introduced the Chronic
Disease Dental Scheme (CDDS) as the first major dental policy to attract Medicare rebates.

Implementation of the CDDS was a risk as this represented unprecedented policy. There was a paucity of research and no general consensus between influential stakeholders as to the best way to approach oral health policy.\(^8\) In other areas, while Australia has existing mechanisms that enable data linkage between the health professions, there is a lack of clinical data relating to dental and general health outcomes. The Australian National Advisory Council on Oral Health made the statement “Public health does not receive sufficient emphasis. There is a need for sustained data collection activity as there are gaps in population level data”.\(^9\) This sentiment reflects general consensus about epidemiological research; these studies require considerable investment making it is difficult for follow up or comparative studies.\(^2\) Despite this, the US Surgeon Report identified a need for more population level research as the key to reducing the burden of oral disease.\(^10\) Given these concerns, the objective is to critically discuss one way in which e-Health can benefit population level research using the CDDS as an example.

**Why is it difficult to obtain dental health data for research?**

Dentistry is one of the most isolated health professions with a high degree of autonomy. The majority of the workforce operate in private practice which also happen to be small businesses in a free market economy. Unlike medicine, Commonwealth governments have been reluctant to fund dental services. The exclusion of dentistry from Medicare has created the uncanny situation in which no government subsidy is afforded to treating the mouth whereas other organs such as the ear, nose or throat are recognized. Dentists have therefore operated in a climate with little government influence. This may affect response rates or questionnaires because dentists operate in a busy clinical environment as independent business owners.

Another confounding problem with obtaining health data in dentistry is that a high volume of activity is based around the regular attendance of asymptomatic patients. With many practices favouring cosmetic and elective services, this may
create distortions in health need and supply.\textsuperscript{11,12} It is becoming increasingly
difficult to ascertain whether dentistry is a health service or a cosmetic
commodity; making it difficult to plan national policies with a primary health focus.
\textsuperscript{11}

There is also the issue of exclusion bias which may be prominent in the dental
environment. Exclusion of data may represent localised or acute problems with
accessing dental services and its omission in population data may convey a more
optimistic situation than actually exists. Many patients expressed difficulty in
paying a $120 health bill which is lower than the average fee to visit a private
dentist.\textsuperscript{6,7,11} It is also difficult to quantify the number of patients in the public sector
awaiting treatment. Best estimations have indicated that up to half a million
Australians are on public wait lists which have been reported to be as high as
seven years.\textsuperscript{11} Many of these people may be disheartened about public services
to the point that they fail to maintain their registration. Another source of
discrepancy is the number of patients presenting to emergency departments for
palliative care. Emergency admissions to hospitals due to preventable dental
diseases are the fourth most common presenting condition.\textsuperscript{13} A majority of these
individuals do not have a dental home and only seek palliative care on a needs
basis.\textsuperscript{13} As such, it is difficult to sample or quantify these individuals.

\textbf{What is special about the CDDS and how can this make e-Health effective?}
The administration of the CDDS provided the unique opportunity to demonstrate
the effectiveness of e-Health in obtaining population research data. Using the
industry standard Australian \textit{Schedule of Services and Glossary} and a single
department responsible for processing all claims, it was possible to obtain a
complete (census) database.\textsuperscript{11,14} This database represented all treatment
provided under the scheme as an indirect result of processing claims.\textsuperscript{15} All private
practices participating in the scheme were required to submit item codes to the
Department of Health for processing. This addressed the common problem with
low response rates in epidemiology. As a result, the database was real-time,
automated, complete, continuously updated and sensitive to changes in service
provision.
The importance of complete data capture has been highlighted by Susser in stating that “The present era of epidemiology is coming to a close. We need to be concerned with causal pathways at the societal level”.\textsuperscript{16(p669)} Likewise, Stanley stated the need to “shift the focus on single risk factors in individuals to societal and environmental contexts”.\textsuperscript{17(p41)} These sentiments reinforce the importance of complete capture of clinical data to account for the complexity and synergy of multiple risk factors.

As dental services are translated into item codes, they are amendable to data collation. On its own, each item code is very prescriptive in describing a dental procedure. In concert, analysis of these codes provides clues to patterns of care. By publishing these codes into subgroup categories such as age, gender and jurisdiction, a population level analysis of the CDDS was possible. Table 1 and 2 provides a summary and example of how item numbers are used by the dental industry. Although unavailable on this occasion, a key recommendation would be to list these item codes against geo-coding (postcode) to permit an assessment of socio-economic status and geography (rural vs. metropolitan).

Although the CDDS was considered unsuccessful, its mechanics had demonstrated an effectively way to seamlessly obtain valuable research data. This data would otherwise require considerable resources with traditional research methods. The benefit of real time, automated and cumulative data collation enables the opportunity for comprehensive research with data that is responsive to changes in health when they become apparent. Publishing this database online allowed for independent analysis by the general public. It would be of great benefit if future oral health policies followed this system of administration to monitor population oral health needs over time.
Table 1: Description of ADA item numbers used in the CDDS

<table>
<thead>
<tr>
<th>Nature of Services</th>
<th>Treatment Description and General Objectives</th>
<th>Example</th>
<th>Item Code Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic</td>
<td>An information gathering exercise where clinical observation, special diagnostic tests, radiographs and photographs are taken to establish a diagnosis</td>
<td>The item code 011 relates to a comprehensive examination of the oral cavity. This is a standard requirement.</td>
<td>011-086</td>
</tr>
<tr>
<td>Preventive and Prophylactic</td>
<td>The removal of the aetiological agents of disease. Patients are also instructed on appropriate lifestyle changes as well as oral hygiene techniques. As this phase deals with disease control and stabilisation, it is the most important part of oral health.</td>
<td>Item code 114 relates to the use of mechanical and hand instruments to remove plaque from the surfaces of teeth.</td>
<td>111-171</td>
</tr>
<tr>
<td>Periodontics</td>
<td>This phase focuses on gum health and deals with the removal of plaque and calculus. This ranges from simple prophylactic procedures such as tooth debridement to removal of soft tissues surgery to facilitate cleaning.</td>
<td>Item code 222 relates to periodontal treatment involving debridement to remove plaque and calculus responsible for periodontal disease.</td>
<td>213-282</td>
</tr>
<tr>
<td>Oral Surgery</td>
<td>This phase deals with the removal of soft and hard tissues that have poor prognosis, infection or part of an elective procedure</td>
<td>Item code 311 is used to indicate an removal of a tooth</td>
<td>311-399</td>
</tr>
<tr>
<td>Endodontics</td>
<td>This phase deals with the pulp/nerve that has been affected by the progression of disease to the inner aspect of the tooth.</td>
<td>Item code 419 involves removing the infected nerve from the tooth.</td>
<td>411-458</td>
</tr>
<tr>
<td>Restorative</td>
<td>This phase involves placing a filling/restoration to restore lost form and function. This phase has no role disease control but rather repairs the outcome of the disease process or to improve aesthetics.</td>
<td>Item code 531 involves placing a tooth coloured filling in a back tooth</td>
<td>511-597</td>
</tr>
<tr>
<td>Prosthodontics</td>
<td>This involves prosthetic devices to replace missing teeth, reinforce weakened teeth or to improve appearance.</td>
<td>Item code 615 involves placing a crown/cap onto a tooth</td>
<td>611-779</td>
</tr>
<tr>
<td>Orthodontics</td>
<td>The movement of teeth into favourable positions to correct irregularities and misalignment or to improve contacts of the teeth and/or jaws.</td>
<td>Item code 811 involves fabrication and placing a removable orthodontic appliance</td>
<td>811-881</td>
</tr>
<tr>
<td>General Services</td>
<td>Palliative care procedures which only relieve pain without addressing the cause.</td>
<td>Item code 911 relates to palliative care where the aim is to provide pain relief in an emergency situation.</td>
<td>911-972</td>
</tr>
</tbody>
</table>
Table 2: Case Study

**CDDS Case Study**
Mrs X is a 65 year old female. She has suffered a recent stroke with right side partial paralysis. She has recently been diagnosed with type 2 diabetes. She is taking a range of anti-hypertensive and diabetic medications. Unfortunately, this combination of poly-pharmacy has caused dry mouth, making it difficult for her to chew. Her reduced ability to brush and the impact of her medications has caused her gums to swell. Considered as a chronic case, her GP had utilised dental benefits under the CDDS.

The dentist carried out a standard comprehensive examination (011). She received a clean at this visit (114) as well as periodontal therapy on her molar tooth (222). Unfortunately, this tooth was later extracted due to severe periodontal disease (311). Options were given with regards to the space resulting from the extraction such as leaving the space or providing a denture (721), implant (661) or a bridge consisting of two crowns and a pontic tooth (615x2, 643). She opted for the bridge.

During the course of her treatment, the dentist lodged all item numbers to the government department. For Mrs X, these item numbers consisted of 011, 114, 222,311,615 x 2 and 643. These ADA item numbers formed the basis of the Medicare database.

What types of information can be obtained?
Based on accessing the database and interpreting the codes against the schedule, a sample of policy relevant information is shown (Fig 1 to Fig 4). From this database, it is easy to deduce what types of services public policy has funded and where these services were provided. As this represents complete data, it is possible to assess utilisation based on geography (regional variation) without sampling bias. Stated differently, as there is no exclusion bias, the dataset reflects actual utilisation patterns and the real problems that exist. Areas with low claims may represent localised problems with accessing dental services, which may prompt targeted measures. Conversely, it is also possible to identify cost concerns when they become apparent, such as in the provision of reconstructive (crown and bridge) services in the state of New South Wales. Continuous
assessment of services provides an effective mechanism to monitor policy performance and sustainability.

This approach to data collation and analysis can also supplement existing work in other areas of e-Health. Australia has made considerable progress in IT infrastructure for the purpose of linking health data.\textsuperscript{18} Relating key metrics in health such as hospital admissions, births, mortalities, disabilities and drugs with dental outcomes provides a more comprehensive database of health information. As the oral cavity can provide clues to systemic illnesses, integration of health data is invaluable in assessing overall patient care. This provides clues to the ultimate measure in dental public health; quantifying the impact of dental intervention to general health. With the addition of geo-coding, the effects of water fluoridation and localised public health measures can be quantified.

\textbf{Figure 1: Nature of services adjusted for differences in population}
Figure 2: Patient Cohort by age and gender

![Patient Cohort by age and gender](chart1)

Figure 3: Cost Breakdown by type of services

![Cost Breakdown by type of dental service](chart2)
What are the practical challenges of implementing and sustaining e-Health initiatives?

As demonstrated by the CDDS, a complete database was obtained as an indirect result of administering the scheme. This was possible because dentists were required to submit industry standard item codes to a government department for processing before receiving Commonwealth funding.

Without a dedicated policy such as the CDDS, it is still possible to obtain large data but this would require strong professional leadership to foster cooperation between practices. Practically, only an electronic database would suffice, mandating that practices need to shift from paper to digital records.

As the database consists entirely of item codes/numbers with no means to identify individuals, it is envisioned that issues with privacy and confidentiality would be minimal.

Interpretation of item codes requires clinical knowledge of dental procedures. As such, a clinically trained professional such as a dentist specialising in public
health would be ideal in assessing patterns of care. This specialist would act as a conduit between the government and the dental profession to foster stronger communication between the parties.

**Conclusion**

Despite its importance to quality of life and wellbeing, epidemiological research requires considerable investment in time and resources. The use of electronic technology has created many opportunities to improve health services. Using the Chronic Disease Dental Scheme as an example, one way in which e-Health technology can benefit population level research is presented. The CDDS method of electronic administration has demonstrated an effective way to seamlessly obtain valuable research data; overcoming many of the problems with traditional data collation. This data consists of non-identifiable item codes that are real time and complete, allowing for continuous monitoring of policy and assessment of utilisation patterns. With the potential for health data linkage, e-Health has been proven to be an invaluable tool for population level dental research.
References


CHAPTER 8: How a modified approach to dental coding can benefit personal and professional development with improved clinical outcomes

Abstract
One disadvantage of the remarkable and often rapid achievements in dentistry is that treatment planning has never been more varied or confusing. The progress of these achievements has also widened the gap between new techniques and its evidence base. This has promoted researchers to look into new ways to supplement traditional research methods to consolidate Evidence Based Dentistry. One area that has shown promise is the field of dental informatics. A sub-area of this speciality is dental coding, where a description of treatment can be represented numerically rather than in words. This provides the opportunity for large electronic data analysis. Despite its potential, informatics has yet to be accepted into mainstream practice. The objective of this discussion is to present an alternative form of informatics using the Australian Schedule of Services and Glossary as a point of reference. By adding suffix codes to existing item numbers, there is the opportunity for each dentist to not only benefit from self-assessment but also affording them to opportunity to contribute to research. This may be one way of strengthening EBD for better clinical outcomes. The difference with this method is the focus towards circumstantial information rather than on diagnostics or disease severity.
Background

It can be argued that the purpose of research in dentistry is to better understand the disease process and clinical procedures so that improved outcomes can be achieved. On the surface, it may seem that dentistry has made tremendous advances with a plethora of new techniques and materials. However, at a clinical level, not all dentists agree to certain procedures and there are mixed views in approaching a clinical situation.\(^1\) Central to this problem is that newer techniques lack a comprehensive evidence base. Dentists demand information on success rates, longevity and adverse effects, where extensive information may not always be available for newer procedures. The difficulty is also compounded with a more informed and litigious society where access to online information has never been easier. Although patients may express interest in newer techniques that have been marketed well, it may be a challenge to place patients' expectations in the context of the evidence. While modern dentistry has a lot to offer, it has also made treatment planning more difficult and confusing.

To assist in the decision making process, dentists have relied on best available evidence to guide clinical decisions. This has been termed Evidenced Based Dentistry (EBD) by professional organisations worldwide.\(^2,3\) Despite merit in its concept, there are difficulties with establishing an evidence base. Dentistry is an autonomous profession with the majority of dentists committed in busy private practices with very few active in research. Dental procedures are technique sensitive and results can vary significantly between operators.\(^1\) There are also a range of patient, environment and operator variables making no clinical situation the same. This calls to question the relevance of the literature for the treating clinician. Can dentists reliably quote published results as the basis of their treatment?

The situation is more challenging when there are gaps in knowledge. For example, a frequently discussed topic in operative dentistry is the ultra-conservative stepwise technique. This technique argues that it is better to leave deep carious lesions in-situ rather than exposing the pulp through complete removal. Some proponents advocate that restricting caries from its nutrients by sealing the cavity is sufficient to arrest the disease process.\(^4\) However, in a Cochrane review by Burrow, it was reported that “the trials selected for review
were not ideal and there is a need for more clinically based evidence to assist in the decision making process". In a survey by Riordan, over half of respondents resorted to restoring reversible cavities confined to enamel when current evidence suggests otherwise. These problems are common in all areas of dentistry. Although these principles embodied by EBD are universally accepted, in reality, the gap between research and clinical practice may be significant.

Given these concerns, there is benefit in considering measures to improve EBD. One major problem with research is that it is often uni-directional in that there is little feedback or continuation of its evidence base. A majority of dentists rely on published results as surrogate markers; inferring that they will be able to match reported results. This may not always be true as there is a correlation between success rates, the environment and clinical experience. As such, it would be beneficial for each dentist to quantify and compare their results with that of their peers and the evidence base. High quality studies rely on a large number of comparable studies and favourable response rates. Many areas of dentistry are not amenable to randomised control trials and meta-analyses are often lacking in acceptable studies. Regrettably, general practice clinicians who are the beneficiaries of new procedures are often too busy in private practice to engage in research. It would be ideal if there were mechanisms to ensure that every dentist can benefit and also contribute to research without sacrifices to their clinical time. What better indicator for self-development than a dentist's own historical data that reflects their clinical practice which can be compared with their peers?

This is possible in the field of dental informatics. The objective of this discussion is to present the proposal that dental informatics can enhance research for both the dentist and the entire profession. This topic will focus on the Australian context using the industry accepted Glossary and Schedule of Services.

**Dental Informatics**

Dental informatics refers to the application of computer and information science to improve dental practice, research, education and management. It is part of e-Health and seeks to improve health care through the application of information
technology to administration, research, information gathering and knowledge sharing. Application of informatics is consistent with the World Health Organization (WHO) vision of developing numerical based codes for health services. One sub-area of this emerging field is dental coding.

In most parts of the world, dental services are administered by item codes. These codes are allocated after treatment and form a part of the clinical records. A dental appointment often consists of a series of codes to describe all services provided at that visit. In Australia, these item codes are based according to the Australian Schedule of Services and Glossary. Similar to most schedules around the world, these item codes are encyclopaedic, encompassing and specific enough to describe almost any clinical procedure. Item codes enable a numerical description of services which would otherwise be written in words. However, the former provides the convenience for large data analysis. This has been recognized in the literature with an increasing number of studies focusing on item codes in dentistry.

So far, most studies on dental coding have focused on diagnostics. A report titled “Oral Status and Interventional Index” adopted by the World Health Organization (WHO) proposed a classification index for oral health. The aim was to provide a single digit integer from 0-9 to describe oral health status and the complexity of care. This model was based on the more successful and established medical model; the “International Classification of Disease”. Arising from this system was a more recent classification system known as the “Systematized Nomenclature of Medical Terms (SNOMED-CT).” Dentistry tried to replicate this model (SNODENT-CT) but its scope was limited and infrequently used. It was reported that dentistry lacked an acceptable vocabulary to classify and identify oral disease. Its use was limited as the majority of oral disease, in terms of volume of cases, belonged either to caries or periodontal disease. It seemed that the specialisation of dentistry to the oro-facial region did not require as broad a diagnostic system as in medicine which dealt with the systemic system. This promoted researchers to explore other areas of dental coding. Another system developed by WHO was a dental subset of its classification known as ICD-10. Rather than focusing on diagnostics, it concentrated on disease severity. For example, its sub-codes describe the extent of caries such as within enamel,
dentine or approximating the pulp. Despite this, its application has mainly been academic with limited use in the Australian dental industry (both private and public sectors). One possible factor limiting its application is that dentists were unwilling to learn or have the time to implement another classification system.

In a review of the current state of dental informatics, Schelyer concluded that “the road to clinical practice supported by informatics will be nothing short of arduous. Putting these concepts into practice requires significant effort and investment”. It has been postulated that dentists would only adopt such a system if there were tangible benefits to them without sacrificing clinical time or requiring substantial start-up cost.

**How a modified approach to coding could benefit dentistry**

This discussion proposes an alternative approach to coding that would benefit each clinician as well as the entire profession at large. As they currently exist, item codes are retrospective and provide no information about health status or the situation in which the procedure was performed. Rather than focusing on diagnostics or further classifying the severity of diseases, it would be of greater benefit to provide circumstantial information to existing item codes.

Using existing item codes makes implementing this method easier as dentists would not have to learn a new classification system. An informatics study in a Canadian community dental clinic found that using a system that dentists were familiar with was more likely to increase utilisation. When dentists select item codes as usual from their digital software, it has been proposed that a checkbox of options appear next to the code to describe circumstantial information relating to the procedure(s) completed. These item codes are still used for administrative purposes such as in clinical records, invoicing or making claims from third party providers. However, by extending existing item codes to provide circumstantial information, each dentist would seamlessly develop a database of clinical relevant information for self-assessment and research.

Clinicians would like to know how long their restorations lasted, whether the use of a particular liner or base was effective, what was the dental history of the tooth extracted or the time since a particular tooth was last restored. The database of
codes reflects each dentist’s preferences for approaching a clinical problem. For example, a dentist who practices the ultra-conservative stepwise technique can compare their results against a dentist that would rather obtain a caries free cavity preparation; or comparisons can be made against single visit endodontics versus multiple visits etc. With large data, it is envisioned that individuals cases would normalise over time to give each dentist a general overview of their performance. By shifting the focus of coding towards clinical circumstances, dentists would not only be able to quantify and compare health outcomes from various interventions but they will also have a personalised database of results that they can compare with their peers and against published results. This would be an invaluable tool for continuous assessment, personal development and quality assurance. The profession would also benefit as all its members would have a chance to provide much needed feedback to the evidence base without the need for significant time or resources.

How exactly would this work?
Similar with many schedules throughout the world, the Australian Glossary and Schedule of Services is very prescriptive and encyclopaedic. Every service or act of dentistry is assigned a unique item code. The schedule provides detailed guidelines about what actions a clinician must perform to be able to assign that code as part of treatment. For example, a one surface posterior adhesive restoration is assigned the item code 531 in the Australian schedule; which is equivalent to a 02380 in the American system. These numeric codes represent a service which would otherwise be written in words but in a more computer readable descriptor.

The addition of suffixes to existing item codes is one way of providing circumstantial information. These suffixes are additional numeric codes that are based on the selected checkbox of options which appear when a dentist chooses a particular item code. As such, dentists do not need to learn an additional classification system or remember what numbers each suffix represents as this would be digitally automated and annotated as a popup template. For convenience and consistency, a modified form of coding similar to the ICD index has been proposed. The suggested format would then be a numeric sequence such as [ADA-001-002-003] where ADA represents the schedule code with a
trailing series of sub-codes. As selection of these codes form part of the clinician’s course of care, circumstantial information relevant to the treatment can also be recorded.

**What are some examples of how this method may work?**

A commonly prescribed code in the schedule is a comprehensive examination. Represented by the code (011), this service is performed when a clinician sees a new patient for the first examination. Although this procedure is a systematic examination of the oral cavity, the reasons and motivations of each presenting patient are different. Some patients are reliable, visit the dentist regularly and are well schooled in oral hygiene. For various reasons such as relocation or retirement of their existing dentist, they may need to see a new clinician. Given this knowledge, this may prompt the new dentist to monitor borderline cases where restorative intervention is considered. There are many protocols to guide clinicians as to when to operatively intervene but few consider compliance as this information may not be readily assessable. Keller noted an increased tendency to replace restorations when a patient sees another dentist for the first time.\textsuperscript{15} A minimalist approach to dentistry may be possible with circumstantial information demonstrating compliance. On the flip side, some patients only present to the clinic when an acute exacerbation of disease becomes unbearable. This may prompt a focus of prevention, disease control and education before any complex rehabilitation is considered. In some situations, time dictates the nature of treatment such as in traumatic dental injuries where patients may present to the dentist anywhere between 24 hours and 12 months after the incident.\textsuperscript{16} Without a systematic or standardised approach to trauma, only half of the important information is recorded.\textsuperscript{17} A checkbox of options appearing beside an examination for a trauma case may assist in recording all relevant findings.

These examples demonstrate many factors and presenting conditions likely to influence the success of various treatments. Recording this information by modifying existing item codes is one way to capture these circumstances (Table 1 and Table 2). While some of these terms may be subjective, such as caries risk, using existing protocols which define these terms may improve consistency between clinicians. For example, the Caries Management System by Evans quantifies many terms involved with caries including risk.\textsuperscript{18}
In operative dentistry, circumstantial information can be incorporated into item codes to indicate why a restoration was placed. It is at the pre-restorative phase where ambiguity exists on whether to intervene. There may also be different outcomes with the use of liners, bases, different bonding agents or placement techniques. Confusion also exists in the management of non-carious tooth lesions in teeth subjected to abrasion, erosion or attrition. Table 3 outlines a possible template to record important pre-restorative information. It is important to note the time since a tooth was last restored as this can give clues to oral health status, rate of caries progression and patient compliance.

These codes can be used to supplement existing population measures such as the commonly quoted Decayed Missing Filled Teeth (DMFT) index used in epidemiological research. For example, one of the item codes [531-001-003-006] relates to placing a restoration due to caries on a tooth that has not been previously restored; indicating active caries.

An opportunity also exists to link materials used with restorative item codes. There is considerable debate in the use of amalgam as direct restorations or formocresol as haemostatic agents in immature pulps. Location preferences such as the use of glass ionomers or cortico-steroid endodontic pastes in the southern hemisphere can also be recorded. The number of dressings in endodontic treated teeth would also provide more information concerning the issue regarding single vs multiple visit endodontics. These are a small sample of controversial topics in dentistry that can be quantified by large data to provide more certainty in treatment selection.

Another area worth consideration are item codes relating to the extraction of teeth (Table 4). This can provide clues to longevity, prognosis and enables the clinician to personally appraise their success rates with their chosen methods of treatment.
Table 1: Comprehensive Examination Template

<table>
<thead>
<tr>
<th>ITEM CODE</th>
<th>Patient Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>011-001-002</td>
<td>Post Code</td>
</tr>
<tr>
<td></td>
<td>Date of Birth</td>
</tr>
<tr>
<td></td>
<td>Sex</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sub Code 1</th>
<th>Time since last exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>Less 6 months</td>
</tr>
<tr>
<td>002</td>
<td>6-12 months</td>
</tr>
<tr>
<td>003</td>
<td>1-2 years</td>
</tr>
<tr>
<td>004</td>
<td>2-5 years</td>
</tr>
<tr>
<td>005</td>
<td>More than 5 years</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sub Code 2</th>
<th>Disease and caries risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>Low</td>
</tr>
<tr>
<td>002</td>
<td>Medium</td>
</tr>
<tr>
<td>003</td>
<td>High</td>
</tr>
</tbody>
</table>

Note: Sub Code 2 relating to caries risk can be based on various protocols in the literature such as the Caries Management System by Evans.18
Table 2: Limited Examination Template

| ITEM CODE | Patient Details | | | |
|-----------|----------------|---|---|
| 013 AAA-BBB-CCC | Post Code | XXXX | | |
| | Date of Birth | XX | | |
| | Sex | M/F | | |
| | Reason for Presentation | Sub-classification | Time |
| Sub Code 1 (AAA) | Sub Code 2 (BBB) | Sub Code 3 (CCC) | |
| 001 | TRAUMA | Classification | Time of Injury |
| 001 | Uncomplicated Crown | 001: less than 15 minutes | |
| 002 | Complicated Crown | 002: 15 - 60 minutes | |
| 003 | Crown Root | 003: More than 60 minutes | |
| 004 | Subluxation | 004: More than 1 day | |
| 005 | Concussion | | |
| 006 | Root Fracture Coronal 2/3 | | |
| 007 | Root Fracture Apical 1/3rd | | |
| 008 | Luxation | | |
| 009 | Avulsion | | |
| 002 | ORTHODONTIC | Eruption Status | Time since last visit |
| 001 | Early Dentition | 001: Less than 6 months | |
| 002 | Mixed Dentition | 002: 6-12 months | |
| 003 | Permanent Dentition | 003: 1-2 years | |
| | | 004: 1-2 years | |
| | | 005: More than 2 years | |
| 003 | EMERGENCY ACUTE | Origin | Time since last treatment |
| 001 | Caries | 001: Less than 3 months | |
| 002 | Periodontal | 002: 3-6 months | |
| 003 | Pericoronal | 003: 6-12 months | |
| 004 | Oral Med (soft tissue) | 004: 1-2 years | |
| 005 | Crack | 005: More than 2 years | |
| 006 | Non carious tooth loss | | |
| 004 | CONSULTIVE | Nature of Consult | Time since last visit |
| 001 | Prosthodontic | 001: Less than 6 months | |
| 002 | Restorative | 002: 6-12 months | |
| 003 | Aesthetic | 003: 1-2 years | |
| 004 | Impacted Teeth | 004: 1-2 years | |
| | | 005: More than 2 years | |

Note: a limited examination is a problem focused examination that deals with the presenting complaint. As such, there is greater variability in this examination to reflect the number of possible presentations.
Table 3: Restorative Template

<table>
<thead>
<tr>
<th>ITEM CODE</th>
<th>Patient Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>531-001-002-006</td>
<td>Post Code XXXX</td>
</tr>
<tr>
<td></td>
<td>Date of Birth XX</td>
</tr>
<tr>
<td></td>
<td>Sex M/F</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sub Code 1</th>
<th>Reason for Restoration</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>Caries on Virgin Tooth X</td>
</tr>
<tr>
<td>002</td>
<td>Recurrent Caries</td>
</tr>
<tr>
<td>003</td>
<td>Non carious tooth loss</td>
</tr>
<tr>
<td>004</td>
<td>Prophylactic</td>
</tr>
<tr>
<td>005</td>
<td>Trauma</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sub Code 2</th>
<th>Depth of Restoration</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>Enamel</td>
</tr>
<tr>
<td>002</td>
<td>DEJ                  X</td>
</tr>
<tr>
<td>003</td>
<td>DEJ outer 1/3 Dentine</td>
</tr>
<tr>
<td>004</td>
<td>Within inner 2/3rd Dentine</td>
</tr>
<tr>
<td>005</td>
<td>Indirect Pulp Capping</td>
</tr>
<tr>
<td>006</td>
<td>Direct Pulp Capping</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sub Code 3</th>
<th>Time since tooth last treated</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>Less 6 months</td>
</tr>
<tr>
<td>002</td>
<td>6-12 months</td>
</tr>
<tr>
<td>003</td>
<td>1-2 years</td>
</tr>
<tr>
<td>004</td>
<td>2-5 years</td>
</tr>
<tr>
<td>005</td>
<td>More than 5 years</td>
</tr>
<tr>
<td>006</td>
<td>N/A X</td>
</tr>
</tbody>
</table>

Notes

Non carious tooth loss relates to erosion, abfraction, abrasion and attrition

"This entry depicts an adhesive restoration that was placed on an non restored virgin tooth due to caries that had reached the DEJ"
Table 4: Simple Extraction Template

<table>
<thead>
<tr>
<th>ITEM CODE</th>
<th>Patient Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>311-002-004</td>
<td>Post Code XXXX</td>
</tr>
<tr>
<td></td>
<td>Date of Birth XX</td>
</tr>
<tr>
<td></td>
<td>Sex M/F</td>
</tr>
</tbody>
</table>

**Sub Code 1** | Reasons for Extraction
---|---
001 | Periodontal
002 | Recurrent Caries
003 | Non carious tooth loss
004 | Endodontic
005 | Pericoronal/Impacted
006 | Prophylactic
007 | Trauma
008 | Orthodontic
009 | Oral Medicine Related

**Sub Code 2** | Time since tooth last treated
---|---
001 | Less 6 months
002 | 6-12 months
003 | 1-2 years
004 | 2-5 years
005 | More than 5 years

**Sub Code 3**
---
001 | Elective
002 | Non Functional/ Non-strategic
003 | Non Restorable/ Poor Prognosis
004 | Financial
005 | Medically and Lifestyle related

"This entry depicts the extraction of a tooth that developed endodontic and peri-radicular complications as a result of unsuccessful treatment over last 6-12 months with the patient opting for extraction for financial reasons"
What are the practical challenges?
As with any new proposal it is uncertain whether the profession will accept this model. An overview of many schedules indicate that there are hundreds of item codes in dentistry. This proposal does not attempt to replace clinical notes or change schedules but rather aims to identify opportunities to improve research with the resources a dentist would already have in their working environment (i.e.- access to a computer). The aim is to identify key item codes to consolidate dental research. To benefit from these features, it is mandatory for practices to move from paper to digital records. The templates need to be incorporated into existing dental practice software. The greatest benefit from this technology would be for the global profession to adopt a universal set of codes to allow for consistency and transparency. If this were to occur, every dentist in the world with a computer would be able to contribute to the evidence base without significant sacrifices to their clinical time. The magnitude of data that would not be possible with traditional research methods without significant resources.

Conclusion
This discussion introduced a novel method of using item codes in the field of dental informatics to enhance evidenced based research. Using item codes contained in the Australian Schedule and Glossary of Services, there is an opportunity to obtain valuable information by adding suffix codes to key item codes. The key difference with this method is that it utilises an existing schedule where these suffix codes represent circumstantial data. This is different to previous models which were based around diagnostics or assessing disease severity. Under this proposal, these modified codes not only provides valuable self-assessment for the dentist, but also the opportunity to contribute to global dental research.
References


Section Three: Tumour, Trauma and Trust

Preface
The key to improving dental health and making oral health policy work does not rely solely on how well policy is formulated or how well dental science is researched. There are other factors that influence presentation to a dental professional.

Misdiagnosis and continual pain can contribute to patient anxiety and frustration which can impact patient attendance. Not all signs and symptoms that occur in the mouth are abnormalities within the mouth. This underscores the importance of a dental examination and the systematic steps taken to reach a definitive diagnosis. The importance of these principles will be highlighted by discussing a rare case of non-odontogenic tumour masked as a simple toothache.

Health promotion and health education are important components of health policy. Apart from providing clinical care, this is where dentists can take a more proactive role as community health leaders. Ultimately, patients need the health belief that presenting for dental services is necessary. There are also situations where the prognosis of teeth is dependent on what occurs before seeing the dentist. This will be highlighted using a very important public health issue in traumatic dental injuries.

With ample online information afforded by modern technology and greater patient expectations, dentists are at increased risk of litigation. This can harm public perceptions about dentistry and affect attendance patterns. As such, there is a need to reinforce the importance of communication and developing patient trust. This will be demonstrated by exploring the field of dental law and litigation.

Although the topics in this section are wide and varied, they contribute to the more personal attributes in the framework for an ideal oral health system. There is a need for ethical, culturally aware and competent professionals with the ability to empower individuals and communities.
CHAPTER 9: Acoustic neuroma manifesting as toothache and numbness

Abstract
Acoustic Neuroma, also known as Vestibular Schwannoma, is a rare benign brainstem tumour involving the abnormal growth and proliferation of Schwann cells surrounding the vestibular division of the eighth cranial nerve. Although the most common symptoms are non-dentally related, there are instances where diagnosis of this potentially life threatening condition is triggered by an emergency presentation to the dentist for the most trivial of reasons. A 56 year old male presented to a dental clinic complaining of a toothache. Following history taking, examination and radiographs a carious lower right molar was extracted. The patient reported relief but later described post extraction numbness on the opposite side (left) of his lower jaw that could not be explained by anatomical principles or previous dental history. Further investigations revealed an acoustic neuroma as the underlying cause. This case highlights that not all signs and symptoms that occur in the mouth are abnormalities within the mouth. In particular, this case underscores the importance of recognizing that the spontaneous onset of certain oral symptoms may be due to significant non-dental pathology. Any numbness over the distribution of the trigeminal nerve must be investigated. The importance of the basic sciences and referring will also be emphasised.
INTRODUCTION
Acoustic Neuroma is a rare benign brainstem tumour involving the abnormal
growth and proliferation of Schwann cells. Unabated growth can compress
cranial nerves V to XII. This area is rich in nerves, their sensory tracts on the
lateral side of the medulla and vascular structures (vertebral, basilar arteries and
their important branches) around the brain stem (Figure 1)\textsuperscript{1}. Compression of
these structures may result in a series of complications with the most common
symptoms being tinnitus, hearing loss and imbalance\textsuperscript{2}. Despite this, these
tumours can also present with other symptoms.

This case report describes how a common complaint resulting in a visit to the
dentist resulted in the detection of an acoustic neuroma. A patient with a
toothache sought treatment in a dental clinic as an emergency visit. The source
of the pain was located, and the offending tooth extracted. Shortly after reporting
relief from his presenting complaint, the patient reported unusual patterns of
altered sensation that could not be explained by anatomical principles or previous
dental history. In presenting this case report, an appreciation of the basic
sciences as well as the importance of multi-disciplinary management will be
emphasised. Whilst a complete account is documented, the focus is on aspects
that are important to the general dentist rather than on the surgical aspects
involved with neurosurgery.
Figure 1: Acoustic Neuroma and its relationship to nerves and vessels

Small neurinoma arising from superior vestibular nerve in internal auditory meatus and protruding into posterior fossa.

Large acoustic neurinoma filling cerebellopontine angle, distorting brainstem and cranial nerves V, VII, VIII, IX, X.
CASE REPORT
A 56 year old male with a history of well controlled type II diabetes mellitus and hypertension presented to the dental clinic complaining of a toothache. Following history taking, examination and radiographs (Figure 2) a carious and unrestorable lower right molar (47) was extracted under an inferior alveolar nerve block. The extraction was uncomplicated. The dentist contacted the patient by telephone a few days later and his presenting pain had subsided.

Figure 2: A peri apical radiograph demonstrating extensive caries breaching the pulp on the distal aspect of tooth 47.

Three weeks later the patient reported numbness on the tongue and lip which caused difficulty with eating. He was advised to return to the clinic for a review examination. The findings at this appointment were most unusual.

Two inconsistent findings in relation to the recent extraction and numbness prompted the dentist to consider alternative diagnoses. Firstly, as the peri-apical radiograph demonstrated that the apex of the tooth was beyond the inferior alveolar canal, its extraction was excluded as the cause of the numbness. Secondly, the numbness on the lip and tongue was always on the opposite side of the extracted tooth.

The patient was questioned further about his history. He reported a previous burning sensation on the left side of the tongue not mentioned at the initial examination. The dentist initially thought this may be associated with the disturbance to his diabetic condition following the recent extraction. An OPG was
taken for general assessment of the maxilla-mandibular region (Figure 3). As the image did not provide further clues to explain the symptoms with local causes excluded, the patient was referred to an Oral Medicine specialist where the condition was jointly monitored and investigated.

**Figure 3: A panoramic tomogram obtained 3 weeks after the extraction of tooth 47 showed no signs of obvious pathology relating to his presenting symptoms**

The patient informed the dentist that the numbness had shifted over time. Using a periodontal probe and noting the patient’s response, the numbness (anaesthesia to reduced sensation) had shifted around the orofacial region but was always on the patient’s left side. He noted that it was difficult to chew, which was likely due to the reduced tonicity and sensation of his muscles of mastication that accompanied the paraesthesia. This was further compounded by the increased burning sensation on the tongue and the patient favouring his left side when eating due to the recent extraction. Cranial nerve tests were within clinical normal limits, apart from a 10 year history of tinnitus in the left ear. Minor reduced hearing was also noticed in the left ear.

An MRI was obtained and the cause of the paraesthesia located (Figure 4). The images revealed a large complex solid mass alongside the brain stem averaging 20mm in all dimensions. The lesion was most likely an Acoustic Neuroma. Displacement of the maxillary and mandibular divisions of the trigeminal nerve
and widening of the auditory canal by the lesion had caused the unexplained numbness.

**Figure 4: MRI sections revealing tumour mass (indicated with "x")**

The patient was referred to a neurosurgeon and an ENT specialist where the lesion was surgically removed. The surgery resulted in an exacerbation in the loss of hearing and resulted in a drooping eye from facial palsy on the left side. The patient's speech and chewing were affected as well as occasional dental discomfort consistent with trigeminal neuralgia.

**DISCUSSION**

**Diagnostic Challenge**

This case highlights the diagnostic challenges that may be encountered in the dental clinic. Appreciating that nerve injuries may occur when teeth are extracted, it was unsurprising that this was the dentist's provisional diagnosis. Renton et al reported that up to 70% of nerve injuries from extractions result in some form of neuropathic condition\(^3\). However, in the present case, it was the atypical location and character of the condition that raised suspicion.
Considering first principles, it was unlikely that damage to the mandibular branch of the trigeminal nerve would affect its contra-lateral side. Basic principles in neuro-anatomy indicate clear divisions between the left and right side with no evidence to demonstrate cross-over of nerve fibres. Furthermore, as the peri-apical radiograph excluded a local cause, namely nerve damage during extraction, there had to be another reason for the symptoms.

Since numbness over the patient’s face could not be explained by anatomical principles or previous dental history, a range of diagnoses were considered. Table 1 outlines a range of differential diagnoses, odontogenic and non-odontogenic, for the loss of sensation in the trigeminal region. After revisiting the history, and OPG was obtained for general assessment. As this did not provide any clues to explain the symptoms, further radiographic imaging was considered where a MRI subsequently revealed a tumour.

Table 1: Differential diagnosis for loss of sensation in trigeminal nerve

<table>
<thead>
<tr>
<th>Differential Diagnosis for loss of sensation in trigeminal nerve</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Developmental (eg. syringobulbia)</td>
</tr>
<tr>
<td>• Inflammatory</td>
</tr>
<tr>
<td>o Mixed Connective tissue Disease (eg. scleroderma)</td>
</tr>
<tr>
<td>o Autoimmune (eg. multiple sclerosis)</td>
</tr>
<tr>
<td>o Metabolic (eg. diabetes mellitus)</td>
</tr>
<tr>
<td>• Infective</td>
</tr>
<tr>
<td>o Viral (eg. Herpes zoster virus, herpes simplex)</td>
</tr>
<tr>
<td>o Bacterial (eg. syphilis)</td>
</tr>
<tr>
<td>• Neoplastic</td>
</tr>
<tr>
<td>o Intra-cranial compression (eg. acoustic neuroma, nasopharyngeal carcinoma)</td>
</tr>
<tr>
<td>o Perineural spread (eg. adenoid cystic carcinoma)</td>
</tr>
<tr>
<td>o Metastasis (eg. adenocarcinoma)</td>
</tr>
<tr>
<td>• Drug Induced</td>
</tr>
<tr>
<td>o Local Analgesia (eg. block analgesia)</td>
</tr>
<tr>
<td>o Prescription (eg. statins, anti-depressants, chemotherapeutics)</td>
</tr>
<tr>
<td>• Traumatic</td>
</tr>
<tr>
<td>o Maxillary and Mandibular Fractures (eg. middle cranial fossa, Le Fort)</td>
</tr>
<tr>
<td>o Iatrogenic (eg. implant placement, endodontics, third molar removal)</td>
</tr>
<tr>
<td>• Vascular</td>
</tr>
<tr>
<td>o Cerebrovascular disease (eg. stroke, embolism)</td>
</tr>
</tbody>
</table>

Note: This table was composed by the author from various sources to indicate some common causes of loss of sensation with the Trigeminal Nerve.
In relation to the initial toothache, this case represented two separate lesions presenting in a close temporal relationship. The patient presented with a toothache, received treatment and the pain resolved. He subsequently presented with neurological symptoms and referred for appropriate management. Stated differently, this case involved two mutually exclusive diagnoses with symptoms localised in the mouth. Any numbness over the distribution of the trigeminal nerve must be investigated until the source has been identified.

**Acoustic Neuroma**

In this case, an MRI at the level of the internal auditory canal demonstrated an Acoustic Neuroma. These are rare CNS tumours with an incidence of 1:100,000. Although the patient exhibited the classic symptoms of AN, namely tinnitus and loss of hearing, he considered these symptoms unremarkable. These symptoms had only been diagnosed as part of his dental follow up. The patient stated that he only sought treatment because the toothache became unbearable. In this instance, the patient received surgery to remove the tumour under the management of a neurosurgeon and ENT specialist.

**Post-operative status**

As surgical access to this confined zone is difficult, there is a high likelihood of introducing new symptoms and/or exacerbating pre-existing conditions. Many of these symptoms can be related to the nerves affected by the tumour (Figure 1). Damage to the facial nerve resulted in reduced tonicity in his muscles of facial expression, as well as affecting taste in the anterior two thirds of the tongue via the chorda tympani nerve. Similarly, compression of the hypoglossal nerve affects motor movement in this region of the tongue. Impingement of the maxillary and mandibular divisions of the trigeminal nerve caused neuralgic pain in the mid to lower face as well as affecting motor fibres that innervate the muscles of mastication. Due to encirclement of the vestibulocochlear nerve around the tumour, the patient suffered complete hearing loss on the left side and also affected his balance. The glossopharyngeal nerve that innervates the posterior tongue and pharynx resulted in swallowing difficulty (dysphagia), also contributing to speech difficulties. By appreciating anatomy, all potential complications following surgery can be predicted and explained to the patient.
CONCLUSION
An acoustic neuroma is a benign brainstem tumour that can manifest as a toothache and/or numbness around the oro-facial region. This case demonstrates that not all signs and symptoms that occur in the mouth are abnormalities within the mouth. It is important to recognize that the spontaneous onset of certain oral symptoms may be due to significant and more sinister non-dental pathology. Although this may present as a diagnostic challenge in dental practice, any numbness over the distribution of the trigeminal nerve must be investigated. This underscores the importance of the basic sciences and knowing when to refer to specialists for multi-disciplinary management.
References


CHAPTER 10: Minimally Legally Invasive Dentistry

Abstract
One disadvantage of the rapid advances in modern dentistry is that treatment options have never been more varied or confusing. Compounded by a more educated population readily assisted by online information in an increasingly litigious society, a major concern in recent times is increased litigation against health practitioners. The manner in which courts handle disputes is ambiguous and what is considered fair or just may not be reflected in the judicial process. Although legal decisions in Australia follow a doctrine of precedent, the law is not static and is often reflected by community sentiment. In medical litigation, this has seen the rejection of the Bolam principle with a preference towards greater patient rights. Recent court decisions may change the practice of dentistry and it is important that the clinician is not caught unaware. The aim of this article is to discuss legal issues that are pertinent to the practice of modern dentistry through an analysis of legal cases that have shaped health law. This is essential in modern clinical practice as there is a correlation between trust and positive health outcomes. Through these discussions, the importance of continuing professional development, professional association and informed consent will be realized as a means to limit the legal complications of dental practice.
Introduction
An unfortunate consequence of the advancements in dentistry is that treatment options have never been more varied or confusing. In an era of high expectation, consumer driven demand and ample online information, it is difficult to recall a time when a patient has been more informed. Newer technologies and materials are constantly pushing the boundaries of what is considered dentally possible. With the increasing importance of appearance and more expensive and complex options, it is unsurprising that dentistry is becoming more involved with litigation. Approximately one in seven dentists worldwide are sued annually and trends indicate that the number of claims is increasing each year.\cite{1,2} Interpretation of the law is difficult and ambiguous at best. Unlike dentistry which strives to be scientifically based on factual and proven evidence, law does not always lend itself to black or white solutions but is rather obscured with infinite shades of grey. Quite often, words in statute law are open to interpretation and the relevance of case law may be questionable. What is considered legitimate or fair may not always be reflected in the judicial process. Alarmingly, actions taken by a clinician and assumed to be standard may in fact be open to litigation. Justice Kirby discussed the impact on the unaware clinician as ‘the allegation of professional negligence is not only personally insulting, it is emotionally hurtful. It tends to attract media coverage and word gets around’.\cite{2} It is unfortunate that dentistry is now practised in a climate of increased legal risk and uncertainty. With this in mind, there is a need to appreciate the legal implications for the practice of modern dentistry. A basic understanding of the judicial process will at least provide the clinician with a platform to minimize legal complications from an informed position. It will also serve to confirm or to inform the clinician about how their patient management would fare in light of these current medico-legal developments. Clinicians also need to appreciate that there is a direct correlation between trust and positive health outcomes.

The aim of this article is to discuss legal issues that are pertinent to the practice of modern dentistry. The emphasis is on demonstrating how an appreciation of judicial decisions may enable clinicians to minimize the potential for litigation. A brief outline of the Australian legal system is followed by a critical analysis of key legal cases and how these principles may apply to dentistry. A secondary aim is to demystify these legal aspects for the dental practitioner with a focus on areas
that often appear in litigation. Whilst in certain instances a dental case appearing in court may be more relevant to the discussion, this article omits the identity of the dental practitioners involved and their situation. The selection of cases represents some of the most widely discussed in the legal literature and in many regards are considered as landmark cases. These cases are all publicly assessable from the law database AustLII and are often considered in medical litigation.4

It will be shown that the law is never static; decisions may be overruled or seem unjust and what is considered legitimate may change with time and community sentiment. As dentistry is often practised with high independence and autonomy, there is a risk that an uninformed clinician may be subject to litigation. This is not only harmful to the treating clinician but undermines trust in the entire profession. The importance of belonging and contributing to the profession as well as the need for continuing professional development (CPD) will be realized through these discussions. However, superseding all these aspects is the importance of informed consent, which ultimately determines whether litigation arises and is often unrelated to actual clinical care.

The Australian legal system
The Australian legal system shares much of its history with the English legal system. Although the Australian system evolved independently with the arrival of the first British settlers in Sydney Cove in 1788, it still practises the common law similar to many Commonwealth nations.5 Common law is the law developed by judges and is a major source of legal authority along with statutes and legislation. These primary sources of law constitute the letter of the law in Australia. Historically, in thirteenth century England, a practice was developed where royal judges appointed by the King ruled on disputes based on their opinions on what they thought were fair. This was the origin of precedent and while judgements were still based on opinion, there was a gradual evolution of the legal system in which current decisions were influenced by past decisions. Known as the doctrine of precedent, it follows that when passing judgement6:
(1) Courts are bound by the material decisions made by courts in a higher hierarchy. In Australia, the High Court, otherwise known as the ultimate appeal court, is the highest court with the greatest authority.

(2) A decision of a court in the same or lower hierarchy may be persuasive but not binding.

(3) A court will not consider itself bound by a past decision in the same hierarchy, but it will only depart from it with reluctance.

(4) Only the ratio decidendi (the reason for the decision) of a past case is binding for the above scenarios. This is often stated by the judge in the verdict.

(5) An orbiter dicta is a remark that is made in passing by a judge and is persuasive but not binding.

Judge made law (case law) can be considered as separate building blocks to a legal framework. Although judges make decisions on the case in question, they form a series of decisions dealing with the same general topic under the doctrine of precedent. This ensures consistency and fairness in future court rulings as similar cases may be referred to in the verdict. For this reason, it is essential that all health practitioners act ethically and do not set negative trends that may harm their profession. It will be shown that much of the principles discussed throughout this article arise from the application of this doctrine.

The legal relevance of standard of care
The issue ‘Standard of Care’ has for many decades been the cornerstone of health practice. Notwithstanding, there are still many supporters of the principle within the medical and legal professions. However, many may be unaware that Australian courts have recently downplayed its significance. First mentioned in Vaughan v Manlove in 1987 and made famous by Bolam v Friern Hospital Management Committee, the judge in the former case stated ‘Standard of Care’ as ‘reasonable caution a prudent man would have exercised under such circumstances’. As Australian law traditionally followed English law, one
landmark case in tort law (private law, such as negligence) became known as the Bolam Principle.\textsuperscript{9} Many Commonwealth countries still operate under this principle but in light of recent developments, it is essential for the dental practitioner to appreciate the current view of Australian courts as they may be surprised by some rulings.

In *Bolam v Friern Hospital Management Committee*, Mr Bolam was a manic depressive who was given electroconvulsive therapy.\textsuperscript{9} A complication of this procedure was the potential to fracture his bones from a resulting seizure. Measures such as relaxant drugs and restraints were available to reduce the chance of injury. However, the risk of injury was considered too remote and it was accepted practice to not warn patients of such risks or offer these precautions unless specifically asked. Unfortunately, Mr Bolam subsequently fractured his bones and launched legal action but lost in court. He argued that the doctors were negligent for not taking these measures and warning him of the risks involved. The *ratio decidendi* of the case according to Judge McNair was that 'if a doctor reaches the standard of a responsible body of medical opinion, he is not negligent'.\textsuperscript{9} This verdict placed enormous trust in the health professions as they were traditionally their own guardians in establishing standards.

Perhaps the most pivotal case that represented a landmark shift in health law involved *Rogers v Whitaker* in the Australian High Court.\textsuperscript{10} Mrs Whitaker developed a rare condition in her left eye. As a result of the penetrating injury, she was almost blind in her right eye. At the age of 47 she attended a routine eye examination in which ophthalmic surgeon Dr Rogers advised that he could operate on the right eye to remove scar tissue. In doing so, Mrs Whitaker was advised that this would prevent glaucoma and restore sight to that eye. Although Mrs Whitaker did not specifically ask about the complications, most likely due to her lack of knowledge about medical procedures, she seemed apprehensive. The apprehension was to the extent that pre-hospital records noted her concerns that the wrong eye would be operated. Unfortunately, the operation resulted in extensive inflammation in the right eye, triggering a rare condition known as sympathetic ophthalmia. This affected her functioning left eye, leaving her completely blind. Medical opinion concluded that the incidence was estimated in the vicinity of 1:14 000.\textsuperscript{10} The initial verdict by Justice Campbell in the Supreme
Court of New South Wales ruled in favour of Mrs Whitaker because she had not been properly warned of the risks. The judge considered her demeanour and situation, concluding that had she been adequately warned, she would not have undergone surgery.

This caught the profession by surprise and indeed Dr Rogers. He felt he had a strong case based on history, precedent and the Bolam principle. Cross examination proved no surgical error and it was established that no other surgeon would have operated differently. Although English cases were not legally binding in Australia, they were often persuasive (*orbiter dictum*) in court decisions. Notwithstanding, the material circumstances are identical to the Bolam case as the procedure was performed to an acceptable standard. Dr Rogers challenged this decision through the NSW Court of Appeal without success. Unsatisfied, the High Court of Australia, which is the ultimate appeal court, further dismissed the appeal thereby setting a new climate in health law.

As a result, this High Court decision represents a fundamental shift towards patient rights and concerns over medical paternalism. It may therefore come as a surprise that clinical competency and practice in accordance to science and professional endorsement may still leave a clinician open to litigation. Hence, it is essential to warn of all possible risks and the issue is not one of remoteness but rather severity.

This view was also reinforced in *Chappel v Hart*. If *Rogers v Whitaker* indicated a change in the courts’ perception that health professionals were not superior or omnipotent, this case further reinforces the predisposition towards patient rights. Here, Mrs Hart required surgery to remove a pharyngeal pouch from her oesophagus. The patient clearly sought information regarding the chance of losing her voice. She specifically informed the surgeon that she did not want to sound like a well-known politician in her jurisdiction that had damaged his vocal cords. She emphasized the importance of preserving her speech as her primary mode of employment was a teacher. Dr Hart assured her that the procedure was very common and safe, although no specific warning was given as to the nature of the procedure. Unfortunately, postoperative complications resulted in
irreversible damage to her laryngeal nerve where her gravest fears were realized.

This case is interesting as Mrs Hart conceded that her condition was progressive and required surgery. Although the court concluded that Dr Chappel performed the operation to an acceptable standard, he was negligent as he failed to advise Mrs Hart of the risks. Whilst the defence distinguished this case as being different to *Rogers v Whitaker* as the issue was not about treatment necessity because she would have undergone the procedure regardless, this was rejected. The court accepted the patient’s position that if she had known of the risk, she would have chosen a more experienced surgeon. This case demonstrates that it is not necessary to prove that treatment was negligently performed to be convicted of negligence.

The recent case involving *Gett v Tabet* has many ramifications in health law. Demonstrating that statute law can be ambiguous and obscuring the scope of standard of care, this case involved the unprecedented claim for damages for ‘the loss of chance of a better medical outcome’. What is considered legitimate or fair may not always be reflected in the judicial process and court decisions are not always consistent.

This case involved a six-year-child who was admitted to hospital on 28 December 1990 with a history of vomiting and persistent headache in the prodromal phase of chicken pox. The treating doctor diagnosed a streptococcal infection, prescribed antibiotics and discharged the patient. The condition persisted and a neurological exam was prescribed shortly afterwards which showed clinically normal parameters. The patient continued to suffer and returned to hospital on 11 January 1991, seeing Dr Gett for the first time. Taking note of the patient’s history and an unremarkable neurological exam, Dr Gett arrived at the provisional diagnosis of post chicken pox meningitis. However, he was unable to establish a more definitive diagnosis as the lumbar puncture test recommended was declined by the patient due to apprehension. Two days later, it was noted that the patient had dilated pupils, was drowsy and unresponsive, prompting the patient to accept a lumbar test. The following day on 14 January, the patient suffered a seizure with a CT scan subsequently ordered. The scan revealed a benign
tumour in the form of a medulloblastoma. The patient received surgery on 16 January but the tumour was only partially resected and the patient suffered permanent brain damage.

The uncertainty in the legal system is demonstrated by the procedural history of this case. The trial judge in the NSW Supreme Court found Dr Gett guilty for not ordering a CT scan on 13 January. Although it was argued Dr Gett did not act negligently as he was attempting to confirm his suspicion and provisional diagnosis by ordering a lumbar test, the court dismissed his argument. Instead it ruled Dr Gett negligent as the CT scan should have been ordered on the 13th instead of the 14th of January. Judge Studdert held that if the scan was done one day earlier, this would have prevented the seizure and deterioration of health experienced the following day. With limited expert witnesses, medical opinion could not provide a reliable figure on the aspect of lost opportunity. An argument was also made that performing the scan one day earlier may not have attributed to the tumour being more removable; which was also dismissed in court. The judge found that Dr Gett’s negligence did not cause all of the brain damage but using a ‘robust and pragmatic approach as a matter of common sense’ he postulated, based on a controversial earlier case, even though medical opinion could not conclude, that Dr Gett’s negligence had contributed to 40% of brain damage.

Surprised, Dr Gett successfully appealed the verdict in the NSW Court of Appeal. The court found that the trial judge was mistaken in reaching an assessment of 40%. Although successful, the appeal was somewhat hollow as its basis was not an overturn of negligence but rather a problem with legislation. The claim ‘loss of a better chance of medical outcome’ was inconsistent with tort law and the scope of the Civil Liability Act (an act dealing with negligence). Dr Gett’s actions did not cause brain damage as the tumour was pre-existing but rather increased the risk of existing harm; which was beyond the scope of legislation. The decision was unanimously decided in the High Court which held that damages are not available for the ‘loss of a chance of a better medical outcome’; although the findings in reaching this conclusion were open to potential situations in which it may apply.
In applying the law, decisions from these cases are important for dental practitioners as many parallels can be drawn. Whilst appreciating that clinical competency is an important skill, it must be noted that achieving the standard of care may still leave a clinician open to litigation. It is interesting to apply these concepts to areas of dentistry that represent the majority of cases in litigation.

With increasing demands for cosmetic dentistry, fixed prosthodontic options such as crowns and veneers account for one-fifth of cases in dental litigation. Complaints arise when patients realize that their expensive work will require additional treatment or treatment may not be as ‘permanent’ as they are led to believe. Quite often, patients may resort to alternative treatment options if they were ‘fully’ aware of the risks in complex prosthodontics. Saunders and Saunders have estimated that one-fifth of teeth prepared for full coverage crowns become non-vital within five years of placement. It comes as no surprise that this coincides with the average time that claims are reported. Therefore, it is likely that patients receiving full mouth coverage crowns or porcelain veneers in the aesthetic zone will require root canal therapy on at least one tooth based on the balance of probabilities. Without adequate warning, devitalization of teeth combined with a lack of communication account for almost half of complaints in this area. Expenses involved with root canal therapy and/or reduced prognosis of teeth which subsequently serve as root filled abutments need to be explained to the patient prior to treatment. Studies by Pjetursson have estimated that over one-fifth of prosthodontic cases fail after 10 years. Young and middle aged patients should therefore be warned that treatment may need to be revisited at a later stage which often have reduced prognosis on teeth with cumulative treatment. As demonstrated by Rogers v Whitaker, the preference for patient rights over medical paternalism indicates that treatment according to best practice does not render a clinician free from litigation.

Given the complications involved with fixed prosthodontics, it may be appropriate to consider alternative options. An emerging school of practice is minimally invasive dentistry in which adhesive materials are favoured over porcelain. Teeth do not need to be reduced significantly, thereby preserving enamel for predicable bonding. Problems with hypersensitivity associated with exposed dentinal tubules, devitalization and discolouration of teeth are also avoided. Opposing
teeth are less subjected to the abrasive properties of porcelain, thereby preserving the occlusion. It is interesting to speculate how treatment plans would differ if greater time had been devoted to discussing the risks and benefits of all potential options.

Another area that dominates dental litigation is oral surgery and in particular wisdom teeth extractions. Renton reported an increased number of inferior alveolar nerve injuries in the United Kingdom.\textsuperscript{18} Altered sensation and pain has the tendency to affect quality of life and therefore the likelihood of patients seeking legal compensation. It has been estimated that up to 70\% of patients suffer from a combination of numbness, altered sensation and/or neuropathic pain following oral surgery.\textsuperscript{18} In cases of numbness, it has been estimated by Friedman that 0.33\% to 1\% of extractions result in permanent paraesthesia of the tongue, lips and/or cheeks.\textsuperscript{19} As seen in \textit{Chappel v Hart}, a procedure performed competently to the standard of care can still have significant legal consequences. Whilst the probability of permanent numbness may seem remote, it has a much greater probability than the incidence of vocal cord palsy in \textit{Chappel v Hart} or sympathetic ophthalmia in \textit{Rogers v Whitaker}. Given that over 10 million wisdom teeth are extracted in America alone, permanent numbness may seem more common than face value.\textsuperscript{19} Alarmingly, it has been reported that less than 30\% of patients are adequately warned of nerve injuries in high risk oral surgery procedures.\textsuperscript{18} It is prudent to err on the side of caution in cases where the consequences can be serious, irrespective of its probability.

Given the wide range of different implant systems, high cost and procedural risk, it comes as no surprise that dental implants feature highly in litigation. An unfortunate consequence of the rapid growth in dental technology over the last two decades is that implant teaching and graduate competencies in dental curriculums around the world are underdeveloped.\textsuperscript{20} Most practising dentists in Australia with the median age of 45 had little exposure to placing implants during their undergraduate training.\textsuperscript{21} Clinical training is therefore met by a range of short and formal courses where there is a large variation in teaching. Education in implantology is voluntary and the high degree of independence afforded to dentists is unique as a health care profession. A general dentist by choice can perform their chosen scope of procedures without the requirement for further
training. This distinguishes dentistry from medicine as doctors are required to serve a term of internship and further specialist training prior to earning their scope of practice. For these reasons, there are significant dental-legal ramifications in standard of care, especially in a climate where the legal pendulum is shifting from medical paternalism towards greater patient rights.

There is concern that dentistry may be hampered by increased legal complications that may set precedent in health law. For example, one widely discussed topic is implant placement and loading. In a recent meta-analysis by Esposito, it was concluded that not all clinicians can achieve optimal results with a wide variation that is correlated with experience. Applying the principle in Chappel v Hart, it was found that courts were influenced by the fact the surgeon, although qualified in his specialty and performed the procedure without fault, was inexperienced and favoured the patient’s argument of being denied the chance of a more experienced surgeon. The placement of implants by general dentists distinguishes the principle from this case by two key factors that would not favour a general dental practitioner; the absence of further training and/or the lack of being a recognized specialist. This underscores the importance of case selection, CPD, experience and referring when in doubt.

There are issues arising from Gett v Tabet that have significant dental implications. The High Court ruled that damages are not available for the ‘loss of a chance of a better medical outcome’ unless the patient can prove, on the balance of probabilities, that they would have had a better outcome had the clinician not been negligent. Within this ratio decidendi, it appears that there may be instances in which a patient may seek damages under this verdict. An argument may be made by distinguishing a dental case from Gett v Tabet in that a general dental practitioner, which is different from Dr Gett who was a specialist, may be deemed negligent not because of clinical competency but rather the absence of adequate consent in referring to a specialist who may have a greater chance of a better outcome.
The importance of CPD and the profession

Given that society is becoming more litigious with court sentiment favouring patients' rights, CPD and contributing to the profession has never been more important. Although courts have downplayed the significance of standard of care, the value of CPD and the professional association will be realized through these cases.

The case in *McCann v Buck* involved the family of a patient receiving treatment for ovarian cancer. Unfortunately, surgery had produced a condition known as *pseudomyxoma peritonei*. The treating doctor kept the patient under review but the tumour continued to grow despite chemotherapy. The doctor informed the patient that she was unsuitable for further surgery with no other forms of chemotherapy available. The patient was disappointed and searched the internet for other options. During her online search, the patient became aware of a doctor in the United States investigating the same types of cancers. When questioned, the treating doctor replied that he was aware of the work but informed the patient that it was highly experimental. Trying all avenues, the patient travelled to the United States to undergo the radical surgery. As the treating doctor was aware that the patient was single and not in a position to earn her own living, he agreed to sign documentation for financial assistance. Sadly, the procedure was unsuccessful and the patient passed away. The family later discovered that the same form of treatment was available in their own jurisdiction and were infuriated. The family claimed that the treating doctor failed to advise them that alternative treatment was available in Australia at their significant economic loss.

During trial, the doctor called on members of the profession to testify. Professor Hacker was an experienced specialist and testified that the treatment in question was not recognized in Australia. He further stated that it was unproven and highly experimental. The court held that the treating doctor did not breach duty in omitting treatment outside the scope of an evidence based accepted by his peers, as testified by members of the profession.

Appreciating that science is constantly evolving, it is understandable that there may be differences of opinion. Such was the case in *Lee v Barker* where the treating neurosurgeon was managing an 11-year-old patient for a long-standing...
benign tumour. Although the neurosurgeon, Mr Lee, provided alternative treatment options, he continued to advise the family against surgery as the risks outweighed its benefit. Frustrated that the condition deteriorated, the family eventually found a surgeon who would operate on the tumour. The family pursued legal compensation, arguing that there were other surgeons who acting reasonably would have undertaken the procedure.

At trial, the decision was ultimately influenced by professional support and evidenced based research. All neurosurgeons called to testify, except for the surgeon that operated, agreed with Mr Lee that surgery was too risky. More so, Mr Lee was unaware of any surgeon who would have recommended resection given the circumstances. The only witness for the family was the surgeon that operated and could not name any other surgeon that would have undertaken surgery. The judge accepted the body of literature provided by the profession. In contrast, the operating surgeon acting on behalf of the family failed to address the literature which had an alternative view to his own and found it unorthodox that he acted as both the sole witness and expert.

These cases underscore the importance of CPD and contributing to professional networks, especially in dentistry where there is a wide scope of practice and autonomy. Dentists need to be up to date with the body of evidence and this can be achieved by actively engaging with the profession. Fortunately, most health associations promote evidenced based practice through the establishment of journals and guidelines. Therefore, dentists have a duty to appraise the literature especially as patients are becoming more aware with online information. Online information may not always reflect best practice and needs to be made known to patients. This is especially relevant with the emergence of dental tourism where patients seek cheaper but perhaps less scientifically based options. In cases such as McCann v Buck and Lee v Barker, this has been shown to be persuasive in court. Where scientific ambiguity exists, there is an obligation to liaise with experts who are often active leaders within the professional association. As a matter of duty, dentists need to fully communicate all appropriate options and risks which can only be achieved by knowing the evidence base themselves.
Importance of informed consent

As the majority of dental training and CPD is focused on the scientific and technical aspects of practice, the personal side of dentistry is often neglected. With a plethora of materials and emerging technologies, it is easy to be focused entirely on clinical techniques. However, superseding clinical CPD is the importance of informed consent. Demonstrated by these cases, it must be noted that no decision or outcome was dependent on actual clinical treatment but rather the communication and consent process. The axiom ‘never treat a stranger’ is no more applicable than in dental practice. Patients present with clues which relate to the personal side of dentistry. The apprehension shown by Mrs Whitaker at the possibility of losing her only functioning eye, concerns at how altered speech would affect Mrs Harts teaching, or the financial struggle of Catherine McCann, a single mother resorting to all avenues to raise money to travel overseas for questionable treatment are vital clues. Unsurprisingly, if something unexpected goes wrong for these patients already on edge, litigation will likely follow.

Time spent getting to know the patient is seldom a waste of effort. Patients will sue regardless of the standard of care as indicated by these cases. On the flip side, patients tend not to sue clinicians they like and who they feel rapport; they sue doctors who never took the effort to know them and their beliefs. Gladwell studied conversations between patients and their doctors and predicted with accuracy which patients were more likely to consider litigation. It has been demonstrated that a patient’s decision to take further action has often been made before the incident that apparently gave rise to it occurred. A study of patients that sued their clinicians and won revealed that more than half wanted to sue the clinician even before the alleged procedure occurred.

With this in mind, informed consent must be tailored to each patient in a way that they understand the options and material risks. Material risks, as considered by the High Court, are risks to which a reasonable person in the patient’s position would attach some significance. As with any legal definition, this is quite subjective and it is prudent to always err on the side of caution by spending extra time with the patient without the handpiece.
Conclusion

A review of modern legal decisions in health law reveals uncertainty in judicial decisions. Despite its ambiguity, it is clear that the law is not static. Although court decisions are guided by the doctrine of precedent, there seems to be a shift from medical paternalism towards greater patient rights. It may be a surprise to many clinicians that the significance of standard of care has been downgraded by the Australian courts as evidenced by the rejection of the Bolam principle. This may result in decisions that come as a surprise. Therefore, it is essential that health practitioners have some legal knowledge about how cases arise as this may change the manner in which they practice. Although technology has advanced dentistry, the disadvantage is that treatment options have never been more varied or confusing. This underscores the importance of CPD and professional association, especially in an increasing litigious society where online information has produced a more educated and demanding population. With many unique features in the profession such as high autonomy and wide scope of practice, there is a risk that precedent in health law may be established from dentistry. Dentists should take extra care in the consent process, especially in areas such as oral surgery, prosthodontics and implantology which constitute the majority of disputes. The focus should be on the severity of a potential complication rather than its probability. With this in mind, communication and developing rapport is essential which is often more critical than clinical competency. Communication and trust has also been linked with more positive health outcomes. The key to minimally legally invasive dentistry in practice is informed consent. This is the difference between patient conciliation and patient conflict.
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CHAPTER 11: Epidemiology and outcomes of Traumatic Dental Injuries: A review of the literature

ABSTRACT
Dental trauma is a significant public health problem because of its frequency, impact on economic productivity and quality of life. It is not a disease and no individual is ever at zero risk of sustaining these potentially life changing injuries. The aim of this article is to review the literature on the prevalence, incidence, aetiology, prognosis and outcomes of dental trauma. The importance of standardized reporting, oral health policy, adjunctive research methods, prevention and education will also be discussed. A search for relevant articles appearing in databases such as Medline, Cochrane and SSCI formed the basis of this review. Epidemiological studies indicate the annual incidence of dental trauma globally at about 4.5%. Approximately one third of children and toddlers (primary teeth) and one fifth of adolescent and adults (permanent teeth) sustained a traumatic dental injury. The majority involved the maxillary central incisors mainly from falls in toddlers at home and contact sport in adolescents. Despite these trends, there is considerable variation between studies within and across jurisdictions. There is a need to standardise research with a consistent approach to reporting, classification and methodology. This will improve research and form a greater basis for predicting prognosis. This research basis will assist in consent and clinical management.
INTRODUCTION

Dental trauma (traumatic dental injury) is an impact injury to the teeth and/or other hard and soft tissues within and around the vicinity of the mouth and oral cavity. It is usually sudden, circumstantial, unexpected, accidental and often requires emergency attention. It is not a disease but a consequence of several unavoidable risk factors in life. Although these injuries are more common in certain groups, no individual is ever at zero risk through their activities of daily living. These injuries may render an individual with meticulous oral hygiene and a life experience of only the standard check-up and clean with life changing dentistry. Costs to the injured person and the community throughout the world have been substantial.1,3

Dental trauma is often more time consuming and costly compared with many other accidental injuries presenting to emergency clinics and hospitals.4 Trauma to the body, inclusive of the oral cavity, is a significant public health problem worldwide. In certain groups, dental trauma is almost as high as one fifth of all bodily injuries.4 Bodily injuries have been reported to be the leading cause of death among young people aged between 12-24 years of age.5 In some western countries, the direct (treatment) and indirect (lost productivity and wages, transport cost and quality of life) cost of trauma has been estimated to be around 4-5% of gross domestic product.4 In the United States alone, the lifetime cost of bodily injuries has been estimated to be US $406 billion.6 It has been reported that traumatic dental injuries and its consequences may exceed the burden of caries and periodontal disease in the young population.7,8 These consequences are not only physical or economic but there is also the unquantifiable psychosocial burden on the individual.

Managing dental trauma is never the same and presents a challenge to carers. Emergency management should be considered to begin at the time of injury rather than the time the patient first sees the dentist as this impacts recovery. This highlights the importance of first aid and the need to educate the public. Even with timely presentation, management of dental trauma is not an ordinary situation in daily dental practice. It is a procedure where the initial appointment cannot be anticipated or scheduled. Furthermore, this uncommon procedure carries risk, diagnostic uncertainty and potential long term follow up for the
patient. There is also an unlimited combination of environmental, impact and patient factors making every case unique. Given this variability, evidence based practice is best established at the population level where large data can provide some guidance. This underscores the importance of epidemiology, or the study of patterns and causes of specific conditions such as dental trauma, at the population level.

With this in mind, the aim of this article is to review the literature on the prevalence, incidence, aetiology, prognosis and outcomes of dental trauma. This consisted of an electronic search of major databases such as Medline (PubMed), Cochrane and the SSCI (Social Citation Index) for pertinent and relevant articles using the following search words: tooth injuries, tooth trauma, traumatized teeth, dental trauma, dento-alveolar trauma, oral injury, epidemiology, prevalence, incidence, prevention, oral trauma and review. Although the search methodology endeavoured to find the most relevant articles, it could not guarantee that all articles associated with the topic have been included. The objective was to provide an overview of current trends rather than providing a comprehensive summary of all articles in this area.

TRAUMA RESEARCH AND ITS CHALLENGES

Establishing a research basis for the effective management, resource allocation, education and planning for dental trauma is challenging. Unlike most fields of dentistry, trauma data are obtained only as a result of an incident that has occurred unexpectedly. Its evidence base cannot be purposefully established with the collection of samples, teeth or patients. As such, randomized controlled studies are nonexistent for ethical reasons. Most injuries occur in young patients in a heightened emotional state where description of injuries can be vague. There are reports that some patients do not present to the dentist until months after an injury and some leave these injuries undiagnosed.¹ There are also regional, cultural and seasonal differences in the incidence of trauma and differences in classification. At the clinical level, there are mixed views on the use of medicaments, types and duration of splinting and when to commence root canal therapy for certain injuries. Treating dental trauma is also not an elective procedure where a dentist can provide treatment options with emphasis on
options that they are more familiar with. Given these challenges, it is unsurprising that there are differences in existing data within and between countries.

The difference in trauma data can be partly explained by the design of these studies. Unfortunately, these differences may obscure the actual reasons as to why the incidence or prevalence may be higher in a particular jurisdiction. In general, trauma research is time and labour intensive and the scope of research is often limited to specific sub-populations. A majority of these studies are cross sectional as opposed to longitudinal.

Cross sectional studies are retrospective studies of patient records collected at a particular point in time. These data represent events and experiences that have occurred when treatment was sought. As such, these figures are an underestimation as there is no reliable means to quantify the number of patients not seeking professional care. Presentation is influenced by local factors such as culture, affordability and access to dental services. It has been noted that more severe injuries occur ‘after hours’, considered the time outside business hours when most practices do not operate.\textsuperscript{9} Certain injuries such as soft tissue and alveolar fractures may not be recorded at the time of injury.\textsuperscript{2} Other injuries may be perceived as not requiring treatment and patients’ recall of the event, particularly in young patients, may not be accurate.\textsuperscript{1}

Longitudinal studies are prospective studies of a population over a pre-determined period of time. These studies are more time consuming and resource intensive, especially when a long period is chosen for data collation. However, they are beneficial because they allow the determination of incidence rates, a key epidemiological metric not possible with cross sectional studies. Longitudinal studies are less subjected to recall bias as injuries occur during the period of study rather than relying on the recollection of events. As such, real time examination of trauma is more focused and allows the opportunity for better reporting. For example, radiographic examination at the time of injury is more obtainable with the incident fresh in the patients mind compared to retrospective studies as patients may not seek immediate care. Despite this, a problem with these studies is that they require ongoing co-operation with dentists over a period of time. This may be difficult to co-ordinate in private practices where there is high
autonomy in daily operations. Access and affordability to dental services is also more restricted in the private sector which may limit and skew data. From the few longitudinal studies available, most were conducted in public health clinics where eligibility was less dependent on finances. A governing body such as the public health system allows consistency and coordination of professionals. A majority of longitudinal studies were found to have been conducted in Scandinavia where the public health system provided free dental care for patients up to the age of 20.\textsuperscript{10} While these studies are also reliant on patients presenting for treatment, a public health system which is more universal is more likely to capture a substantial sample size of the population.

Although these studies are more resource intensive, prospective longitudinal studies are preferred for trauma research. These studies can quantify the frequency and causes of trauma and identify risk factors, coordinate/target planning, costing and education. Despite its importance, there is a lack of these studies in the literature.

Many studies describe the occurrence of dental trauma either as prevalence (retrospective) or incidence (prospective). Prevalence is commonly reported in cross sectional studies and refers to the total number of cases reported in a population at a given point in time. These cases can range from existing longstanding cases to new cases. Prevalence is often expressed as a percentage and is obtained by the cumulative number of cases (new and existing) divided by the population. In contrast, incidence rates refer only to new cases that are reported within a population during a specified period of time. Incidence is often expressed as a percentage and is calculated by the number of reported new cases divided by the population size. As prevalence rates are cumulative and retrospective, they are always higher than incidence rates.

A methodological source of variability between studies is the manner in which injuries are classified. Feliciano & Caldas identified over 50 classification systems for dental trauma.\textsuperscript{11} These classification systems have differences in definition, scope and inclusion criteria. These authors concluded that most classification systems are not suitable for epidemiological studies.\textsuperscript{11} It will be demonstrated later in this review that the inclusion criteria can have a significant impact on
reported prevalence and incidence rates. For example, some studies considered injuries to the supporting structures such as luxation injuries. These rates are higher than studies which excluded these injuries in their scope of analysis. It has been observed that clinicians assess trauma under a wide variety of conditions and factors such as pathology, aetiology, treatment and anatomy.\textsuperscript{11-14} With no universal consensus, the literature has shown studies using existing classification systems, a modification of existing systems at the investigators discretion or a proposed new classification. A number of studies have also chosen to limit their inclusion criteria to include specific injuries which may simplify data collection and analysis but making it difficult to compare studies.

One of the earliest classification systems dates back to 1936 where Brauer classified fractures of anterior teeth.\textsuperscript{15} Despite this, it was not until 1962 where Ellis proposed a more widely accepted classification system based on expert opinion and case reporting.\textsuperscript{16} Ellis proposed a classification system based on numerical and anatomical location of traumatised anterior teeth into 6 groups; enamel fracture, dentine fracture, crown fracture with pulp exposure, root fracture, luxation and intrusion. Although this classification became popular because it defined a wide range of injuries, it caused confusion in management because its terms were considered too subjective.\textsuperscript{2, 11} General terms such as “simple” or “extensive” caused inconsistencies amongst dentists and offered little guidance to treatment. Injuries beyond teeth, such as the alveolar complex, were not considered under this classification.

Accordingly, Andreasen in 1972 attempted to classify injuries with a consideration of clinical management.\textsuperscript{17} While still subjective, the terms complicated (injury involving the pulp) and uncomplicated were introduced; where the former involved pulp therapy as part of its management. This system also attempted to broaden the scope of trauma appreciating that injuries in the oral cavity were not exclusive to teeth. As such, this system comprised of 19 categories where injuries were segregated into injuries to the dental hard tissues, the pulp, the PDL, the supporting bone, and the gingiva and oral mucosa.

A model outlined by the World Health Organization (WHO) in 1978 followed a similar approach to the earlier Andreasen model.\textsuperscript{18} Injuries were classified in the
same groups but were assigned coding descriptors. Assigning codes to injuries was consistent with the goal of classifying data based on oral and dental disorders. A secondary goal of assigning codes was to facilitate comparing data. This system attempted to broaden and simplify the classification of injuries. Injuries where teeth were not damaged but displaced were termed luxation injuries. This classification system at this time has gained widespread acceptance and many subsequent classification systems revolved around this system.

Further to their work, Andreasen modified the WHO classification in 1982, again with a clinical focus. As the management of luxation injuries differed with the degree and direction of displacement, Andreasen introduced concussion, subluxation and three classes of luxation; intrusive, extrusive and lateral. This expanded upon the universal WHO definition. Root fractures were also separated into complicated and uncomplicated.

Many other classification systems that followed were modifications of the WHO system. The Garcia-Godoy classification (1981) separates fractures based on whether cementum was involved. Terms such as uncomplicated/complicated were not included and there were no descriptors for subluxation, alveolar injuries or maxilla-mandibular fractures. Luxation was only included if teeth were more mobile without displacement. Similarly, the Ellis classification is also another derivation of the WHO system. This system offered a more simplified classification with broad subjective terms such as “simple” or “extensive”.

The aforementioned classification systems are a mere sample of proposals to describe the types of dental trauma. Feliciano and Caldas conducted a systematic review of studies between 1936 and 2003. They identified the most used systems were Andreasen (32%), Ellis (14%) and Garcia-Godoy (6%). Despite this, the category “Other” accounted for 40%; indicating a significant variability in the use of classification systems. Common to these classification systems, was the conclusion that there was no suitable or universal system that could be effectively applied to describe dental trauma for epidemiological surveys.
The need for consistency with diagnosis and classification has been well documented. One area that is gaining significance is the need for standardized recording of dental injuries. As such, various forms of structured histories (SH) have been proposed. Given the variability with dental trauma, these SH’s are specific and separate to the reporting for a routine examination. It has been demonstrated that without a standardised or systematic process for recording trauma, only half of the important information is recorded.\(^{21}\) Many studies have demonstrated the improved likelihood of recording important factors affecting the prognosis of trauma such as the time, type and nature of injury with a SH.\(^{9,22}\) Day and Duggal have shown that a systematic pattern of recording injuries by the first health care professional (dentist, paramedic, nurse, emergency department doctor) improves the outcomes of avulsion injuries.\(^{22}\) While there are mixed views about whether a computerised or paper based SH was more effective, both methods have lead to greater consistency in recording injuries.\(^{9,22-24}\) Recent studies in a major Australian tertiary hospital have confirmed that electronic collection of dental injury histories or findings has assisted policy planners in preventing and managing dental trauma, thereby addressing previous concerns that many classification systems were not suitable for epidemiology.\(^{23-24}\) Additionally, other proposals such as those from Lam et al have included the use of e-Health, informatics and coding to improve data collation and also to widen the scope of research beyond specific sub populations.\(^{25,26}\)

Given the variability and nature of these injuries, establishing a research basis for dental trauma is challenging. Fortunately, these problems have been clearly identified and various strategies have been proposed. Management could be improved, both clinically and scientifically, if a general consensus is established between all clinicians. Stated differently, there is a need to establish a consistent protocol for assessing, classifying and recording traumatic dental injuries. Accuracy in defining trauma makes it easier to study and understand.

**EPIDEMIOLOGY OF TRAUMATIC DENTAL INJURIES**

**Incidence and prevalence**

There is a paucity of studies reporting the incidence of trauma. Among those few studies, Table 1 shows incidences ranging from 1 to 44 new cases per 1000 persons in a year (up to 4.5% of the population). As previously suggested,
calculation of incidence rates is more demanding on time, cost and professional resources.

One common feature with incidence studies are that the majority are conducted in public health clinics. The public health systems are typically large organisations with greater opportunity for interaction between professionals within the same administration and operating structure. This has permitted collaboration and consistency in collating data. This may not be as evident in the smaller and scattered private sector where there is little emphasis or need for collaboration between private practices. There may also be large variations in the operation of each private practice. Many incidence studies are reported in Scandinavian countries as free and regular dental treatment is provided to children and adolescents by the government.¹⁰ This reduces the financial constraints as well as improving the availability and access to dental treatment.

Another barrier in determining incidence rates is appropriate sampling. Ideally, a reliable metric requires the sample size to be representative of the population with large data. For example, as the public health service in Norway offers free recalls to all children, Skaare reported that approximately 98% of eligible patients attended these clinics where the study was conducted so they were able to present a statistically significant incidence rate.²⁹,³⁰ Effective oral health policies not only benefit the community but there is also the indirect benefit of improving trauma research. Unfortunately, only a few prospective studies were found outside Scandinavia. An Australian study conducted by Davis and Knott followed trauma cases presenting to specialist endodontists affiliated with the Australian Society of Endodontists over a 2 year period.³⁹ Although this study yielded valuable quantitative results, the authors addressed the common problem with incidence studies outside the public sector. There was no reliable means to quantify the percentage of the population that had access to a dentist and how often these visits resulted in a referral to a specialist where data for the study was collated. This underscores one of the main problems in obtaining incidence rates in that obtaining large data sources is difficult and expensive. Many studies are focused on specific sub-populations and are not amendable to calculating reliable incidence rates. It seems that large data sets are more amenable in the public health sector. As such, developing effective oral health policy focused on
coordination, affordability and availability is important to consolidate trauma research.

Despite this, the incidence of dental trauma seems to affect no more than 5% of the population on a global scale. There is no evidence to demonstrate that the incidence of dental trauma is increasing. However, it must be noted that many studies underestimate the burden of dental trauma due to sampling difficulties. Many patients do not present for treatment, attend schools regularly or respond to surveys and questionnaires. It is likely that with improved research and data collation, the actual burden of trauma would be higher than reported. The variation between studies between and within a jurisdiction reflects not only local, socio-economic, environmental and cultural differences but also differences in study methodology and classification.

The prevalence of dental injuries exhibits a wide range from 6% to 59% as shown in Table 2. There appears to be a large variation in the reporting of prevalence throughout the world. Otuyemi explained the higher prevalence in the primary dentition of Nigerian children (30.8%) as a result of them being more accident prone because many of these children had carers that were only a few years older than themselves. It is interesting to observe the potential impact on study methodology on prevalence rates. A large discrepancy was noted between the prevalence rate of Granville-Garcia et al (36.8%) and Oliveira et al (9.4%) despite both studies having very similar circumstances. These studies had the same jurisdiction (Brazil), age group (1-5), dentition (primary) and date (2006/2007). Despite this, the large variation was mainly attributed to Oliveira et al not considering luxation injuries in their study. This demonstrates the impact of classification and inclusion criteria on the results. A systematic review by Al drigui screened over 2000 articles but only 24 articles satisfied their selection criteria.

These observations highlight the importance of standardised reporting and classification. It is generally accepted that the risk of sustaining dental trauma is dependent on factors such as age, circumstance, geography, behaviour and culture. However, it is difficult to quantify these factors when very few studies are comparable. There is a need for a globalized approach to the registration and reporting of trauma.
Despite these variations, there is a general trend indicating that one third of all pre-school (primary teeth) and one quarter of adolescent and adults (permanent teeth) experienced dental trauma at least once during their life. This can be considered significant because the oral cavity comprises approximately 1% of total body area.\textsuperscript{4} Over half of all physical traumas involve the head and neck region.\textsuperscript{4, 60} Gassner \textit{et al} indicated that studies which have reported 48% of facial injuries concurrently involving the oral cavity may be underestimated.\textsuperscript{60} Further to this, Glendor reported that certain individuals are at increased risk of sustaining repeated dental trauma indicating that risk is correlated to lifestyle habits and behaviours.\textsuperscript{61} This underscores the importance of public health education and prevention as the prevalence of dental trauma is high throughout the world.

\textbf{Aetiology}

Despite local and methodological differences among studies there appears to be a consistent pattern in the occurrence of trauma. Table 3 lists a sample of the studies reviewed where key features can be observed.

The victim's home has consistently been reported as the main location for sustaining dental trauma for both the primary and permanent dentition. This was closely followed by injuries in schools. It was also observed that there were an increasing number of causes. Despite this, sporting arenas, playgrounds and roads featured in most studies in varying proportions. Of interest is that some studies reported that approximately one fifth of injuries occurred in unknown locations or where the patient could not remember.\textsuperscript{29, 30, 47, 62} This is unsurprising as Lam \textit{et al} reported only one third of patients presented to a dentist within 24 hours of a dental injury.\textsuperscript{1} This study also reported that the remaining third of patients delayed seeking treatment for up to one year.\textsuperscript{1} As such, patient's recollection of events may be vague.

Falls are the most common activity causing trauma and accounts for most injuries in the primary dentition. This is unsurprising as it is typical for toddlers to crawl, stagger and fall before being able to walk as part of their development. Although falls featured prominently in the permanent dentition, sporting activities accounted for the majority of injuries. The nature of sport is a source of variation
due to the amount of physical contact and popularity. Popular sports (national sports) such as rugby, judo or the Australian version of football are intensely physical involving the grappling and tackling of participants. Other impact activities/accidents such as fights, assaults, bicycle and motor vehicle accidents have featured in most studies. Again, without consistent reporting, there is invariably overlap in the registration of these activities. For example, assaults, fights, impact injury, collisions, and ‘hit by something’ may be used interchangeably between studies. There may also be ethical and sensitive issues in the reporting of information. The registration of domestic violence and child abuse may be classified in broad terms as ‘assault’ which may also include clubbing, night life activities and alcohol related behaviour. Certain activities may also be skewed towards specific sub-populations. Warren et al reported at least one third of injuries resulting from playing around, surpassing falls, as the most prominent activity presenting ‘after hours’ to a tertiary hospital.9

**Gender, age and other personal circumstances**

Many of the studies reviewed showed that males experienced trauma more frequently than females in the permanent dentition. Males outnumbering females in sustaining trauma by a ratio ranging from 1.3-2.5:1 respectively. It has been postulated that males had a greater propensity towards contact sports, violent behaviour and were less mature.66, 67 Despite this, it has been noted that gender disparities were on the decline with females showing an increased participation in sports.66, 68 Traebert et al noted that females can be exposed to the same risk factors in males which are characteristic of modern Western society.68 Disparities in the primary dentition were generally not as significant or obvious. As falls in the primary dentition are mostly uncontrolled and given that participation in sport is by choice, it seems that gender as a risk factor is essentially related to activities undertaken. Appreciation of gender disparities is an important consideration when interpreting other epidemiological parameters. For example, Gottems et al reported a lower prevalence rate compared to similar studies in Brazil.46 However, this study relied on questionnaires where the response rate in females was higher.

Age is another frequently reported risk factor where studies indicate that trauma experience was skewed towards the younger population (toddlers, children,
adolescents and young adults). The specific age(s) was another source of variation affected by local and methodological differences. Local differences include the environment, standard of living, access to services and culture. Studies in Nigeria noted a higher prevalence of trauma in toddlers due to their carers being barely older than the children being looked after.59 This was also inconsistent reporting with a wide variation in segregating age brackets for each study. Despite these differences, there is a general trend indicating toddlers sustained injuries from involuntary falls while adolescents experienced accidental injuries from contact sports and other impact injuries. In an Australian study, Lam et al chose to classify age in 5-year increments and found that these injuries were predominant in the 0-4 year group and the 10-14 year group.1 In this cohort, 92% of injuries occurred before the age of 34 years.1 This is consistent with other studies indicating that dental trauma is skewed to the younger and likely more physically active population.2,3,4,10,66

Other personal circumstances besides well known dental factors (over-jet, class II incisor protrusion and lip coverage) have also been considered. The association between obesity and dental trauma is mixed. Petti et al noted an increased risk for sustaining trauma from obese children owing to less dexterity and agility from trauma predisposing behaviours.69 However, this result was not universally shared where an alternative view was that obese children were less active in physical activities. Soriano noted no statistically significant difference between obese and non-obese adolescents.70 The correlation between trauma and race/ethnicity is unclear. One practical problem is that ethnic minorities experience many adversities and live in more deprived areas, making it difficult not only to collect data but to disentangle these effects from other risk factors.61 In Australia, the indigenous population are more dispersed throughout rural and remote regions where services and availability of researchers are limited.71 This is similar in other jurisdictions throughout the world and perhaps accounts for the paucity of studies considering race/ethnicity. Despite this, Kaste et al noted that there was a similar prevalence of trauma among various ethnicities (Mexican, black and white non-Hispanic) in the USA.41 Similarly, few studies have considered economic status and the results are conflicting. Hamilton et al from the United Kingdom reported children from lower socio-economic groups sustained more injuries owing to behaviour and the environment.28 This was in
contrast to Marcenes et al who indicated that more privileged children had a higher experience because of greater ownership of bicycles, skateboards and participation in sports. Although there is conflicting evidence as to the degree of association of particular personal circumstances to trauma, it is clear that trauma experience is highly circumstantial. Some studies also reported trauma experiences in the geriatric population.

Types of Injuries and teeth

Uncomplicated crown fractures in the permanent dentition are the most common type of injury. This has ramifications for epidemiological studies as many of these injuries are not perceived as requiring treatment. As such, the prevalence of dental trauma is likely to be underestimated. Subluxation injuries, when reported, were also common, especially in the primary dentition. In most studies, displacement (luxation injuries) of teeth occurred more frequently in the primary dentition where some authors have suggested the resilient nature of the supporting structures favour dislocation rather than fracture. The prevalence of luxation may also be underestimated given that the majority of studies were retrospective and some studies did not consider these injuries. Avulsion injuries were uncommon but were more prevalent in studies focusing on certain sub-populations. An ‘after hours’ study by Warren et al indicated a higher incidence of these injuries. Similarly, Adekoya acknowledged fights were common in their sub-population where one fifth of injuries were avulsions. Only a few studies considered the recording of soft tissue injuries.

The majority of dental trauma in both the primary and permanent dentition involved the anterior teeth. The maxillary central and lateral incisors were the most common teeth injured. In most cases, trauma affected a single tooth but certain events (sports, violence and traffic accidents) reported a greater probability of injuring multiple teeth. Some studies also reported a greater incidence of multiple injuries during ‘after hours’ trauma and in association with facial injuries. There are also mixed results as to whether teeth were more susceptible to injuries during particular months or seasons. Certain individuals had an increased risk for sustaining multiple traumatic episodes. A systematic review by Lenzi et al found some evidence that individuals with trauma in their primary dentitions have more developmental disorders in the permanent
dentitions than individuals without previous trauma. These authors further suggested that the younger the child is at the time of the trauma, the greater the severity of complications experienced in the permanent dentition.

**DENTAL OUTCOMES AND PROGNOSIS OF TRAUMATIZED TEETH**

As dental trauma is unpredictable, it is difficult to accurately determine the prognosis of injuries. Patients with dental trauma need to be aware that certain injuries require multiple appointments and/or subsequent reviews over time. Success rates can be as varied as the nature and circumstances causing trauma. This has obvious cost and quality of life implications and forms an important part of management and informed consent. This underscores the pivotal role of epidemiological studies as large data sets can predict the likely scenario of consequences following trauma.

Studies have demonstrated that some injuries have more favourable outcomes compared to others. The ultimate goal of management is the recovery of the pulp and peri-radicular tissues through repair or regeneration. This outcome is dependent on the pulp maintaining its integrity in the presence of reduced vascular supply (ischemia), loss of substance from the tooth (breakdown of natural barriers) and the presence of bacteria. This triad of factors may limit recovery and result in a range of complications. In the pulp, these complications include necrosis, canal calcification, infection of the root canal system or internal resorption. Similarly, the peri-radicular tissues may undergo apical periodontitis, external resorption (inflammatory or replacement), disturbances in root development, loss of periodontal ligament (ankylosis), transient apical breakdown, soft tissue recession and/or fibrous healing. It has been estimated that 26-76% of injuries result in the permanent loss of dental hard tissue in the various types of dental injuries. Other complications include mal-alignment and discolouration of teeth, difficulty with eating, compromised aesthetics and discomfort.

The prognosis of certain injuries is dependent on early and correct management. Regardless of the injury, management objectives should always be focused on minimising the impact of the aforementioned triad of factors. Other factors aside, a healthy pulp has a better prognosis than a pulp without blood supply.
Healthy pulps are more resistant to bacterial invasion through the dentinal tubules and the resistance afforded by the host defence mechanisms through the neurovascular supply.\textsuperscript{77} This underscores the importance of conservative pulp therapies and restorative dentistry aimed at limiting the ingress of bacterial invasion.

Table 4 shows the sequelae of teeth affected by different types of injuries based on reported data. The prognosis of teeth is reduced where there are concurrent injuries on the same teeth. Studies reporting success rates must be considered with caution as there are a wide range of clinical techniques and materials. For example, the choice of medicament (corticosteroid pastes, calcium hydroxide, MTA or mixtures of each), root canal therapy after avulsion, bonding technique, or the type and duration of splinting impacts healing. There are also patient factors such as the time of injury and presentation, stage of root development, compliance, behaviour and previous dental history. As such, assessment of prognosis requires an individualised case based assessment using the literature as a guide. Although beyond the scope of this discussion, it is important to be fully aware of the different treatment modalities and to exercise care in selecting the correct management for each case.

In general, fractures to the dental hard tissues confined to enamel and dentine represent pathways for the ingress of bacteria to potentially cause pulpitis. Fortunately, pulp necrosis following uncomplicated crown fractures is rare. Despite this, Wang \textit{et al} reported that injuries without dentine coverage exhibited an almost three-fold increase in the probability of pulp necrosis compared to teeth that received dentine coverage.\textsuperscript{80} The prognosis of complicated fractures when the pulp is exposed is also favourable with conservative pulp therapies. Amongst these methods, the Cvek partial pulpotomy technique is the most successful demonstrating high success rates in preserving pulp sensibility and function.\textsuperscript{83}

Maintaining pulp sensibility in root fractures is also favourable despite having a higher risk of necrosis compared to crown fractures. The degree of recovery and repair is related to the ability to maintain a viable vascular supply to the pulp following injury. It was found that pulp necrosis was significantly related to the diameter of the apical foramen. Representing the major supply channel to the
pulp, Andreasen and Kahler demonstrated that a 1.2mm diameter had a greater potential for recovery compared to apical foramen of 0.7mm.\textsuperscript{100} As such, immature teeth with incompletely developed roots have a greater vascular supply to the pulp and correspondingly a better prognosis.

Displacement of teeth in luxation injuries has the potential to disrupt the neurovascular supply to the pulp. Crushing of the periodontal fibres and restriction/compression of supply channels (apical canal, lateral canal, fins, transverse anastomoses and loops) to the pulp causes ischemia which may lead to necrosis. Besides root maturity, the degree and direction of displacement has a significant influence on the onset of ischemic necrosis. This highlights the rationale in repositioning and splinting teeth following injury. Studies have demonstrated the following order (increasing order of risk) for developing pulp necrosis; concussion, subluxation, extrusion, lateral luxation and intrusion. Intrusion is the most severe form of luxation where necrosis is inevitable in permanent teeth with developed roots.\textsuperscript{91} This can be related to complete restriction of the main blood supply (apical foramen) to the pulp as the tooth is crushed into the underlying bone. Despite this, Humphrey \textit{et al} reported pulp necrosis in 45\% of intruded teeth which is significantly lower than most studies (85-100\%).\textsuperscript{94} The authors in this study reported that the majority of teeth (58\%) with incompletely developed roots.\textsuperscript{94} This is quite different to the study by Andreasen \textit{et al} who reported a higher rate of 85\% in an older cohort (adults included) with completely developed roots.\textsuperscript{89} In concurrent injuries on the same teeth, where more than one factor in the triad is present, the prognosis is worse. For example, teeth subjected to luxation and fracture has been reported to have a higher prevalence of pulp necrosis due to damage to the neurovascular supply and the ingress of bacteria.\textsuperscript{101,102} The combination of bacteria internally in the root canal system and external cementum damage can then result in external inflammatory root resorption.

The importance of management and periodic examination is underscored by a study by Andreasen.\textsuperscript{90} In a population of 637 luxated permanent teeth, approximately 4\% of all teeth (subjected to all luxations except intrusion) demonstrated complete and spontaneous repair within one year following trauma despite demonstrating radiographic changes and not responding to initial pulp
sensibility testing. Described as “transient apical breakdown”, Andreasen proposed that certain injuries may be monitored without invasive treatment unless there were other signs or symptoms of pathosis. Similarly, pulp canal calcification can occur following trauma. It has been estimated by McCabe and Dummer that approximately 2-4% of traumatized permanent teeth develop this condition characterized by loss of radiographic pulp space with slight clinical yellow discoloration. Robertson et al followed luxated teeth for a mean time of 16 years and concluded that 8.5 percent of teeth with pulp canal calcification subsequently became pulpless and infected. Although there is a paucity of data relating to primary teeth, 10-15% of pulp canal calcification in primary teeth becoming infected has been suggested.

Avulsion is the most serious form of dental trauma where early and correct management is pivotal. All permanent and mature avulsed teeth undergo pulp necrosis. Revascularization may be possible in immature teeth with incompletely developed roots but success rates have been reported to be less than 50%. Andreasen estimated that one third of avulsions occur before the age of 9 when incisors are incompletely developed. Studies have indicated that early replantation is critical for the best chance of success. The presence of bacteria in the root canal system may result in internal inflammatory resorption and damage to the periodontal ligament may result in external replacement resorption. Many authors agree that an extra-oral dry time of 60 minutes or more results in necrosis of all periodontal ligament cells with eventual replacement resorption. The critical time varies between studies but many authors consider an extra-oral dry time of 15 minutes or less to reduce resorption.

Epidemiological studies have been pivotal in providing an evidence base for managing traumatic dental injuries. Although beyond the scope of this discussion, it is evident that many protocols have changed over the last few decades because of advances in research.
CONCLUSIONS
Dental trauma is not a disease but rather an unfortunate impact injury to the teeth and mouth that can arise from any activity of daily living. Its prevalence remains high and studies have indicated that its impact may exceed caries and periodontal disease in certain populations. Although there is a need to standardise reporting and research, epidemiological studies have indicated that approximately one third of toddlers and one quarter of adolescents and adults have experienced dental trauma. Most of these injuries involve the upper central incisors from falls at home or sustained while playing sport. Predicting the prognosis of teeth is difficult due to methodological, behavioural, cultural and environmental factors. This further suggests the need to establish a reliable evidence base. This is where standardised classification and adjunct methods for recording data may assist.
REFERENCES


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<td>Traumatized permanent teeth in Kerala</td>
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<td>Patel (56)</td>
<td>Traumatized permanent teeth in school children in Vadodara City</td>
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<td>2012</td>
<td>8-13</td>
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<td>Adekoya-Sofowora, Adesina, Nasir, Ogomi and Ugboke (57)</td>
<td>Traumatized permanent incisors in Nigerian school children</td>
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# Table 3: Aetiology, teeth, types, location and types of traumatic dental injuries

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<th>Region</th>
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<th>Year</th>
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<th>Activity causing injury</th>
<th>% Teeth Affected</th>
<th>% Location of Injury</th>
<th>% Nature of Trauma</th>
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<td>22.7 Maxillary Central Incisors 71.9 Home</td>
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<td>Sport related injuries</td>
<td>9.3 Mandibular Central Incisors 16 Roads, Street, bike track 8.2 Other</td>
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<th>% Location of Injury</th>
<th>% Nature of Trauma</th>
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<td>Chen, Yan, Yi Gong, Jian Guo, Jing Xin, Yang He, Wen Peng, Zhe Nan, Yi Zhang (62)</td>
<td>China</td>
<td>2014</td>
<td>8-12</td>
<td>367</td>
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<td>Hasan, Qudeimat, Andersson (64)</td>
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<td>Fight 1.8</td>
<td>Mandibular Central Incisors 1.8</td>
<td>School 6%</td>
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<td>*Primary Teeth</td>
<td>Intrusion 6.8</td>
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<td></td>
<td>Hasan, Qudeimat, Andersson (64)</td>
<td>Kuwait</td>
<td>2010</td>
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<td>Sport 3.6</td>
<td>Maxillary Lateral Incisors 19</td>
<td>Street 7%</td>
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<td>Fight 1.8</td>
<td>Mandibular Central Incisors 1.8</td>
<td>School 6%</td>
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*Did not consider root fractures and luxation injuries
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<tr>
<th>Region</th>
<th>Author (Reference)</th>
<th>Country</th>
<th>Year</th>
<th>Age (yrs)</th>
<th>Sample Size</th>
<th>Activity causing injury</th>
<th>%</th>
<th>Teeth Affected</th>
<th>%</th>
<th>Location of Injury</th>
<th>%</th>
<th>Nature of Trauma</th>
<th>%</th>
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<tr>
<td>Africa</td>
<td>Adekoya, Sofowora, Bruimah, Ogunbode (65)</td>
<td>Nigeria</td>
<td>2004</td>
<td>13-15</td>
<td>415</td>
<td>Falls</td>
<td>42.6</td>
<td>Maxillary Central Incisors</td>
<td>74.3</td>
<td>This study was conducted exclusively in schools</td>
<td>57.4</td>
<td>Uncomplicated crown fracture</td>
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<td>Fights</td>
<td>14.9</td>
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<td>14.8</td>
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<td>Complicated crown fracture</td>
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<td>Contact Sports</td>
<td>14.9</td>
<td>Maxillary Canine</td>
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<td>Crown discolouration</td>
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<td>Collision</td>
<td>7.4</td>
<td>Mandibular Central Incisors</td>
<td>7.9</td>
<td></td>
<td></td>
<td>Intrusive Luxation</td>
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<td></td>
<td>Bicycle Accident</td>
<td>5.3</td>
<td>Mandibular Lateral Incisors</td>
<td>1.9</td>
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<td></td>
<td>Extrusive Luxation</td>
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<td>Child Abuse</td>
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<td>Assaults</td>
<td>5.3</td>
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<td>INJURY TYPE</td>
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<tr>
<td>Injuries to dental hard tissues and pulp</td>
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<tr>
<td>Enamel Infraction</td>
<td>Generally favourable outcomes with conservative treatment. Incidence of pulpal necrosis rare</td>
<td>Borssen and Holm (79)</td>
<td>PN: 2-5%</td>
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<tr>
<td>Enamel Dentine Fracture</td>
<td>Generally favourable outcomes with conservative treatment. Exposed dentine tubules have a higher tendency to result in pulpal necrosis.</td>
<td>Cavelleri and Zerman (81)</td>
<td>PN: 5-15%</td>
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<td>Wang et al (83)</td>
<td>PN: up to 13.7%, up to 40% without dentine protection</td>
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<tr>
<td>Complicated Crown Fracture</td>
<td>Outcome is case sensitive and depends on age, severity and management. Losing pulp sensibility has been observed in 72% cases. Teeth treated with conservative pulp therapy methods has preserved the pulp in 98% of cases.</td>
<td>Viduskalne and Care (82)</td>
<td>Pulp Vitality 98%</td>
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<td></td>
<td>Partial pulpotomy is has a higher incidence of more favourable outcomes compared to direct pulp capping.</td>
<td>Borssen and Holm (79)</td>
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<td>Cvek Partial pulpotomy has one of the highest success rates</td>
<td>Cvek (83)</td>
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<td>No other concurrent injuries</td>
<td>Lauridsen et al (94)</td>
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<tr>
<td>Crown Root Fracture</td>
<td>Prognosis is dependent on the level of root fracture. Less favourable outcome the more cervical the level of fracture. The likelihood of healing by calcified tissues is poorest in the cervical third</td>
<td>Andreasen et al (85),(86)</td>
<td>PN: 2-10%</td>
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<td>Welbury et al (87)</td>
<td>PCC: 69-23%</td>
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<td></td>
<td>Mahkora (88)</td>
<td>PN: 25%</td>
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<td>Injuries to the periodontal tissues</td>
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<td>Concussion</td>
<td>Low risk of complications. If occurred, mainly in teeth with completed root development.</td>
<td>Andreasen and Pedersen (89), Andreasen (90)</td>
<td>PN= 3%, RR = 5%, PCC=5%, TAB = 1.5% (permanent dentition)</td>
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<td>Subluxation</td>
<td>Low risk of complications. If occurred, mainly in teeth with completed root development.</td>
<td>Andreasen and Pedersen (89), Andreasen (91)</td>
<td>PN = 6%, RR = 2%, PCC = 10-20%, TAB = 1.5% (permanent dentition)</td>
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<td>Extrusive Luxation</td>
<td>Moderate risk of complications.</td>
<td>Andreasen and Pedersen (89)</td>
<td>PN = 26%, RR = 9%, IR = 9%, PCC=26-45% (permanent dentition)</td>
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<td>Lee, Barrett and Kenny (93)</td>
<td>PN = 45% (permanent incisions)</td>
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<td>Andreasen (90)</td>
<td>TAB - 11.3%</td>
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<tr>
<td>Lateral Luxation</td>
<td>Relatively High risk of complications</td>
<td>Andreasen and Pedersen (89)</td>
<td>PN = 58%, RR = 27%, IR = 3%, PCC = 28% (permanent dentition)</td>
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<td>Nikoui, Kenny and Barrett (93)</td>
<td>PN = 40%, PCC = 40% (permanent incisions)</td>
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<td>Andreasen (90)</td>
<td>TAB = 12.3%</td>
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<tr>
<td>Intrusive Luxation</td>
<td>Intrusive luxation is the most serious type of luxation injury.</td>
<td>Andreasen and Pedersen (89), Andreasen (91)</td>
<td>PN = 85%, RR= 60%, IR = 38%, PCC = 4-10%, TAB = 0%, ANK= 24%</td>
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<td>Risk of multiple/concurrent complications high.</td>
<td>Risk of multiple/concurrent complications high.</td>
<td>Wang (80)</td>
<td>PN = 100% (Permanent mature teeth)</td>
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<td></td>
<td>Prognosis also depends on age and degree of intrusion. Prognosis improves with root immaturity.</td>
<td>Humphrey, Kenny and Barrett (94)</td>
<td>Significantly decreased pulp survival if intruded over 4mm. PN = 45%</td>
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<td>Avulsion</td>
<td>Pulp necrosis is inevitable in permanent teeth. Objective is to reduce inflammatory resorption</td>
<td>Andreasen et al (96) Trope (95)</td>
<td>PN: 100% (Permanent mature teeth)</td>
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<td>Revascularization may be possible in immature teeth with open apex</td>
<td>Revascularization may be possible in immature teeth with open apex.</td>
<td>Andreasen et al (96) Trope (95)</td>
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<td>The success rates (clinical outcomes other than pulpal necrosis) of replanted teeth achieving varying degrees of root development of immature teeth is less than 50%</td>
<td>Andreasen et al (96) Trope (95)</td>
<td>Success rates of replanted immature teeth ranged from as low as 4% to as high as 50%</td>
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<td>Inflammatory resorption following avulsion is very common regardless of appropriate treatment.</td>
<td>Kinirons (97)</td>
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<td>Replanted with no contamination IR=57%</td>
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<td>Replanted after washing contamination IR=87.5%</td>
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<td>Replanted with contamination IR=100%</td>
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<td>*Median dry time was 15 minutes, patient age 7-18 years</td>
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<td>Post re plantation root resorption (inflammatory/replacement) is very high</td>
<td>Kinirons (97)</td>
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<td>Andreasen et al (96) Trope (95)</td>
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<td>Donaldson and Kinirons (98)</td>
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<td>Gonda et al (99)</td>
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<td>RR ranges from 59-80%</td>
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Legend:
PN = Pulp Necrosis
PCC = Pulp Canal Calcification
TAB = Transient Apical Breakdown
RR = Root Resorption
IR = Inflammatory Resorption
ANK = Ankylosis
General Discussion
This thesis focuses on improving dental health and making oral health policy work. Although dentistry has made significant advances both in understanding and in treatment, the burden of oral disease remains high. There are a number of factors influencing presentation to the dentist, which is at least reflected in the range of topics discussed in this thesis. Although there is no single factor, access, affordability, trust and health promotion/education have been identified as major factors.

In answering this pivotal question, the framework of this thesis has been designed in accordance with the principles identified by major health organisations as being ideal attributes of an oral health care system. Before placing each chapter in the context of this framework, it is necessary to review the salient points of each chapter.

Part One: Oral Health Policy in Action
Chapter 1 provided a macroscopic overview of the first major dental policy in Australia. Although it had taken five decades since Commonwealth governments had the constitutional rights to provide health services for its people, the Chronic Disease Dental Scheme represented the first oral health policy to attract Medicare benefits. Utilisation of the scheme was not only disproportionate to the distribution of disease and population, there was a focus on treatment that had little emphasis towards the objectives of the policy. This may not have been a significant problem if it were not for the increases in expenditure that made the policy unsustainable. The scheme saw huge swings in utilisation before and after increases in subsidy which provided the first clue that there were other factors driving utilisation. In particular, the provision of aesthetic crowns and restorative services which accounted for two thirds of expenditure in addition to the excessive value of care in New South Wales was a concern.

Chapter 2 provided a comparative analysis of dentistry with the other allied health professions. The Enhanced Primary Care Scheme was a major policy by the Commonwealth government to fund a range of allied health services on the premise that better health outcomes were possible with multi-disciplinary care. This formed the basis of the CDDS and AHP subsidiary programs.
objectives of the two programs were the same, with an emphasis towards primary health care, they operated on different fee schedules. This provided an insight into how different funding mechanisms affected health expenditure. A *fee per service* schedule in the CDDS had greater problems with cost containment as there were financial incentive to provide more extensive treatment. Despite this, one major finding was that even when expenditure was at its highest in 2009, dental services focused on prevention was comparable in cost to allied health services. This indicates that with the right mix of care, a balanced workforce and a primary health focus, oral health can be sustainable.

Chapter 3 addressed a key recommendation from the Senate Inquiry that health managers and policy makers needed a greater understanding of dentistry and the provision of its services. As such, the first part of this chapter provided a description of the various types of dental services and its contribution to health. This provided the groundwork to report on patterns of care. Despite its stated aim towards prevention and disease control, it was unfortunate that a large part CDDS expenditure was focused towards reconstructive services. The majority of crowns and fillings were white colour indicating that aesthetic considerations influenced treatment. When funded by policy, there was a noticeable increase in highly technical procedures such as orthodontics. This chapter also introduced another Medicare policy in the Teen Dental Plan. Although the stated aims of the CDDS and TEEN were based on prevention and disease control, its principles did not seem to be reflected in private practice in terms of volume of activity. This highlighted an even greater problem – how can we make preventive dentistry viable in private practice?

Chapter 4 explores the practice private environment in greater detail. It identifies a major problem with health policy. No matter how well policy is funded or regardless of the merit in its principles, the outcomes are ultimately determined by the workforce available to deliver its services. Analysis of the CDDS and TEEN in the private practice environment has identified many unintended consequences. Many of these problems can be attributed to the unique circumstances in this setting. As small businesses in a competitive free market economy, there is a tendency to focus on services which are not necessarily health related but rather more financially rewarding. As such, more money for
services does not necessarily translate to better health outcomes. When dentists have substantial influence over the course of care, patients being exempt from payment and financial responsibility directed to a third party such as health policy, there may be a tendency to over-service. Under this system of dentistry, it cannot be assured that the practice of dentistry represents a prioritised approach to combat disease. This is a major problem for governments as the private practice workforce is the only sector with the capacity to handle a national agenda. A majority of private practices operate independently where business considerations have enormous influence over the course of care. As such, the chapter argues that structural reform in the profession is necessary as a key measure to improve oral health.

Chapter 5 is the final chapter of this sub-section and based on the findings of the preceding chapters, offers a model of care. It argues that oral health policies should be based around four overarching principles; a justified, economical and research based model of care (JERM). Based on these principles, there is a need to justify services to reflect more of a preventive approach. By segregating services, governments are able to provide targeted funding based on health contribution and what the community is willing to pay for a particular service. Greater emphasis should be placed on eligibility criteria which should be based on disease severity. However, all individuals should be at least entitled to the minimum of basic preventive care. There needs to be cost effective mechanisms to monitor policy and the health needs of the population. This model has identified opportunities in the field of e-Health. Upskilling and increasing the number of training positions for allied dental professionals can provide a more balanced workforce with greater opportunities to focus on primary care.

Part Two: e-Health Research
One desirable attribute identified by leading health organisations is the need to monitor the oral health needs of the population. These mechanisms must be cost effective, sensitive to change, comprehensive and evidenced based. Although traditional research methods have served the profession well, they are unlikely to achieve the above objectives without significant resources. As such, many health authorities acknowledge that gaps in population research are concerning.
The problems observed in the CDDS demonstrated the need to identify cost concerns when they become apparent. Oral health policy requires mechanisms for continuous assessment and quality assurance of policy.

The plethora of new materials and techniques has created confusion in treatment planning. Although many clinicians are guided by evidence, information may not always be available or relevant to their circumstances. To achieve better outcomes, dentists need to be able obtain an evidence base that is not only specific to their needs but also affording them the opportunity to contribute to research.

To address these concerns, this section follows on from one of the recommendations made in chapter 5 (JERM model of care) in introducing e-Health and Dental Informatics.

Chapter 6 is a brief introduction where it defines e-Health and dental informatics before discussing its application in dental research. Importantly, this method addresses many of the desirable attributes for an ideal oral health system.

Chapter 7 focuses on e-Health technology to improve population level (epidemiological) research. Using the CDDS as an example, it has been demonstrated that a range of policy relevant data can be seamlessly obtained as an indirect result of administering the scheme. This data is real-time, complete, and accurately reflects patterns of care.

Chapter 8 demonstrates how personal and professional outcomes can be enhanced by focusing on item codes in the Australian Schedule of Services and Glossary. Using a selection of key item codes, the addition of suffix codes alongside existing item numbers has demonstrated a useful way to obtain valuable clinical information.

**Part Three: Tumour, Trauma and Trust**
This section deals with the more personal side of dentistry. No matter how well policy is funded or how well dentistry is researched, presentation to the dentist is a personal choice. Although modern techniques have improved patient comfort
and reduced anxiety, a number of patients avoid the dentist for reasons other than finances. Patients will only visit if they perceive a need and trust the clinician providing care. This underscores the important role of health promotion and education. Granted that dentistry is based around a high volume of asymptomatic patients, there are certain situations and oral conditions where even the most reluctant individual will seek care.

Despite the prevalence of caries and periodontal disease, other less frequent conditions such as tumours and traumatic dental injuries can be more serious. Besides providing clinical treatment, dentists have an important community role in preventing or reducing the consequences of these conditions. Participation in health promotional activities has the potential to instil trust in the profession which will no doubt improve public perceptions about dentistry.

Above all, the importance of consent and communication is what fosters trust in a health professional. This not only affects patient cooperation but also presentation patterns. The key to reducing oral disease lies in regular attendance to services focused on primary care. Mistrust and litigation can affect these objectives.

Chapter 9 highlights the importance of a dental examination as there are instances where diagnosis of life threatening conditions is triggered by presenting to the dentist for the most trivial of reasons. This case not only highlights an essential link between oral health and general health, but also why a national oral health policy focused on primary care is essential. The reporting of this case highlights that not all signs and symptoms that occur in the mouth are abnormalities within the mouth. The steps employed to reach a correct diagnosis when presented with a toothache that revealed an underlying brain tumour is highlighted through this case report. This has important ramifications as misdiagnosis has been correlated with patient anxiety and mistrust.

Chapter 10 deals with the importance of communication in an area that is becoming more prominent in healthcare. Although dentistry is an autonomous profession, it cannot be practiced outside the law. Unfortunately, this has seen the rise in the number of cases presenting to courts. This chapter provides a
timely review of the importance of consent and communication from a legal perspective. It has been demonstrated that trust and communication has been linked with more positive outcomes and is more important than clinical care in determining whether a patient may sue. Patients who cannot develop rapport with their dentist will not present regularly for services, no matter well oral health policy may afford them to do so.

Chapter 11 focuses on a very important public health issue in dental trauma as these can be sudden life changing injuries. An epidemiological review has shown that traumatic dental injuries are still prominent throughout the world. Despite this, there is considerable variation in results between jurisdictions which is partly due to the need to standardise the reporting of data. There is also the opportunity for dentists to take a greater role in prevention and education. Analysis of the outcomes of these injuries indicates that the prognosis of dental trauma is often correlated to the time it takes to present to the dentist; highlighting the need that dental services must not only be accessible but affordable.

A Framework for an Ideal Oral Health System
How to improve dental health and make oral health policy work? In answering this question, this thesis is presented as a series of papers structured according to a framework identified by authoritative organisations as essential for an ideal oral health system (Table 1).

Increased health expenditure does not directly relate to better health outcomes. Structural reform in key areas of the dental profession is needed. It is about the right policies, an appropriate workforce balance, evidenced based care, integrated research, health promotion, informed consent and communication.
Table 1: Framework for Oral Health System

<table>
<thead>
<tr>
<th>Ideal Attributes of an Oral Health System</th>
<th>A Framework for Oral Health Policy</th>
<th>(Key C#: thesis chapter number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Integrated</td>
<td>Oral health is an integral part of general health and should be included in the Medicare system. • C5: The JERM model proposed an outline to consolidate the public system while providing a more balanced workforce in private practice. • C6-C8: e-Health and informatics can seamlessly integrate private practices to enhance personal, practice, professional and population research. Every dentist can contribute and benefit to research without significant start-up costs or sacrifices to their clinical time. • C8: Health data linkage with oral health outcomes is possible by expanding existing item codes.</td>
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<tr>
<td>2 Emphasis on health promotion and disease prevention</td>
<td>C5 proposes a model of care based on disease control and prevention. It is possible to expand the role of allied dental professionals to place greater emphasis on health promotion and prevention. • C9 provides further evidence that oral health is an integral part of general health. There are life threatening situations in which the only symptoms may be confined to the oral cavity. • C9 + C10 emphasize the need for dentists to take an active role in dental trauma and tumour education especially the importance of early presentation and regular screening.</td>
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</tr>
<tr>
<td>3 Monitors population oral health status and needs</td>
<td>C6+C7: It is possible to continuously monitor the health needs of the population through the use of e-Health and informatics. Real time assessment afforded by this technology ensures that policy is sensitive to changes while continuously building a database of information for population research.</td>
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<tr>
<td>4 Evidenced Based</td>
<td>C6-C8: e-Health and dental informatics provides real time and consolidating database that accurately reflects utilisation of policy and patterns of care. Clinicians have a useful tool for professional development while also enabling them to contribute to research.</td>
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<tr>
<td>5 Cost Effective</td>
<td>C2: Dental policy is cost effective when restricted to primary health services. • C3: Health managers when formulating policy need a greater understanding of dental services and how it contributes to their objectives. • C4: Health managers and policy makers need to appreciate the stressors in private practice and how they influences service provision. Different remuneration systems, especially when funded by third parties, can affect patterns of care. • C5: Segregating services into “Primary Oral Health Care” and “Rehabilitative and Reconstructive” enables governments to fund services based on its contribution to health and what the taxpayers are willing to pay.</td>
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<tr>
<td>6 Sustainable</td>
<td>C1-C4: There is a need to restrict reconstructive services with a refocus towards primary health dentistry.</td>
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</tr>
<tr>
<td>Ideal Attributes of an Oral Health System</td>
<td>A Framework for Oral Health Policy</td>
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<tr>
<td>C2: A national policy restricted to primary care services is sustainable and comparable to other allied health services.</td>
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<tr>
<td>C7: e-Health mechanisms can identify cost concerns as soon as they become apparent.</td>
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<tr>
<td>C5 recommends establishment of an Oral Health Committee to monitor utilisation of policy to ensure that all groups have adequate access to services.</td>
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<tr>
<td>C6: The addition of geo-coding (postcode) to item numbers allows an assessment of geography and socio-economic status. This allows identification of areas of need where targeted measures can be considered.</td>
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<tr>
<td>C5: All Australians should be at least entitled to basic dental care. Individuals with more complex needs should be afforded extra assistance commensurate with their health needs. An Oral Health Committee led by a specialist dentist in public health would be an effective custodian and conduit between all stakeholders.</td>
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<td>C4+C5: Although the focus of oral health policy should be towards primary care, there are instances where an Oral Health Committee may grant subsidy for comprehensive treatment (including reconstructive services).</td>
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<td>C6-C8: Health data linkage using e-Health technology has the ability to integrate data from all health professions thereby enhancing multi-disciplinary engagement.</td>
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<td>C7: e-Health enables a real time and continuously updated database (census data) of treatment without the need for sampling or relying on statistical inferences.</td>
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<td>C11: Provides a timely review of law, ethics and communication for the modern dentist in Australia. It emphasizes the consequences of various treatments, identifies areas of concern and reinforces the importance of informed consent.</td>
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<tr>
<td>C6+C7: e-Health provides an effective mechanism to continuously monitor policy.</td>
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<tr>
<td>C6+C8: Dental informatics and the use of expanded item codes is an invaluable self-assessment tool for dentists and enables the profession to consolidate its research base.</td>
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<tr>
<td>C11: Dentists need to focus their CPD in the area of consent and communication. The importance of getting to know each patient is stressed through the reporting of cases arising in courts. It has been demonstrated that patients who like their clinician do not proceed with litigation regardless of clinical competency.</td>
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<tr>
<td>C5: A sustainable oral health care policy based on prevention provides the opportunity to reinforce healthy oral hygiene habits.</td>
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<td></td>
<td>• C10: By stressing the impact of dental trauma and educating the public about preventive procedures and trauma management, dentists can take an active role in reducing the burden of these injuries.</td>
<td>C10.</td>
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</tbody>
</table>

General Conclusion and Recommendations

How to improve dental health and make oral health policy work? The ultimate objective of this thesis was to explore the issues around the question in an attempt to provide a workable solution with recommendations for change. The thesis argued that increasing public health expenditure, without structural changes to the profession, will not improve dental health. The current private practice environment has competing objectives that is not ideal for delivering public health policy based on prevention and disease control. This hypothesis was tested by observing and reporting on patterns of care in the Chronic Disease Dental Scheme and Teen Dental Plan. In addition, this thesis explored other factors influencing presentation to the dentist and how this impacts oral health care. These factors such as consent, education and communication were discussed through the topics of dental trauma, litigation and oncology.

This thesis concludes that:

- Utilisation of oral health policy in private practice is correlated to remuneration rather than its contribution to health. The CDDS experienced large swings in the number of services which was coincident in the level of subsidy during that time.
- Two different funding mechanism under the same overarching policy in the EPC showed that a fee per service schedule (CDDS) had greater problems with cost containment as opposed to a fee per visit schedule. However, during the period of highest expenditure, the CDDS demonstrated that services focused on prevention and disease control were comparable in cost to allied health services.
- Health managers and policy makers need a better understanding of the types of dental services and how they contribute to health. As a majority of patients visiting dentists are asymptomatic, it is increasingly difficult to distinguish dentistry as a health service as opposed to a cosmetic commodity. Establishing an Oral Health Advisory Committee would enable governments to understand item codes and provide better scrutiny of claims.
- In terms of expenditure and volume of activity, the CDDS and TEEN have demonstrated that private practices are more concerned with repairing the effects of disease rather than preventing them. Restorative services such as aesthetic crowns
and fillings accounted for over two thirds of CDDS expenditure. Preventive services such as diagnostic saliva tests in medically compromised patients were overshadowed by the number of restorative services. Despite offering free preventive visits in the TEEN dental plan, the number of yearly visits declined.

- When dentists had influence over the course of care, patient being exempt from payment and financial responsibility shifted to a third party (health policy), there was a tendency to over-service. Under the current system, it cannot be assured that the practice of dentistry represents a prioritised approach to combat disease patterns based on scientific evidence in primary health. The focus needs to shift from an increasingly unaffordable reconstructive model to a cost-effective evidence-based preventive model.

- In formulating oral health policy, the emphasis of any initiative should be based around two overarching objectives; minimising the burden of oral disease and ensuring adequate access to preventive services. There is a need to justify dental services to reflect a more preventive approach and to enable governments to fund services based on its contribution to health and what the community is willing to pay. This can be achieved by segregating the schedule of services into two groups; Group 1: Primary Oral Health Care and Group 2: Rehabilitative and Reconstructive.

- While the appropriate level of funding needs to be established based on what the public considers fair and is willing to pay through tax, it is believed that oral health policy should be based on a combination of universal eligibility for essential services and clinical need for more extensive treatment.

- Oral health policy needs to address the current imbalance between the public/private sectors and also consider reforming the profession with greater emphasis on primary health. This can be achieved by revisiting the role of Allied Dental Professionals with a view to upgrading their skills through further training, increased Commonwealth support and offering independent rights of practice.

- There are many opportunities in the emerging area of e-Health to improve service delivery and research. One significant advantage of e-Health is the ability to seamlessly obtain census data that is not only vital for public health research but also relevant to the needs of the practising clinician and the greater profession.
• The importance of oral health to general health has been demonstrated with the reporting of a rare benign brainstem tumour. There are instances where diagnosis of life threatening conditions are made by a routine visit to the dentist. Not all signs and symptoms that occur in the mouth are abnormalities within the mouth, highlighting the need for national policy to be focused on primary health.

• Communication and trust has been linked to more positive health outcomes and presentation patterns. Unfortunately, the availability of more complex and expensive procedures combined with the relative ease in which information can be accessed online, has seen a rise in the number of court cases. As such, dentists need to appreciate the legal aspects of clinical practice and to appreciate that communication and rapport is more important than clinical competency in developing patient trust.

• Dental trauma is a significant public health problem where costs to the injured person and community throughout the world have been substantial. Oral health policies focused on improving affordability and access to dental services as well as efforts in education and health promotion can substantially reduce the impact of these injuries. A review of epidemiology has indicated that approximately one third of toddlers and one quarter of adolescents and adults have experienced dental trauma. There is also a need to standardise reporting and research of dental trauma which can be achieved by e-Health strategies.

Based on these conclusions, this thesis makes the following recommendations and areas for further study:
• Establish the position of National Dental Officer
  o Employment of a registered dentist recognised by the Australian Health Practitioner Agency as a specialist in the field of Public Health Dentistry.
    ▪ Advise health ministers and policy makers on aspects of dental treatment and its contribution to health.
  o Roles and Responsibilities.
    ▪ Oral health leader and main contact between government departments and the dental profession.
      • Establish an Oral Health Advisory Committee
        o To assess claims and item codes.
        o To identify cost concerns when they become apparent
        o Assess utilisation patterns across jurisdictions.
    ▪ Establish links with existing Chief Dental Officers (or equivalent positions) in the states and territories.
      • Long term objective is to develop the public dental system (cost savings assumed from more effective oral health policies in reducing oral disease burden).
        o Reduce wait lists.
        o Increase public sector workforce (to improve balance between private and public dentistry).
  ▪ Health promotion and Education
    • Participation in health promotion and prevention activities.
    • Discuss and develop mechanisms to capture incidences of dental trauma in tertiary hospitals (e.g. e-Health).
  ▪ Oversee the implementation of national oral health policy.
    • Segregate services based on item codes into two main groups:
      o Group 1 = Primary Oral Health Care
      o Group 2 = Rehabilitative and Reconstructive
    • Scrutinise claims and item codes as they are lodged to government departments for processing.
    • Assess cases of greater need when allocating subsidy for Group 2 services.
• Liaise with universities with regards to curriculum development for Allied Dental Professionals with a view to enhance primary care skills such as in examination and diagnosis.

• Develop e-Health Software to improve data collation and policy assessment
  o Short Term.
    • A pilot study to assess the use of selected item codes in a small number of practices.
    • Develop a larger scale study to quantify
      • Benefit/Cost
      • Feasibility
      • Practicality
  o Medium Term.
    • Approach important stakeholders (software companies and dental associations) with research findings with a view to establishing partnerships.
    • Development and testing (alpha and beta testing) of new software and/or integration into existing dental software.
  o Long Term.
    • Approach national and international oral health groups with a view to implementing software into mainstream practice.

• Allied Dental Professionals (ADP)
  o Approach important stakeholders with a view to developing a memorandum of understanding and establishing a working committee. Key groups include
    • Government health ministers and politicians
    • Universities faculty leaders
    • ADP associations (i.e.- Australian Dental and Oral Health Therapists Association)
    • Oral health groups (i.e.- International Research Collaborative- Oral health and Equity Division, University of Western Australia)
    • Registration boards (i.e.- Australian Health Practitioner Regulation Agency, Australian Dental Council)
  o Discuss proposal and develop a framework to include the following elements.
- Curriculum development
- Assessment standards
- Cost and Feasibility
  - Develop an evidence base in cooperation with teaching centres
    - Design a diagnostic test accuracy study to assess sensitivity and specificity values for detecting caries and periodontal disease in ADPs.
    - Setting of study will initially be in a university teaching hospital under the supervision of registered dentists.
    - Subsequent study in public dental clinics under the supervision of government dentists.
  - Establish and refine framework based on results and forward proposal to Commonwealth Health Minister.
- Develop new oral health policy based on JERM principles.
  - Approach important stakeholders (similar to above) with a view to developing a memorandum of understanding and establishing a working committee.
  - Develop an initial working proposal
    - Limit eligibility to disadvantaged groups (rural and remote, financial, and medically compromised).
    - Limit subsidy to Group 1 services.
    - Set subsidy to half of CDDS for a 2 year period with services restricted to Group 1 Services.
    - Encourage public health clinics and private practices in rural centres subscribed to government incentives (i.e. Dental Relocation and Infrastructure Scheme (DRISS)) to test policy.
  - Consider as part of the requirements of receiving Commonwealth funding, private practices should participate in oral health research to assist in verifying the feasibility of oral health policy.
  - Note: DRISS is a recent Commonwealth government initiative to encourage private practices to relocate to areas of need. This initiative was introduced shortly after cessation of the CDDS.
- Consolidate proposal based on performance/research with a view for widespread adoption and universal eligibility for Group 1 services.