

Review of Indigenous oral health

Scott Williams¹, Lisa Jamieson¹, Andrea MacRae² and Caitlin Gray²

1. University of Adelaide 2. Australian Indigenous HealthInfoNet

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Introduction

Indigenous Australians¹ have poorer oral health than other Australians [1, 2]. Indigenous people suffer from more caries, periodontal diseases, and tooth loss than non-Indigenous people [3]. Tooth decay among the Indigenous population more commonly goes untreated, leading to more extractions. This discrepancy is attributed in part to the fact that access to culturally appropriate and timely dental care is often not available to Indigenous people, especially in rural and remote areas. Other information on oral health such as culturally appropriate resources about maintaining healthy teeth and mouths, and nutritional guidance on how much sugar is contained in certain foods and drinks, is also less available for the Indigenous Australian population. If Indigenous oral health is to be ameliorated, access to dental care must be improved, and an integrated holistic approach to oral health, which includes preventative measures, needs to be established.

1 The term Indigenous is used in this review to refer to the two Indigenous populations of Australia - Australian Aboriginal people and Torres Strait Islanders.

Contents

Introduction	1
Oral health and disease.....	2
Brief history of the oral health of Indigenous people.....	3
Data sources and quality.....	3
Structure of this review.....	4
Oral health of Indigenous people	5
Caries.....	5
Periodontal disease.....	8
Tooth loss.....	10
Experience of oral health impairment.....	11
Services	12
Oral health promotion services.....	12
Oral health service delivery.....	12
Barriers to good oral health among Indigenous people ...	14
Oral health services.....	14
Diet.....	14
Water fluoridation.....	14
Living conditions.....	14
Oral hygiene.....	15
Professional dental care.....	15
Policies and strategies	16
Concluding comments	17
References	17

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Oral health and disease

Modern definitions of disease usually include some reference to health and tend to provide a continuum of health through to advanced disease. Oral health can be defined as 'a standard of health of the oral and related tissues that enables an individual to eat, speak, and socialise without active disease, discomfort, or embarrassment, and that contributes to general wellbeing' [4, cited in 5, p.55]. Oral health plays an important role in general health and wellbeing [6] and is more than simply the absence of disease in the mouth; it should be viewed as a standard of oral functioning that enables comfortable participation in everyday activities.

Oral diseases can cause substantial infection and tooth loss. They commonly result in severe pain and make everyday activities, such as eating and speaking, difficult, resulting in limited social interaction [7]. Oral diseases affect not only the mouth, but have been associated with cardiovascular diseases [8], diabetes [9], stroke [10] and pre-term low birthweight [11]. Two common diseases that affect oral health are dental caries and periodontal disease. Both caries and periodontal diseases are affected by diet and oral hygiene, and may lead to discomfort and tooth loss if not treated in a timely manner. Fortunately both caries and periodontal disease are easily prevented, and early caries (i.e. non-cavitated demineralised tooth structure contained within the enamel) and early periodontal disease (i.e. gingivitis) are curable. Once the appropriate educational measures have been instigated, prevention is the cheapest, easiest, least invasive, and most appropriate 'treatment' option.

Caries

Dental caries, commonly known as cavities or tooth decay, are caused by acid-producing bacteria living in the oral environment that proliferate in the presence of sweet and sticky foods [12]. In the early stages, dental caries can be completely reversed; however, if they go untreated, they will cause irreversible damage (such as cavitation of tooth enamel). Small cavitations do not usually produce severe ongoing or sporadic pain and require small restorations (fillings); however larger carious lesions can completely undermine the structural integrity of the tooth. These will require substantial restorative treatment (e.g. indirect restorations: crowns) or extraction; furthermore, larger carious lesions usually extend to the dental pulp, resulting in pulpal infection, and cause some degree of pulpal inflammation.

Pulpal inflammation can be extremely painful and is one of the most common reasons for attendance at the dentist. Pulpal inflammation can be reversible in most cases where the carious lesions have not yet reached the pulp, however large cavitated carious lesions that have reached the pulp, are more likely to

be irreversible [13]. The treatment protocol for long standing irreversible pulpal inflammation is root canal therapy or extraction [14]. Long standing pulpal inflammation will result in pulp necrosis. As pulp necrosis results in loss of the tooth's sensory apparatus, the dental pain associated with the initial inflammation completely subsides. Many patients mistake this for an improvement or healing; however, the infection of the dental pulp will continue and spread through the apex of the pulp canal/s into the supporting structures causing periapical periodontitis [13]. This ultimately results in severe pain and often has systemic effects (e.g. febrility). Patients with periapical periodontitis require root canal treatment or extraction.

If the tooth is to be restored (i.e. not extracted), the remaining decay usually requires substantial extra coronal restoration (i.e. crowns). Both the root canal therapy and the crown are expensive, and this type of treatment from a private practitioner is likely to cost more than two to three-thousand dollars. If specialists are performing the treatment it will likely be more. Such costs present an insurmountable barrier to many patients, particularly the socially and financially disadvantaged. If the patient is seen in the public sector, whilst the cost is substantially less, the waiting lists are large in some jurisdictions and treatment options are restricted by policy in many cases.

As extractions are usually a few hundred dollars in the private sector and tens of dollars in the public sector, it is no surprise that many disadvantaged patients (e.g. Indigenous Australians) opt for extraction, rather than other treatments. Whilst extraction may provide quick relief of pain, there are long term consequences that may need to be addressed later on. For instance, masticatory efficiency diminishes as teeth are lost. If a patient has many extractions they may require dentures. In the private sector dentures may cost upwards of a thousand dollars. In the public sector they cost hundreds of dollars; however there may be a further waiting list for dentures in the public sector.

Caries are a major health concern and if not prevented they have many painful and difficult consequences. Regardless of the extent of the caries and the required treatment modality, all of the options will have life-long consequences and require maintenance/treatment even if a tooth is lost [12]. Increased policy and interventions aimed at the prevention of dental caries would be cost beneficial.

Caries experience is measured by the *Decayed missing and filled teeth index* (DMFT) for permanent (adult) teeth or by the *dmft index* for deciduous (juvenile) teeth [12]. Both indices measure how many teeth (T/t) are decayed (D/d), missing (M/s) or filled (F/f). Neither index differentiates between a tooth with minor problems and one with major problems, nor do they provide a direct indication of the

discomfort or dysfunction experienced.

To get a more accurate picture of decay, another index, the Decayed Missing and Filled Surfaces (DMFS), is used. By measuring the number of decayed/missing/filled surfaces on each tooth, rather than the tooth as a whole, the DMFS provides more detail about an individual's caries experience [12]. It is also important to note that the DMFT/dmft and DMFS/dmfs indices are cumulative: once a tooth has experienced caries it is permanently recorded by the index. As a result, these indices provide information about caries experience over a lifetime and cannot account for changes in risk factors or active disease levels.

It should also be noted that these indices do not measure the effect of caries experience on quality of life. As caries can have a profound impact on oral health and quality of life, it is important to understand this relationship. Several instruments have been developed to measure the effect oral health has on quality of life. The *Oral health impact profile* (OHIP) is one such index. The shortened version, OHIP-14, contains fourteen questions that address the effect of oral health on a subject's life, for instance, recent pain levels or disruptions to sleep [7].

Periodontal disease

Periodontal diseases are associated with bacterial infection of the periodontal tissues causing inflammation. Unlike caries, they are specifically attributed to poor oral hygiene as opposed to a poor diet. Like caries, periodontal diseases are preventable and treatable. Periodontal diseases range in severity from gingivitis (a mild and completely reversible form) to periodontitis (a severe destruction of the tissues that support the teeth) [12]. Gingivitis is characterised by inflammation and bleeding gums and can be completely cured. Symptoms of periodontitis include the loss of tooth-supporting bone and the formation of periodontal pockets (spaces between the gum and tooth), and clinical attachment loss, where bacteria have caused the deterioration of bone and ligament. Periodontitis can result in tooth mobility, partial and total edentulism (tooth loss), and halitosis. Most forms of periodontitis do not cause pain, although some forms, namely Acute necrotising ulcerative gingivitis (ANUG) and Acute necrotising ulcerative periodontitis (ANUP), do cause significant pain. Periodontitis can be localised (to a few teeth) or generalised (to larger areas of the mouth, or the whole mouth). Acute forms exist, however these are rare and tend to occur in patients with complicating systemic factors. Acute forms also tend to be localised. Periodontitis is modified by systemic factors: smoking, diabetes, hormonal imbalances, stress and poor diet (e.g. scurvy), and can greatly exacerbate the extent of periodontal involvement.

Indices exist to measure periodontal disease, however definitions about what to include in an index are contentious, and the use of different definitions has resulted in a wide range of prevalences within the same populations. As with caries, these indices do not measure the effect of periodontal disease on quality of life. Once again, measures like OHIP are useful to gauge the effect of disease on quality of life.

Brief history of the oral health of Indigenous people

The oral health of Indigenous Australians was once better than the oral health of non-Indigenous Australians [12]. Dental caries and periodontal diseases were uncommon in rural and remote Indigenous communities up until the later twentieth century; the main problem experienced by the Indigenous population at that time was attrition (dental wear) [15]. Dental decay, a disease of affluence that emerged in the 19th and 20th centuries, was not common in Indigenous communities until foods rich in fermentable carbohydrates (cariogenic foods) became common in rural and remote parts of Australia [12]. When these foods became accessible, what had been a disease of affluence became an indicator of deprivation; Indigenous people did not have the same access to the new preventive measures, such as fluoridated water and toothpaste, or easy access to dental care, which was available to the largely urban-based non-Indigenous population. Indigenous people currently have the same oral health risk factors as non-Indigenous people, but do not have the same access to protection from dental decay. The oral health of Indigenous people has deteriorated alongside general health and is now a significant problem among the Indigenous population.

Data sources and quality

Until recently, Indigenous health overall, and Indigenous oral health in particular, had not been studied systematically. As a result, the information available is incomplete and has generally focused on small geographical areas or remote communities instead of providing broad, national information. Further, older information cannot often be reliably used to draw comparisons with current information due to significant variations in study designs and the geographical and social distribution of the Indigenous population. Significantly more epidemiological information is required to develop a truly complete and rigorous understanding of the oral health of the Indigenous population in Australia.

This review draws on the most up-to-date information available but, due to limitations in current information, it has been necessary to draw on older information and/or information from specific communities in some instances. Each study has its own inherent limitations. The limitations of the main studies used for this review are summarised below.

- The *National survey of adult oral health 2004-2006* (NSAOH) provides the most current national-level information, but only 87 of the 5,505 (1.6%) people examined were Indigenous (Indigenous people comprise approximately 2.5% of the Australian population) [16]. The periodontal examinations conducted in this study only inspected 75 Indigenous individuals, which may have distorted the differences in periodontal disease between Indigenous and non-Indigenous people. Further, random sampling was drawn from a digital telephone book. This may be a good sampling technique for the total population, but many Indigenous people do not have a landline telephone (mobile telephones were eliminated for reasons of cost). The *National Aboriginal and Torres Strait Islander social survey, 2002* (NATSISS) found that telephone ownership is considerably lower in Indigenous households in remote areas than in non-remote areas, and also that telephone ownership is lower for Indigenous people than for non-Indigenous people in both remote and non-remote areas [17]. As such, the Indigenous sample in the NSAOH is not representative of the Indigenous population as a whole. Also, the very small number of Indigenous people in the NSAOH has implications for the robustness of the estimates for various conditions.
- The *Aboriginal birth cohort* (ABC) study is a prospective longitudinal study following a birth cohort of Aboriginal people born at the Royal Darwin Hospital, Northern Territory (NT), between January 1987 and March 1990 [18]. The large sample of the ABC study enables comparisons to be made between data collected for Indigenous people of 16–20 years of age in that study and data about age-matched non-Indigenous people from the NSAOH. Some caution should be exercised in interpretation of these comparisons because of differences in data collection and study design. However, in the absence of rigorous national level data, these data do provide information about important trends in Indigenous oral health.
- The *Child dental health survey* (CDHS) is a national survey that examines the oral health of children enrolled in the School dental service (SDS) in public and private schools in Australia [19]. This study includes samples from only New South Wales (NSW), South Australia (SA) and the NT because of poor identification of Indigenous status and/or small numbers of Indigenous children in the other states and territories. Indigenous children not enrolled or present in schools for dental examinations were not examined and as such were not included in the study. The results are therefore not indicative of the oral health of Indigenous children not enrolled or present at school when examinations were undertaken.
- The *Aboriginal and Torres Strait Islander children and receipt of hospital dental care investigation* examined data on dental procedures conducted in public and private hospitals in

Queensland (Qld), Western Australia (WA), SA, and the NT (other states and territories were excluded because of poor identification of Indigenous status) available from Australian Institute of Health and Welfare's (AIHW) *National hospital morbidity database (2002-03)* [19].

- Data from a large retrospective study of Indigenous Australians in rural and remote WA demonstrates a similar picture to other studies, however as a caveat, it cannot statistically be generalised to other remote communities. It does however provide an important insight into the oral health of these communities [20].
- The *Study of Aboriginal and Torres Strait Islander child oral health in remote communities* included data gathered by dental health professionals from remote Indigenous communities around Alice Springs, NT, in the Far West Area Health Service, NSW and the Nganampa lands, SA [19]. Again, the focus on only a small number of communities means these data may not be generalised to other remote communities.

Without larger sample sizes, preferably from a national survey specifically targeted at the Indigenous population, it is difficult to develop a full understanding of Indigenous oral health and draw statistically significant comparisons. Rigorous and accountable policy design should be based on statistically significant, statistically powerful, representative data derived from well designed research. Data of this type is not always available and disparities often exist. There is a clear disparity between the amount and quality of data pertaining to the oral health of Indigenous Australians when compared with non-Indigenous Australians. Until national data are consistently available, information has to be drawn together from a variety of sources to provide a more general understanding of the oral health of Indigenous Australians.

Structure of this review

The next section summarises the oral health status of Indigenous people, with specific attention to caries, periodontal disease and tooth loss, and associated protective and risk factors. As well as tooth loss, it also considers other outcomes of poor oral health. The following two sections outline details of oral health services and the barriers to good oral health for Indigenous people. The final substantial section provides brief details of the two most relevant national strategies for addressing the oral health of Indigenous people.

Oral health of Indigenous people

Caries

Caries among Indigenous children

Indigenous children experience more caries than non-Indigenous children in their deciduous teeth [19]. According to the CDHS, the mean number of dmft in Indigenous children aged 4-10 years was significantly higher than for their non-Indigenous counterparts in NSW, SA and the NT. The highest dmft scores were for Indigenous six-year-olds, who experienced 2.4 times the dmft of non-Indigenous children of that age. Four-year-old Indigenous children had more than three times the decay of their non-Indigenous counterparts. The highest numbers of missing teeth occurred in five-year-old Indigenous children, with a level more than five times that of non-Indigenous five-year-olds. The highest number of filled teeth occurred in eight-year-old Indigenous children. Taken together, the dmft scores indicated much poorer oral health in the deciduous dentition of Indigenous children aged 4-10 years than of their non-Indigenous counterparts, with the largest differences in the younger age groups.

Poorer oral health for Indigenous children continues among those with permanent teeth: the DMFT² was 1.5 times greater for Indigenous children aged 6-15 years than for their non-Indigenous counterparts, with higher DMFTs for each increasing age group (Table 1).

Table 1. Proportions (%) of children aged 6-17 years with DMFT>0, by Indigenous status and age, NSW, SA and the NT, 2000-2003

Age (years)	Indigenous	Non-Indigenous
6	8	3
7	14	10
8	24	14
9	29	17
10	38	21
11	37	25
12	45	29
13	46	31
14	59	39
15	62	58
16	67	59
17	73	61

Source: Jamieson LM, Armfield JM, Roberts-Thomson KF (2007) [19]

Note: 1. Data are for 12-month periods: NSW from 2000; SA from 2003; and the NT from 2002

2. Where children had more than one examination, information from the first examination has been used

2 The number of missing permanent teeth of children aged 6-15 years were negligible.

Indigenous children had higher numbers of decayed teeth across all ages, with those aged 15 years having almost three times the number among their non-Indigenous counterparts. Filled teeth were similarly higher for Indigenous children, with six-year-old Indigenous children experiencing twice the number of filled teeth (0.02) than non-Indigenous six-year-olds (0.01).

Where children live affects their experience of caries, with caries more common in rural and remote settings than in metropolitan centres [19]. According to the *Study of Aboriginal and Torres Strait Islander child oral health in remote communities*, Indigenous children living in rural areas had the worst oral health with the highest dmft and DMFT scores, followed by Indigenous children in metropolitan areas. Non-Indigenous children in both rural and metropolitan areas had similar oral health, with levels of decayed, filled and missing teeth in their deciduous and permanent teeth lower than among Indigenous children. Cariogenic food products are easily available in metropolitan, rural, and remote communities, and as such, consumption patterns can be considered fairly constant [19]. Fluoridation of water supplies in metropolitan and many rural areas is fairly consistent, however many remote communities do not have access to artificially fluoridated water, although some naturally occurring fluoride may exist [19]. It is likely that differing levels of water fluoridation are implicated in caries levels. Although water fluoridation has been shown to be an effective method for reducing the prevalence of dental caries, patterns of consumption and distribution of fluoridated water vary across Australia, and fluoridation alone cannot totally negate the effects of poor oral hygiene and highly cariogenic diets. Whilst the increase in caries among Indigenous children in remote communities may be associated with decreased water fluoridation, in light of the widespread availability of cariogenic food, it is likely that reduced access to oral care and oral hygiene education may be important factors in the caries rates of remote Indigenous children [19]. Appropriate oral care includes the use of fluoridated toothpaste twice a day. Fluoridated toothpastes are an important part of preventing decay, however in areas without optimally fluoridated water supplies, the use of fluoridated toothpaste becomes more important [19]. The SDS provides annual community visits, but many Indigenous children either are not enrolled in schools or are not present on the visit day, and miss the professional care benefits offered by this mainstream service.

Rates for hospital dental care were similar for Indigenous and non-Indigenous children living in metropolitan and rural areas, with rates for children living in rural areas 1.3 times higher than those for children living in metropolitan areas [19]. The higher rates in rural areas reflect the limited oral health services in these locations. The high rate of extractions in rural areas suggests that either more children in rural locations had unsalvageable teeth or

that the delay for another appointment would be unreasonable if restorative treatment was unsuccessful.

The age pattern of hospitalisation for dental care was quite different for Indigenous and non-Indigenous children: more than one-half (51%) of Indigenous children hospitalised were less than five years of age compared with around one-third (34%) of non-Indigenous children (Table 2) [19]. Only one-tenth of Indigenous children hospitalised for dental care were aged 10-14 years, compared with more than one-quarter (27%) of non-Indigenous children. Hospitalisation for younger children is usually sought when gross caries results in a need for several or many extractions. In these cases it is done under general anaesthesia in one appointment so as to reduce trauma for the child.

The more uniform distribution of the rates and proportions, as well as the age pattern of hospitalisation for dental care suggests that young Indigenous children had more advanced tooth decay in their deciduous teeth, or had a higher number of deciduous teeth that were affected and required extraction, than did young non-Indigenous children [19].

The overall rate of dental extractions was slightly higher for Indigenous children than for non-Indigenous children, with the rate for Indigenous children, less than 5 years of age, more than twice that of their non-Indigenous counterparts [19]. Tooth restoration rates were 1.3 times higher for Indigenous children aged less than 5 years than for their non-Indigenous counterpart, but Indigenous children of all ages were less likely than other children to have pulpal and 'other' treatments.

A WA study examined hospitalisations of children for oral health conditions over a four year period, 1999-2000 to 2002-2003, and showed that the age standardised rates (ASR) for Indigenous children decreased after the period 1999-2000 from 772.4 to 759.3 in 2000-2001, and 751.6 in 2001-2002 [21]. This figure increased to 906.6 during the 2002-2003 periods. Data for non-Indigenous children followed a different pattern, while initially decreasing from 1331.3 to 1300.0 between 1999-2000 and 2000-2001, figures then rose to 1425.2 and 1561.1 over the following periods 2001-2002 and 2002-2003. Data from this study revealed ASR for Indigenous children less than 12 months of age to be higher than non-Indigenous children (940.8 and 780.9 respectively) but lower for all other age groups. The greatest discrepancy between groups occurred in the 13-17 year age range with ASR for Indigenous

Table 2. Proportions and rates of children receiving hospital dental care, by Indigenous status and age group, and Indigenous: non-Indigenous rate ratios, Qld, WA, SA and the NT, 2002-03

Age group	Indigenous		Non-Indigenous		Rate ratio
	Proportion (%)	Rate	Proportion (%)	Rate	
<5 years	51%	907	34%	657	1.4
5-9 year	39%	667	39%	721	0.9
10-14 years	10%	181	27%	501	0.4

Source: Jamieson LM, Armfield JM, Roberts-Thomson KE, 2007 [19]

- Note:
- 1 Rates are per 100,000
 - 2 Rate ratio is the Indigenous rate divided by the non-Indigenous rate

Table 3. Prevalence of caries-related conditions, by Indigenous status, and Indigenous-non-Indigenous ratios, Australia, 2004-2007

	Indigenous		Non-Indigenous		Ratio
	Prevalence	Confidence Interval (95%)	Prevalence	Confidence Interval (95%)	
Caries	78	74-82	63	51-73	1.2
Decayed teeth (DT>0)	74	70-79	23	15-34	3.2
Missing teeth (MT>0)	52	47-57	21	12-34	2.5
Filled teeth (FT>0)	23	19-27	49	38-61	0.5

Source: Jamieson LM (2010) [27]

- Note:
- 1 Indigenous data from NT participants in ABC study (2006-2007) and comparable non-Indigenous data from the NSAOH (2004-2006)
 - 2 Prevalence is percentage of people with the condition; confidence interval provides an indication of the reliability of the estimated prevalence
 - 3 Ratio is the Indigenous prevalence divided by the non-Indigenous prevalence

children (545.4), much lower than non-Indigenous children (2024.3).

Increased referral rates for hospitalisation might also be indicative of a lack of cultural awareness of dentists treating Indigenous Australians. The experience at Pika Wiya in Port Augusta, SA has shown that increased cultural sensitivity has resulted in improved oral health outcomes [22]. In light of a decreasing labour market, the Centre for Rural and Remote Oral Health (CRROH) has described sustainable models for servicing rural and remote Indigenous populations that include the training of Aboriginal Health Care Workers and provision of culturally sensitive education programs [23, 24, 25]. CRROH has also been involved in pre-graduate placements for dental students in WA [26].

Caries among Indigenous adults

Caries is much more common among Indigenous people than among non-Indigenous people [16]. According to the NSAOH, the Indigenous adult population had 2.3 times more untreated caries than the non-Indigenous adult population, and 57% of Indigenous adults had one or more teeth affected compared with 25% of non-Indigenous adults.

The severity of decay that Indigenous adults suffer is also notably higher than that experienced by non-Indigenous adults [16]. According to the NSAOH, Indigenous people 15 years and older had more than three times the number of decayed tooth surfaces than their non-Indigenous counterparts. The greatest difference was in the 35-54 years age group, with Indigenous people experiencing more than five times the decayed tooth surfaces than their non-Indigenous counterparts.

Almost four-fifths (78%) of Indigenous people aged 16-20 years included in the ABC Study were found to have caries, a level 1.2 times that documented for non-Indigenous people of that age

group who participated in the NSAOH (Table 3)[27].

Indigenous people aged 17-20 years had 3.2 times the prevalence of decayed teeth and 2.5 times the prevalence of missing teeth than did their non-Indigenous counterparts. On the other hand, the level of fillings was lower among Indigenous people than among their non-Indigenous counterparts: the ratio for filled teeth was 0.5 and for filled surfaces was 0.3. Together with their higher decay rates, these ratios suggest that service utilisation was lower, and levels of untreated caries substantially higher, among this Indigenous population than among age-matched non-Indigenous people who participated in the NSAOH.

A comparison of the mean number of decayed teeth and surfaces (severity) reveals the same trends. Indigenous people aged 17-20 years experienced 1.7 times the mean number of decayed, missing, or filled teeth than their non-Indigenous counterparts [27]. When broken down into its components, this group experienced 8.2 times the prevalence of decayed teeth. When using the DMFS compared to DMFT, the mean number of decayed, missing, or filled teeth compared to surfaces increased from 1.7 to 2.6, and the mean number of decayed teeth compared to surfaces increased from 8.2 to 10.9 (Table 4).

Data from a large WA retrospective study paints a less favourable picture of the oral health of Indigenous Australians. It calculated an average DMFT score of 8.5, four times higher than the NSAOH DMFT for the general population [20].

Table 4. Mean caries scores, by Indigenous status, and Indigenous-non-Indigenous ratios, Australia, 2004-2007

	Indigenous		Non-Indigenous		Ratio
	Prevalence	Confidence Interval (95%)	Prevalence	Confidence Interval (95%)	
DMFT	4.8	4.3-5.3	2.8	1.8-3.8	1.7
Decayed teeth (DT)	4.1	3.7-4.5	0.5	0.3-0.7	8.2
DMFS	8.3	7.2-9.4	3.2	2.1-4.3	2.6
Decayed surfaces (DS)	7.6	6.5-8.7	0.7	0.3-1.0	10.9
Filled surfaces (FS)	0.7	0.5-0.9	2.6	1.5-3.7	0.3

Source: Jamieson LM (2010) [27]

- Note:
- 1 Indigenous data from NT participants in ABC study (2006-2007) and comparable non-Indigenous data from the NSAOH (2004-2006)
 - 2 Prevalence is percentage of people with the condition; confidence interval provides an indication of the reliability of the estimated prevalence
 - 3 Ratio is the Indigenous prevalence divided by the non-Indigenous prevalence
 - 4 See text for details of DMFT

Protective and risk factors for caries

Diet

Caries can largely be prevented by maintaining a healthy diet [12]. Since the arrival of Europeans in Australia in 1788, there has been a rapid change in diet for many Indigenous people from a fibre rich, high protein, low saturated fat, traditional diet to a diet high in refined carbohydrates and saturated fats [28, 29]. This new diet includes a lot of processed and sugary foods, and little fresh produce. This is especially true for people living in remote and very remote areas where food can be considerably more expensive than in urban areas [30] and fresh produce may be in poor condition after being transported long distances. Many Indigenous people, including children, consume a high level of sugary, cariogenic foods, such as carbonated drinks and confectionary [29]. This non-traditional diet substantially increases the risk of caries.

Water fluoridation

Fluoridation of public water supplies is an effective way to prevent caries [31]. It is considered the most cost-effective and socially equitable way of preventing dental decay and could significantly benefit communities that are socioeconomically disadvantaged, such as remote Indigenous communities. National reports have documented that one-third of Australians, most of whom live in rural areas, currently do not have access to fluoridated water [32, 33]. These reports have recommended that water fluoridation should be extended to small rural communities. *Healthy mouths healthy lives: Australia's national oral health plan 2004-2013* suggests that water fluoridation should be made available to communities with populations less than 1,000 people [34], and there is evidence to suggest that fluoridation may be cost effective in larger remote Indigenous communities [31]. Until fluoridation becomes available to all Indigenous people, they will continue to be at increased risk of dental decay. It should be noted, that fluoridation of Qld's water supply has begun. By the end of 2010, 80% of the population were expected to have access to fluoridated water, and by the end of 2012, 95% of the population will have access to fluoridated water. With the inclusion of Qld in community water fluoridation statistics, the national figure mentioned above (one-third of Australians without access to fluoridised water) will decline to reflect the Qld coverage [35].

Oral hygiene

Good oral hygiene is fundamental to prevent caries. Self-care includes frequent tooth-brushing with fluoridated toothpaste and requires an understanding of the value of good oral care, as well as resources available to purchase toothbrushes and toothpaste [29]. There is evidence that oral care practices were not necessary with a traditional Indigenous diet, and were not part of some Indigenous

cultures [12]. There are also strong ties between socioeconomic status and oral hygiene with those who are more disadvantaged being less likely to practice good oral hygiene [12, 16]. Thus, for economic and socio-cultural reasons, Indigenous people are at increased risk of caries.

Professional dental care

Many professional dental services are not affordable for, or available to, Indigenous people [12]. Few dental professionals work in rural or remote locations, and studies have found that private dental care is too costly for many Indigenous people. Similarly, many dental services are not culturally sensitive, thus creating access barriers for Indigenous people. Without professional dental care, Indigenous people are at increased risk of untreated dental decay.

Hypoplasia

Another important factor for the prevention of caries is having strong teeth from birth [36]. Tooth enamel provides a hard, protective surface on the tooth. If the enamel becomes weak, a condition known as enamel hypoplasia, may result in increased incidence of caries. Enamel hypoplasia can result from a congenital condition, premature birth, infections during childhood, malnutrition [37] and low birthweight [38], many of which occur at higher rates among Indigenous people than in the total population [39].

Periodontal disease

Periodontal disease among Indigenous children

Children rarely develop severe periodontal disease, but gingivitis is relatively common among Indigenous children, especially older children. Although gingivitis in itself does not cause destruction of periodontal structures, as it is inflammation it should be prevented. Periodontitis is an exacerbation of gingivitis, however the progression from gingivitis to periodontitis is not certain and only occurs in individuals at risk [19]. Risk factors include smoking, diabetes, stress, genetic and epigenetic inherited factors, hormonal imbalance, immunosuppression, maleness, mouth breathing, decreased socioeconomic status (SES), poor education, and poor nutrition. As Indigenous Australians are more likely to smoke, have diabetes, have poor nutrition, are typically lower on the SES ladder, and may be at an increased genetic risk (not yet supported directly by the literature), they are likely to be at an increased risk of developing periodontal disease. Furthermore the prevention of gingivitis through appropriate oral hygiene decreases the likelihood of developing dental caries. According to the *Study of Aboriginal and Torres Strait Islander child oral health in remote communities*, the prevalence of gingival bleeding, a common symptom of gingivitis, was higher for Indigenous

children aged 6-15 years in SA than for their non-Indigenous counterparts [19]. The level of gingival bleeding among Indigenous five-year-olds was almost four times higher than that among their non-Indigenous counterparts. Among 12 year-olds, almost half (48%) of Indigenous children had gingival bleeding compared with 23% of non-Indigenous children. The same study found that gingival bleeding was common among Indigenous children in NSW. In NSW Indigenous children aged 12-14 years had a markedly higher prevalence of bleeding than did their non-Indigenous counterparts, but there was little difference in prevalence between Indigenous and non-Indigenous children 4-12 years. Three-in-five Indigenous children living in remote communities showed some evidence of gingivitis and approximately one-in-five children were at moderate risk of developing gingivitis. More than two-fifths (42%) of Indigenous children aged 15-16 years were at moderate risk of developing gingivitis and 25% were at high risk.

Periodontal disease among Indigenous adults

Indigenous adults are more likely to suffer from periodontal disease than their non-Indigenous counterparts [16]. According to the NSAOH, almost 27% of Indigenous people 15-74 years had gingivitis; they experienced approximately 1.3 times the prevalence of moderate and severe periodontitis than did their non-Indigenous counterparts. Indigenous people had a slightly higher prevalence of deep (4+mm) periodontal pockets and clinical attachment loss than did non-Indigenous people.

An ABC-NSAOH comparison of Indigenous and non-Indigenous people aged 17-20 years demonstrates a more notable difference in periodontal diseases between the two groups: Indigenous people had 1.7 times the prevalence of calculus deposits (a risk indicator of periodontal diseases), 1.2 times the prevalence of gingivitis, 9.5 times the prevalence of moderate or severe periodontal disease, and 11.8 times the prevalence of deep periodontal than their non-Indigenous counterparts (Table 5) [27, 40].

Indigenous people are affected by periodontal diseases at much younger ages than non-Indigenous people [12, 41, 42]. According to the NSAOH, Indigenous people aged 15-34 years experienced almost twice the prevalence of moderate or severe periodontitis than their non-Indigenous counterparts (13.5% and 7.3% respectively) [16]. Compared to non-Indigenous people aged 15-34 years, Indigenous people in that age group had higher prevalences of: deep periodontal pockets (18% compared with 13%); clinical attachment loss (24% compared with 17%); and tooth sites with deep periodontal pockets (1.3% compared with 0.6%).

Protective and risk factors for periodontal diseases

Smoking

Smoking is a significant risk factor for the development, progression and severity of periodontal diseases [43]. According to the *2004-2005 National Aboriginal and Torres Strait Islander health survey*, half of the adult Indigenous population smoked daily or regularly, a level more than twice that of non-Indigenous adults [44].

Diabetes

Diabetes, especially uncontrolled or poorly controlled diabetes, is associated with increased risk of oral infections [12]. Diabetes/high sugar levels were reported by around 6% of Indigenous people who participated in the *2004-2005 National Aboriginal and Torres Strait Islander health survey* [44]. After adjusting for differences in the age structures of the two populations, diabetes/high sugar levels were around 3.4 times more common for Indigenous people than for non-Indigenous people. A 1998-2000 study of periodontal diseases among diabetic and non-diabetic residents of the Anangu Pitjantjatjara lands in SA found that Anangu people with diabetes were more than three times as likely as those without diabetes to have 4-5 mm periodontal pockets and almost 10 times as likely to have 6+mm pockets.

Table 5. Prevalence of periodontal risk indicators and periodontal diseases, by Indigenous status, and Indigenous:non-Indigenous ratios, Australia, 2004-2007

	Indigenous		Non-Indigenous		Ratio
	Prevalence	Confidence interval (95%)	Prevalence	Confidence interval (95%)	
Calculus deposits	89	86-92	52	41-63	1.7
Gingivitis	89	86-93	74	65-82	1.2
Periodontal pockets 4mm or deeper	61	57-66	5.2	2.3-11.5	11.8
Moderate or severe periodontal disease	27	19-35	2.8	0.8-8.9	9.5

Source: Jamieson LM (2010) [27]

- Note:
- 1 Indigenous data from NT participants in ABC study (2006-2007) and comparable non-Indigenous data from the NSAOH (2004-2006)
 - 2 Prevalence is percentage of people with the condition; confidence interval provides an indication of the reliability of the estimated prevalence
 - 3 Ratio is the Indigenous prevalence divided by the non-Indigenous prevalence

Oral hygiene

Periodontal diseases are also attributed to poor oral hygiene, of which self-care plays an important role. According to the *Study of Aboriginal and Torres Strait Islander child oral health in remote communities*, only around one-fifth of Indigenous children living in remote communities in NSW, SA and the NT brushed their teeth at home (20%) or at school (18%), and less than 5% of those younger than five years of age brushed their teeth regularly [19]. A study in the Top End of the NT in 2003 found low levels of regular preventive oral health care among remote Indigenous children [29]. The study noted that about 84% of the children in the study used a toothbrush, but only 20% used toothpaste on a daily basis. The use of toothpaste generally started relatively later in life, with the most common commencement age being four years. This may reflect commencement of pre-school and exposure to oral hygiene strategies organised by schools. Children learn their oral self-care habits from seeing what other people do on a daily basis; caregivers who regularly partake in oral self-care habits, such as brushing and/or flossing, are likely to instil such behaviours in the children in their household [45].

Professional dental care

Professional dental care is also important in periodontal health. According to the NSAOH, fewer Indigenous adults than non-Indigenous adults reported visiting a dentist within the last twelve months (51% compared with 60%) [16]. Similarly, Indigenous people were 10% less likely than non-Indigenous people to visit a dentist annually (43% compared with 53%).

Indigenous people face a number of barriers, including cost, to regular and timely professional dental care [16]. The course of periodontitis can be substantially worse for patients without regular access to dental care. Unfortunately, periodontitis and reduced dental care (professional and self-care) can establish a 'vicious cycle': the onset of disease makes cleaning more difficult, and, as cleaning becomes more difficult, more acute and deeper bacterial invasion of the tooth surface worsens the level of disease. This cycle eventually results in destruction of the tooth-supporting apparatus and tooth loss.

Tooth loss

The main causes of tooth loss are extraction of diseased teeth due to dental caries, periodontal diseases, and trauma [12]. Complete tooth loss, known as total edentulism, significantly affects oral functioning and quality of life of individuals. Tooth loss is overrepresented among Indigenous people and edentulism occurs at younger ages for Indigenous Australians.

Tooth loss due to injury

Injuries of the head and neck may affect dentition; fractures specifically of the maxilla and mandible are directly related to tooth loss and loss of function [46]. Fracture of the skull and facial bones, with associated tooth loss, is the third most prevalent head injury in Australia; tooth loss due to head trauma can markedly reduce quality of life. After adjusting for differences in age, gender and residential location, the rate of hospitalised head injury due to assault was 21 times higher for Indigenous people living in Qld, WA, SA and the NT in the six year period 1 July 1999 to 30 June 2005 than for their non-Indigenous counterparts. The rate ratio was especially high among females: 69 for all ages and 93 for the 30-34 years age group. In a WA study, hospitalisation data between 1999 and 2003 showed that Indigenous adults were hospitalised for jaw fractures at a higher rate than non-Indigenous adults, 42% of total oral health conditions, compared with 3.7% respectively [47]. Indigenous males were 7.7 times more likely to be hospitalised for jaw fractures than their non-Indigenous counterparts, and Indigenous females 22.3 times more likely than their non-Indigenous counterparts. These statistics are not specific for tooth loss or dental trauma, but it is likely that in light of such high rates of facial trauma that increased tooth loss also follows [46].

Edentulism

Edentulism reflects both poor oral hygiene and past surgical approaches to the treatment of oral diseases that relied largely on extractions [16]. Edentulism leads to poorer oral functioning and often to notable discomfort. Individuals missing all of their teeth must either endure with no teeth, which greatly affects a person's ability to eat, or choose to wear full dentures, which are generally uncomfortable and can lead to complications if not properly cleaned and maintained.

Edentulism is strongly correlated to age; in Australia less than 2% of adults aged 35-54 years have complete tooth loss but this increases to 36% for people aged 75 years or older [16]. The age distribution of edentulism for Indigenous people is noticeably different from that of the total population. The level of complete tooth loss is almost five times higher among Indigenous people aged 35-54 years than among their non-Indigenous counterparts (7.6% compared with 1.6%). There was also a notable difference for those aged 55-74 years; 21% of Indigenous people suffer from edentulism compared with 14% of non-Indigenous people.

Experience of oral health impairment

Caries, periodontal diseases and tooth loss all provide visible, quantifiable evidence of poor oral health, but the experience of pain, oral functioning and quality of life are also very important [16]. People's experience of food avoidance because of dental problems, perceptions of their oral health, and experience of toothache provide additional insights into the oral health of Australians. The NSAOH included qualitative questions to assess the experience of oral health impairment.

Poor oral health can cause people to avoid certain foods, which may limit a person's enjoyment of food and their ability to maintain a balanced diet [16]. Indigenous adults were twice as likely as non-Indigenous adults to report avoiding foods due to oral health problems, with the highest difference in those aged 35-54 years (49% of Indigenous people and 17% of non-Indigenous people).

In responses to the NSAOH, Indigenous people were 1.5 times more likely than non-Indigenous people to rate their oral health as 'fair' or 'poor' (the two lowest measures) [16]. Indigenous adults aged 35-54 years were twice as likely as their non-Indigenous counterparts to provide this rating.

Toothache can be caused by dental diseases, related infections, broken teeth, or nerve sensitivity (often triggered by contact with hot or cold food or drinks). Toothache ranges from a short-term mild sensation to persistent, disabling pain. Data on the frequency of toothache collected in the NSAOH identified that Indigenous people were 1.8 times more likely than non-Indigenous people to report toothache in the previous year (27% compared with 15%) [16]. The largest difference was seen for those aged 35-54 years: 39% of Indigenous people and 15% of non-Indigenous people reported toothache.

Services

There is little information about oral health services and service use among Indigenous Australians; however available evidence demonstrates that medical and dental services are underutilised by the Indigenous population. Indigenous specific oral health services are not common, either in the realm of health promotion or professional service delivery, although as mentioned previously, Pika Wiya in Port Augusta, SA and work by CRROH in WA provide examples of more specific services and research.

Oral health promotion services

There are some governmental and non-governmental agencies which have developed Indigenous specific oral health promotion resources and programs. The Queensland Department of Health's Oral Health Unit developed the *Crocodile smiles* programs [48] and Indigenous oral health flip-charts [49]. The Western Australian Department of Health's Dental Health Education Unit developed *The tooth book*, an Indigenous-specific resource that provides positive oral health messages [50].

Despite the emphasis on oral health promotion in *Healthy mouths healthy lives*, there is not a centralised funding body or scheme available for the development of Indigenous-specific oral health promotion programs or resources on a national level, and to share successful promotional tools and ideas between different communities.

Oral health service delivery

The majority of oral health services are provided privately with some public dental services [34]. Aboriginal Controlled Community Health Services (ACCHSs) provide some oral health services, but this is not a widespread form of service delivery. Thus, Indigenous people can access dental services in three ways: privately, publicly, and through ACCHSs.

Private oral health services

Private dental practices' fee for service are set by the practice owner based on what they feel is appropriate for the service provided and are not subject to national regulation [34]. The regulatory bodies in each state (dental boards) do not have jurisdiction over the cost of dental care for private practices and there are no recommended fees schedules. Collusion between dentists to set fees at a certain price is anti-competitive and subject to prosecution under trade practices acts.

Treatment at a private practice generally requires the patient to pay the full cost for treatment, or, if they have dental insurance, the amount their insurer does not cover (the 'gap') [34]. Many

disadvantaged people who are not eligible for public dental services have difficulty accessing private oral health services due to cost [16, 34].

Indigenous patients may seek treatment from a private dentist, or an ACCHS under Medicare's chronic disease dental scheme. The scheme is designed so that patients suffering from chronic illness and who are being managed by their General Practitioner (GP) under an Enhanced Primary Care (EPC) plan, can access dental care through Medicare. This scheme requires a referral from the patient's GP, and as GPs can be hard to access, the subsequent referral can be hard to obtain in certain areas [51]. This rebate provides benefits for most services provided by private dentists and dental specialists. The referral is valid for two years from the first dental service and entitles referees up to \$4250 over the referral period. Dentists are not obligated to charge a set schedule of fees for service and so costs for treatment can vary, and dentists are not required to bulk bill, in which case the patient may still incur a temporary out of pocket cost.

The *Teen dental plan*, implemented in 2008, provides support for Australians aged 12-17 years to have one preventive oral health check per year to a maximum cost of \$157 [52]. The check-up may be conducted by a private dentist or ACCHS registered with Medicare Australia or at a public dental clinic. Patients may be required to pay and be reimbursed by Medicare or the dental office may bulk bill.

Indigenous children are also entitled to *Child health checks* until the age of 15 years [53]. These checks include an examination of teeth and gums, performed by a medical practitioner, and may include follow-up with an oral health care professional.

Public oral health services

The Federal Government has the same powers to fund oral health services as it does for other medical services, but oral services receive relatively little state or federal funding [54]. The services provided by the Australian Government are limited to the SDS, 'safety net' services for disadvantaged adults and funding of dental services available at some ACCHSs [34]. Instead of directly funding oral health services, the Australian Government makes an indirect contribution covering 30% of the rebate on private health insurance [34, 54]. Through its Medicare and Veteran Affairs funding arrangements, the Federal government funds the *EPC dental care scheme*.

To be eligible for state-funded public dental treatment, adults must also be eligible for a concession card from Centrelink [34]. Patients on the public roster are often subject to extensive waiting lists and, depending on the state or territory and the specific treatment required, may have a co-payment obligation. Under certain

arrangements, this fee can be waived for Indigenous people. It is also possible to seek emergency care through the hospital system; often this does not result in direct treatment, but simply the provision of pain and/or antibiotic medications.

All children receive public oral health services through the SDS [34], but there is evidence that this scheme may be underutilised by some Indigenous communities because of a variety of factors (including population mobility, low school attendance, short duration of dental visits to the community, limited awareness of the importance of preventive oral health checks, and not obtaining consent forms from carers) [29]. Whilst some states and territories have expanded and developed the SDS, including extending the program to secondary school students in some cases, the SDS in Victoria (Vic) and NSW is not as active as in other jurisdictions: Vic and NSW provide significantly fewer checkups and treatments. Moreover, it should be noted that many SDS services require co-payments. Whilst the co-payments are significantly cheaper than the equivalent service from a private practitioner, they may still present an economic barrier for some.

Mobile dental clinics operate in certain areas of Australia and are usually used to provide oral health checks and services for children through the SDS [55]. These clinics are equipped with all the basic dental equipment needed to provide treatment. Mobile dental clinic services for children are available in most states and territories, often in rural and remote locations; however, some jurisdictions have abandoned mobile dental clinics and centralised services in larger referral clinics.

One of the initiatives outlined in the 2009-10 Australian Government's \$11 million budget targeted at oral health was a plan to pilot mobile dental clinics to Indigenous communities [56]. These mobile clinics are used in certain Indigenous communities, such as the Ballarat and the District Aboriginal Cooperative in Vic [57] and in the Anangu Pitjantjatjara Yankunytjatjara (APY) Lands in SA [58]. The mobile clinics are used both in the public system and as part of the ACCHS.

Aboriginal community-controlled health services (ACCHSs)

Aboriginal community controlled health services (ACCHSs) are primary health care services that provide culturally appropriate, holistic health care to Indigenous communities across Australia [59]. These services are often initiated by the communities and have complex funding arrangements including various grants, government and non-government sources, and support from Aboriginal agencies and other community services [34]. ACCHSs have been established since the 1970s and were developed in response to barriers to mainstream health care. The services are

built on the principle of self-determination and the communities select the board of management, and are involved in the planning and ongoing development of the services. There are now about 150 ACCHSs across Australia, their workforce includes Aboriginal Health Workers, nurses, doctors and specialists, some of which provide oral health programs to communities [59]. Each service has different eligibility requirements for oral health care that may or may not require concession card eligibility [34].

One example of an ACCHS run oral health program is the Nganampa Health Council's (NHC) dental program [58]. The NHC is an ACCHS available for people living in the APY Lands in SA, it provides a dental program as an integral part of primary health care.

Barriers to good oral health among Indigenous people

Oral health services

Most oral health service providers, both private and public, are based on a business model. Although this is more evident in private service provision, budgetary constraints in the public sector require strict regulation on which oral health care procedures are available to public patients and under what circumstances. Although this is not strictly a business model and is not concerned about profit, extensive cost rationalisation is required to provide the best service possible under tight fiscal conditions. Most oral health service providers do not benefit from cultural sensitivity training and lack access to Aboriginal Health Workers or other cultural brokers [60]. Cultural barriers exist for Indigenous people accessing oral health services. For example, most mainstream service providers have strict appointment times and inflexibility regarding 'failure to attend' which may result in a fee to the patient. There may also be language and communication difficulties because many Indigenous people do not speak English as their first language. Many Indigenous patients also prefer to visit the dentist with family members and friends, a practice that is generally not accommodated.

There are currently few Indigenous people working in oral health services as dentists, dental therapists, or other oral health professionals. It is likely that Indigenous people may feel more comfortable visiting an Indigenous dentist than a non-Indigenous dentist [60]. The recruitment and retention of Indigenous students in oral health programs is identified as a priority in both the *Healthy mouths healthy lives* and the *National strategic framework for Aboriginal and Torres Strait Islander health 2003-2013* [60, 61].

Indigenous people also face geographic barriers in accessing oral health services. One of these barriers includes having to travel long distances to see a dentist. Almost 26% of Indigenous people live in remote areas which would generally require travelling long distances to see a dentist, sometimes over poor roads with vehicles in poor condition [28]. Some Indigenous people, in both rural/remote and urban settings, do not have access to either public or private transportation.

Diet

There are restricted dietary options for many Indigenous people living in rural or remote settings [62]. Nutritious food and fresh produce needs to be transported over long distances to many Indigenous communities. Food, especially fresh food, can be very expensive once it reaches the community stores, sometimes up to 30% more costly than in urban areas [63]. Many nutritious foods, such as reduced-fat milk, wholemeal bread, lean meat, and a variety of fresh fruits and vegetables, are not always stocked in remote community stores. Indigenous people often cannot afford to pay for nutritious and fresh foods, instead consuming the more affordable processed foods that are high in sugars and carbohydrates and which contribute to poor general and oral health.

Water fluoridation

Rural and remote communities are also excluded from the benefits of fluoridated water supplies that are available in urban areas. More than 80% of Indigenous people living in remote locations are not connected to town-water and have no access to fluoridated water supplies [31]. Fluoridated water is an extremely cost effective way of reducing caries by up to 20-40% [64, 65]. *Healthy mouths healthy lives* demonstrates that water fluoridation in populations smaller than 1,000 is supported by cost-benefit analyses and so should be provided [34].

Living conditions

Many Indigenous people live in substandard living conditions, which are associated with increased levels of poor health and disease [66]. A large proportion of the Indigenous population live in housing conditions that do not meet basic Australian standards for shelter, and do not have safe drinking water or adequate sewerage provisions. The *2008 National Aboriginal and Torres Strait Islander social survey* reported 25% of all Indigenous people 15 years and over were living in overcrowded housing [67].

Overcrowding has a direct effect on oral health [68]. For example, if toothbrushes are not considered safe for use, such as dirtying in overcrowded houses or when unguarded at schools, decreased use can result, ultimately leading to increased levels of poor oral health.

Oral hygiene

Generally, Indigenous Australians' use of toothbrushes and fluoridated toothpaste is not at recommended levels [29]. There is evidence that oral self-care may not have been required with a traditional Indigenous diet, so these practices did not form part of many Indigenous cultures [12, 60]. It is likely that there is still a lack of understanding about the benefits of good oral self-care among many Indigenous people. The poor availability of toothbrushes, toothpaste and floss may limit their use in many communities.

Professional dental care

Oral health services are often too costly for many Indigenous people [16]. The NSAOH identified that Indigenous people were 1.5 times more likely than non-Indigenous people to have difficulty paying a \$100 dental bill. Most dental surgeries require the fees to be paid on the day of treatment, which may be hard for many patients. Many clients without concession cards (that is, are not eligible for public dental treatment) cannot afford private dental treatment. There is currently no Medicare scheme available to help Indigenous people pay for oral care despite their identification as a disadvantaged group.

Policies and strategies

The following are policies and strategies in Australia that aim to improve the oral health of Australians and to deal with some of oral health barriers for Indigenous people.

National Strategic Framework for Aboriginal and Torres Strait Islander Health 2003-2013

The *National strategic framework for Aboriginal and Torres Strait Islander health* (NSFATSIH) builds on the *National Aboriginal health strategy (1989)* and provides a plan for guiding changes in Indigenous health policy [69]. The NSFATSIH provides a framework for direct government action over the next decade using a coordinated, collaborative and multi-sectoral approach that is agreed upon by all the states and territories and with the involvement of Indigenous health organisations. Oral health was identified as a priority because of its contribution to chronic disease among adults. The strategies specific to oral health in the NSFATSIH were largely adopted in *Healthy mouths healthy lives* [34].

Healthy mouths healthy lives: Australia's National oral health plan 2004-2013

Healthy mouths health lives was prepared by the National Advisory Committee on Oral Health (NACOH) and builds on the work of the 2001 framework, *Oral health of Australians: national planning for oral health improvement* [34]. It also draws on the *National Aboriginal and Torres Strait Islander oral health workshop's action plan*, released in 2003. *Healthy mouths healthy lives* details the most pressing issues for oral health in Australia and provides a framework for addressing these issues. The themes that underpin the plan are: integrating oral health into general health; focusing on health promotion and disease prevention; providing affordable and appropriate services to all Australians and providing a skilled and educated workforce. It is composed of six 'action areas' that give detailed benchmarks for achieving good oral health for the total Australian population, as well as providing specific strategies for a number of target population groups and a detailed approach to workforce development. Indigenous people are addressed in action area six.

Action area six: Aboriginal and Torres Strait Islander peoples

Action area six specifically addresses the oral health deficit experienced by the Indigenous population [34]. The main actions are as follows:

- support the proposal to include a biennial health assessment for Indigenous adults covered under Medicare that would include an oral exam;
- provide oral health services that are culturally appropriate for Indigenous people by:
 - creating partnerships between Indigenous specific and mainstream services;
 - creating patient transport schemes; and
 - increasing the proportion of mainstream services that are culturally appropriate;
- provide water fluoridation for communities with more than 1,000 residents;
- improve recruitment and retention of oral health staff in rural and remote locations;
- create programs to increase the number of Indigenous oral health care students;
- increase oral health care promotion for Indigenous people by:
 - developing strategies which target Indigenous oral health, focusing both on oral health exclusively and promoting oral health in related health promotion activities (e.g. diabetes, cardiovascular diseases, tobacco, alcohol, nutrition);
 - increasing access to oral hygiene supplies (toothbrushes, toothpaste, floss);
 - increasing access to nutritious foods;
- promote integration of oral health within the wider health care systems and services by:
 - including oral health in health checks for people who experience general good health and health checks for those with chronic illnesses;
 - including oral health in relevant Indigenous health policy;
- improve Indigenous data quality with respect to oral health by:
 - creating a national Indigenous oral health data set;
 - consolidating current data on oral health; and
 - the regular collection and dissemination of Indigenous oral health data;
- increase the Indigenous oral health workforce as outlined by the *National Aboriginal and Torres Strait Islander workforce national strategic framework*:
 - increase the number of Indigenous people working in oral

health professions, including providing scholarships for Indigenous students;

- clarify roles and recognise the key role played by Aboriginal Health Workers in the oral health workforce;
- address the role and development needs of the oral health workforce in relation to Indigenous health;
- improve training, recruitment and retention for oral health staff working in Indigenous primary health care settings; and
- expand the role of dental therapists, dental hygienists and oral health therapists.

Concluding comments

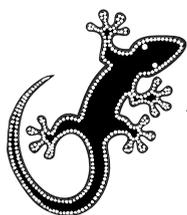
Indigenous people suffer from more caries, periodontal diseases, and partial and total edentulism than non-Indigenous people. They are less able to access services for a number of cultural, economic and geographical reasons [12, 60]. Services have been created to help bridge the gaps in Indigenous oral health, but these are only available to certain communities and not to the wider Indigenous population. The Australian Government, dental bodies, and dental workforce have an obligation to address these inequalities to help Indigenous people obtain a similar oral health status as non-Indigenous people in Australia; and should work in consultation with Indigenous people and Indigenous health organisations to develop the most appropriate policies and service provision models for Indigenous Australians.

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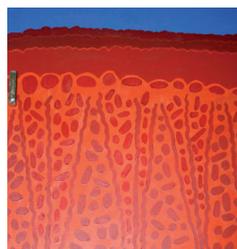
The Australian Indigenous HealthInfoNet is an innovative Internet resource that contributes to 'closing the gap' in health between Indigenous and other Australians by informing practice and policy in Indigenous health.

Two concepts underpin the HealthInfoNet's work. The first is evidence-informed decision-making, whereby practitioners and policy-makers have access to the best available research and other information. This concept is linked with that of translational research (TR), which involves making research and other information available in a form that has immediate, practical utility. Implementation of these two concepts involves synthesis, exchange and ethical application of knowledge through ongoing interaction with key stakeholders.

The HealthInfoNet's work in TR at a population-health level, in which it is at the forefront internationally, addresses the knowledge needs of a wide range of potential users, including policy-makers, health service providers, program managers, clinicians, Indigenous health workers, and other health professionals. The HealthInfoNet also provides easy-to-read and summarised material for students and the general community.

The HealthInfoNet encourages and supports information-sharing among practitioners, policy-makers and others working to improve Indigenous health – its free on line yarning places enable people across the country to share information, knowledge and experience. The HealthInfoNet is funded mainly by the Australian Department of Health and Ageing. Its award-winning web resource (www.healthinonet.ecu.edu.au) is free and available to everyone.

Director	Professor Neil Thomson
Address	Australian Indigenous HealthInfoNet Edith Cowan University 2 Bradford Street Mount Lawley, WA 6050
Telephone	(08) 9370 6336
Facsimile	(08) 9370 6022
Email	healthinonet@ecu.edu.au
Web	www.healthinonet.ecu.edu.au



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