GET REAL ABOUT ORAL HEALTH:
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This report describes the global state of oral health in terms of dental decay, periodontal (gum) diseases, and oral cancer, with a particular focus on France, India and Indonesia. It has been developed from published, and rigorously reviewed scientific literature. Consideration is given to the impact of oral diseases, both to the individual and society. The report also includes an examination of the factors that influence tooth brushing habits. In moving forward, strategies for improving oral health are identified, specifically addressing the fundamental problem of persisting global inequalities.

THE GLOBAL STATE OF ORAL HEALTH
Oral diseases are the most common diseases worldwide, despite the fact that many of them are preventable. Globally, dental decay affects nearly 100% of adult populations and 60–90% of children in many countries. Severe periodontitis affects 5-20% of most adult populations worldwide, and it is a major cause of tooth loss in both developed and developing countries. Evidence linking periodontal health and general health is growing, particularly with respect to diabetes, cardiovascular diseases, pre-term birth, and aspiration pneumonia. Oral cancer is the eighth most common cancer internationally and the most common in men in Southeast Asia.

Despite improvements in oral health in the past three decades, oral disease remains a significant global problem, and widening oral health inequalities exist among different population groups both between and within countries. Dental decay, tooth loss, oral cancer and the destructive form of periodontal disease are more prevalent among the most disadvantaged populations. Even in wealthier countries, high levels of oral disease persist among deprived and vulnerable people.

ORAL HEALTH, GENERAL HEALTH AND AGING
Oral health is essential to general health and well-being and good oral health is a fundamental human right. Furthermore, the mouth can be considered as the gateway to the rest of the body and the mirror too, reflecting what is happening deep inside. All the four main chronic non communicable diseases (NCDs) namely cardiovascular diseases, cancers, chronic respiratory diseases and diabetes are related to oral conditions and, furthermore, they share the same risk factors including unhealthy diet, tobacco use, and harmful alcohol use. The number of people affected by chronic diseases is expected to rise substantially in the coming decades. For example, 285 million people worldwide suffer from diabetes, and this number is predicted to increase by approximately 50% by year 2030. It is therefore essential that oral diseases are not considered in isolation. The burden of oral disease and its consequential impact on the general health of older people is considerable, particularly in terms of high levels of tooth loss, dental decay experience, periodontal disease, dry mouth, and oral cancer. These conditions thus have a major influence on quality of life.
THE IMPACT OF POOR ORAL HEALTH

Poor oral health can have considerable personal, social and economic consequences. Children experiencing dental decay as infants or toddlers have a much greater probability of developing subsequent decay in both their baby and adult teeth. Untreated decay can also have an effect on children’s growth, cognitive development and general health. Dental decay leads to millions of lost days of schooling for children. Research from industrialised countries shows that students with toothache were almost four times more likely than their peers to have a low grade point average. This has very significant long-term implications, because there is strong evidence that educational attainment has a profound effect on long-term health. Furthermore, parents lost an average of two and a half days, from work or school per year, because of their children’s dental problems. Oral diseases in children can impact their self-esteem, and they may avoid laughing or smiling due to the perceived poor appearance of their teeth. Severe decay can seriously compromise the quality of life and daily living of both children and their parents, and the negative impacts on daily life of poor oral health include the inability to chew, difficulties in sleeping, and irritation.

THE ECONOMIC IMPACT OF ORAL DISEASE

The costs of health care continue to grow all over the world, and dental diseases are an enormous burden to both individuals and health care services. In some industrialised countries the mouth is the most expensive part of the body to treat, with expenditure on treatment often exceeding that for other major diseases such as cancer, cardiovascular disease, stroke, and dementia. Oral disease is strongly associated with the development of NCDs, and it is predicted that the global cost of treating these in the next 20 years will exceed US$ 30 trillion, forcing millions of people below the poverty line.

Dental caries is a major cause of absenteeism from work in adults, resulting in both short and long-term impacts on economic productivity. In the USA, it has been estimated that employed adults lose more than 164 million hours of work each year due to dental disease or dental visits. During economic downturns, patients may delay consultation and treatment, with disastrous financial and health ramifications.

FACTORS IMPACTING TOOTH BRUSHING HABITS

Brushing the teeth twice a day with fluoride toothpaste and limiting the frequency of dietary carbohydrate consumption can largely prevent tooth decay and periodontal disease. The Health Behaviour of School-aged Children (HBSC) survey, of 39 countries and regions across Europe and North America, revealed wide differences in self reported tooth brushing frequency. Girls were shown to brush their teeth more frequently than boys, and brushing more regularly was associated with higher family affluence.

Dental decay in childhood is largely preventable by good oral hygiene of mothers and children, instituting proper eating habits early on and providing mothers with information on oral health. In adolescence, research suggests that aesthetic and psychosocial factors (e.g. family and peer pressure) are significant in motivating oral health behaviours, with tooth brushing often characterised as a personal hygiene rather than a health-related behaviour. Tooth brushing behaviour and frequency have also been closely associated with a variety of factors including personal grooming, general cleanliness (e.g. hair/hand washing, frequency of bathing, use of deodorant) and especially a good personal appearance. This is important because adolescents who brush their teeth more than once a day by 12 years of age are more likely to continue to do so throughout their teenage years and into adulthood. Family-related factors, such as home life and routines, have all been associated with tooth brushing frequency in adolescents.

STRATEGIES FOR BETTER ORAL HEALTH

It is clear that to date we have been remarkably ineffective in reducing the burden of oral disease and translating what we have learned from research into practice. Despite significant improvements in oral health in recent decades, inequalities in oral health remain both within and between countries. If we are to address the challenge of poor oral health, we need to address the underlying social determinants of oral health, using interventions that involve the incorporation of strategies to improve oral health into wider general health promotion strategies. Addressing the structural, socioeconomic determinants of health is principally the responsibility of national policy makers and professional organisations.
THE GLOBAL STATE OF ORAL HEALTH

01 SETTING THE CONTEXT: WHY THE MOUTH MATTERS

Oral health is fundamental to overall health and wellbeing; “you cannot be healthy without oral health” Shalala (2000). It is fundamental to the ability to breathe, eat, swallow and speak. Impairment of these functions can seriously damage the ability to interact with others, attend school, and work. This has impacts on psychological and social wellbeing, economic productivity and national development. In addition to their effect on oral health and function, oral diseases are associated with - and may exacerbate - life-threatening diseases such as diabetes mellitus and cardiovascular disease (Aida et al 2011; Pihlström et al 2005).

Oral diseases remain a very significant public health issue for high-income countries. This is a disturbing fact, given that much of the oral disease burden in such countries is due to tooth decay and its complications, which are preventable using cost-effective strategies (Pitts et al 2011). In low-to-middle income countries oral diseases constitute a severe and growing public health problem.

Major inequalities exist both within and between countries in terms of oral disease severity and prevalence (Marmot and Bell 2011), with the major burden of disease in many communities falling particularly on disadvantaged and socially marginalised groups including children, the socioeconomically deprived, elderly and handicapped (Petersen and Kwan 2011; Petersen et al 2010; Kwan and Petersen 2010).

The report is based on published and rigorously reviewed scientific literature. Whilst it has a particular focus on France, India and Indonesia, the review process has demonstrated a clear paucity of reliable data for India and Indonesia in particular. We draw attention to those areas where reliable data are lacking.
DENTAL DECAY
WHAT CAUSES DENTAL DECAY?
Dental decay is the localised destruction of susceptible dental hard tissues by the acidic by-products from bacterial fermentation of dietary carbohydrates (Fejerskov and Kidd 2003). It is a preventable disease that can be arrested and even reversed in its early stages of development (Fisher-Owens et al 2007; Selwitz et al 2007).

Whilst decay is caused by acids produced from the breakdown of dietary carbohydrates, a wide range of factors have been implicated in its development. These are dominated by factors such as socio-demographic status, income, education, oral health literacy and dental insurance coverage. Behavioural factors under an individual’s control are also important and these include poor oral hygiene, insufficient fluoride exposure and frequent consumption of refined carbohydrates (Selwitz et al 2007).

HOW DO WE MEASURE DENTAL DECAY?
The international standard by which the extent of dental decay is measured is the dmft/DMFT (primary dentition/permanent dentition) index, in which the number of teeth in a person’s mouth that are decayed, missing or filled are counted. The indices are used to record the prevalence and severity of dental decay experience in populations (Moynihan 2004); the higher the index, the more severe the extent of the disease.

Unfortunately the quality of the data available on dental decay in global terms is poor, due principally to inconsistencies in methodology and quality standards between countries. Data are not comprehensive and also often out of date; there is also generalised critique of the use of the DMFT index to measure dental decay by Pitts and colleagues (Pitts et al 2011).

HOW BIG IS THE PROBLEM?
Despite general improvements in oral health in the last thirty years, dental decay is still a major public health problem affecting 60%–90% of children globally and the vast majority of adults (Bagramian et al 2009; Petersen et al 2005). It is the most common chronic childhood disease and the most frequent non-communicable disease (NCD) worldwide (Edelstein 2006; Petersen et al 2005), with 90% of people having experienced dental problems or toothache due to dental decay (Williams 2011).

In a recent study of the global burden of disease, the largest of its kind ever conducted, dental decay was found to be the most prevalent of all the 289 diseases studied (Vos et al 2012). In children in industrialised countries, such as the USA, dental decay is up to five times more prevalent than the second most prevalent chronic condition, asthma, and seven times more common than hay fever (USHHS 2000).

Since the pre-1980 period, levels of dental decay in children have reduced significantly, principally driven by the sharp decline within countries with stronger economic and social development (Do 2012; Petersen 2010; Dye et al 2007; Whelton 2004). This is likely to have occurred as a result of effective public health measures, such as community water fluoridation, improved oral hygiene regimes including widespread use of fluoridated toothpaste, and better disease management, alongside improved living conditions (Petersen 2010; Spencer et al 1996).

However, in many low- and middle-income countries, the prevalence of untreated dental decay in the primary dentition of young children is still high (Beaglehole et al 2009). Furthermore, in a number of countries, the incidence of dental decay has increased over recent years, and it is likely to increase further as a result of the growing consumption of sugars and inadequate exposure to fluorides (Petersen 2008).

From a population perspective, dental decay and its complications in the form of tooth loss exceed periodontal disease in importance, as they account for 93–98% of the oral disease burden across the different regions of the world (Murray and Lopez 1996). Dental decay occurs across the life course and people are susceptible to the disease throughout their lives. However, globally, the burden of dental decay is particularly high among older people, and has a negative effect on their quality of life (Srivastava et al 2012; Petersen 2008). This emphasises the crucial importance of preventing dental decay, as the burden of the disease lasts a lifetime. Once the tooth structure is compromised, restoration and additional maintenance will be required throughout the life of the affected tooth incurring cost at every stage.
Dental decay is now becoming a disease of deprivation at a global level (Do et al. 2012), because the greatest burden exists in disadvantaged and poor populations worldwide. There are profound inequalities in dental decay status in developing - as well as developed - countries. The situation is further complicated by the fact that some countries are in rapid transition (Pitts et al. 2011). For example, in developing economies such as Indonesia, as sugary foods become increasingly available as sought-after luxury goods, the consumption of sugar in certain socio-economic groups will also increase, and levels of decay may rise as a result (Amalia et al. 2012).

Figure 1 and Figure 2 demonstrate these trends using survey data from the World Health Organisation (WHO) Oral Health Country/Area Profile Project (WHO 2013a; WHO 2013b). Figure 1 shows a general reduction in global DMFT scores in 12 year olds with a recent slight increase in 2011. Figure 2 shows a decrease in DMFT scores among 12-year-olds between 2004 and 2011 in certain WHO regions such as the Americas (AMRO), Europe (EURO), and the Western Pacific (WPRO). However, in WHO regions such as Africa (AFRO), Eastern Mediterranean (EMRO), and South East Asia (SEARO) levels of decay have begun to increase.

**EMERGING FINDINGS IN FRANCE, INDIA AND INDONESIA**

According to WHO data, DMFT scores in 12 year olds are as follows (WHO 2013c):
- France (2006): 1.2
- India (2003): 0.5 in Kerala and 3.94 in Tamilnadu
- Indonesia (2009): 0.9

These data should be interpreted with caution, as the study sample may not represent the national population. More accurate and recent local information may exist, but this has not been found in peer-reviewed journals in the field.

**EMERGING FINDINGS IN FRANCE**

The levels of dental diseases in today’s French children are low compared with earlier generations (Bourgeois et al. 2004; Cahen et al. 2003), but this improvement in oral health is not evenly distributed. In children from deprived backgrounds, the prevalence of decay is higher than in children from more affluent backgrounds, and there is more untreated disease (Tubert-Jeannin et al. 2012; Droz et al. 2006; Adams et al. 2005; Azogui-Levy et al. 2003). Such inequalities are particularly noticeable in countries like France, which lack a comprehensive dental service for children (Ismail and Sohn 2001).

**EMERGING FINDINGS IN INDIA**

A study of 1500 preschool children aged 8-48 months from urban Bangalore, India, demonstrated an overall prevalence of dental decay of 27.5%, with an average dmft of 0.854. The occurrence of decay was found to be higher in children of low socio economic status and uneducated mothers. Increased frequency of tooth brushing, parental supervision, use of a baby toothbrush, and fluoridated toothpaste were all shown to significantly decrease the prevalence of decay (Prakash et al. 2012).

**EMERGING FINDINGS IN INDONESIA**

A study of 1906 12-year-old children in Yogyakarta Province, Indonesia, demonstrated that levels of decay were high, and most children had untreated decay. Only 19.6% were decay-free (Amalia et al. 2012).
PERIODONTITIS (GUM DISEASE)

WHAT CAUSES PERIODONTITIS?
Periodontitis is the destruction of tissues that support the teeth, namely the gums and underlying bone. It is a multifactorial disease, but it is essentially an inflammatory reaction to the presence of dental plaque. Dental plaque is the diverse bacterial community embedded in a matrix of compounds of bacterial and salivary origin that forms naturally on the surface of teeth (Marsh and Bradshaw 1995). Preventive measures thus focus on establishing excellent oral hygiene, to restrict the accumulation of dental plaque that triggers inflammation.

Smoking is a major risk factor for the development of periodontal disease (Bergstrom 2006; Gelskey 1999). In particular, there is accumulating evidence that tobacco chewing, a common practice in Asia, has a significantly adverse effect on periodontal health (Akhter et al 2008). The prevalence rates and severity of periodontal disease increases in relation to the number of cigarettes consumed and years of smoking (Kibayashi et al 2007; Calsina et al 2002; Tomar and Asma 2000), but stopping smoking leads to a lower risk of periodontal disease (Kinane and Chestnutt 2000). Studies have shown that smoking may account for more than half of the cases of periodontitis among American adults (Tomar and Asma 2000). Advice to quit smoking is therefore an important element of effective prevention of periodontal disease.

HOW BIG IS THE PROBLEM?
Periodontal disease is the major cause of tooth loss in adults in both developed and developing countries (Pihlström et al 2005). It tends to be more prevalent in men than women (Shiau and Reynolds 2010). In addition to the roles of age (Kandelman et al 2008) and smoking (Bergstrom 2006) in the aetiology of this disorder, a further risk factor may be poor social circumstances; it is well established that the severity of periodontal disease follows the social gradient and is more severe in those of lower socioeconomic status. The greatest burden of periodontal disease lies within the disadvantaged and poor populations. Epidemiological studies have established a significant relationship between socioeconomic status and periodontal disease in various age groups, demonstrating how poor periodontal disease status is linked to low income and low educational attainment (Boillot 2011; Borrell et al 2004; Albandar and Tinoco 2002; Papapanou 1999).

Oral health is often impaired in people with physical or mental disability; these groups often have higher levels of periodontal disease, and are more likely to experience oral pain and discomfort (Vishnu et al 2012; Uetani et al 2006; Clarke et al 1996.).

The impact of periodontal disease on individuals and communities is significant, and includes pain and suffering, impairment of function and reduced quality of life (Petersen and Ogawa 2012). It is currently estimated that severe periodontitis affects 5-20% of most adult populations worldwide, and it is a major cause of tooth loss in both developed and developing countries (Jin et al 2011; Petersen et al 2005; Pihlström et al 2005). Analysis of the data from the WHO Global Oral Health Data Bank also show that periodontal disease is highly prevalent amongst 35 – 44 year olds in all the regions, and most children and adolescents exhibit signs of gingivitis (Petersen et al 2005).

Recent research from the USA shows how periodontal disease is a significant public health problem among adults, and is even more prevalent than had previously been assumed. Eke et al (2012) estimated that the prevalence among adults aged over 30 years in the US reaches 47%, with 64% of adults over 65 years having moderate to severe periodontal disease. Globally, good prevalence data are lacking for low and middle-income countries (Konig et al 2010; FDI 2009), but it is reasonable to assume that figures will be at least as high as these results from the USA.

PERIODONTITIS: OTHER IMPORTANT HEALTH CONSIDERATIONS
Periodontitis may have long term consequences for health by increasing the risk of obesity (Chaffee and Weston 2010), metabolic syndrome (D’Aiuto et al 2008), cardiovascular diseases and pulmonary diseases (Li et al 2010; Tonetti et al 2007; Paju and Scannapieco 2007; Garcia et al 2001), and adverse pregnancy outcomes (Scannapieco et al 2010; Wimmer and Pihlström 2008).

Of the associations purported to exist between oral health status, periodontal disease and chronic systemic diseases, the link between severe periodontal disease and diabetes is the best established. Recent research suggests a bidirectional relationship between periodontal disease and diabetes (Taylor 2010). The presence of poorly controlled diabetes is a risk factor for developing periodontal disease. On the other
hand, the presence of periodontal disease may adversely affect glycaemic control, and contribute to the development of diabetic complications (Ray et al 2012; Taylor and Borgnakke 2008; Tsai et al 2002). It has also been shown that periodontal therapy may result in a modest improvement of glycaemic control in patients with diabetes (Lalla and Papapanou 2011), but a firm causal relationship remains to be established.

285 million people worldwide suffer from diabetes and this number is predicted to increase by approximately 50% by year 2030 (IDF 2009). This may lead to an increase in the burden of periodontal disease and tooth loss, particularly in the regions of Africa and Asia where growth rates of diabetes are already very high due to trends in urbanisation and associated lifestyle changes (Petersen and Ogawa 2012). On the other hand, if it is the case that periodontal disease is a risk factor for the development of diabetes, then improving gum health may be an important part of the strategy to reduce the global burden of diabetes.

ORAL (MOUTH) CANCER

WHAT IS ORAL CANCER?
Oral cancer comprises a group of cancers including cancer of the lip, tongue, mouth, and the airways. Early diagnosis through screening (Johnson et al 2011) substantially increases survival rates of this type of cancer, thus regular visits to a dentist are crucial for screening for early signs of oral cancer, and in highlighting mouth cancer risk factors. It is the eighth most common cancer worldwide; it generally carries a poor prognosis and it is the most costly cancer to treat (Glick et al 2012). The causes of oral cancer are predominantly lifestyle-related and these include tobacco use, areca nut use, alcohol abuse, poor diet, viral infections, and pollution (Johnson et al 2011). Much of the geographical variation in incidence across the world can be attributed to differences in tobacco smoking and alcohol consumption. Areca nut use and betel quid chewing are important risk factors for some south Asian and Chinese populations, where it is customarily practiced (Lee et al 2012; Johnson et al 2011; Boucher and Mannan 2002).

As with dental decay and periodontal disease, there is a marked association between oral cancer and socioeconomic status. The risks of developing oral cancer are higher in those of low socioeconomic status, even after taking risk factors like tobacco use and alcohol use into account (Warnakulasuriya 2009; Conway et al 2008).

HOW BIG IS THE GLOBAL PROBLEM OF ORAL CANCER?
Figures for the global incidence of oral cancer are based on data gathered from cancer registries. Although cancer registration has a long history in many countries of the world, particularly in the more affluent regions, it must be recognised that nearly 80% of the world’s populations reside in regions that are not covered by such systems (Ferlay et al 2010).
Global incidence varies widely, and it is most common in men in Southeast Asia (Johnson et al 2011). Oral cancer ranks as the most prevalent cancer in Indian men (Bray et al 2012). It is also an important cause of morbidity and mortality in France, with over 6000 new cases and 1500 deaths each year (Ferlay et al 2010), and incidence rates for males among the highest in the world (De Camargo et al. 2012). Furthermore, the incidence of oral cancers has been strongly decreasing in men, and strongly increasing in women. This emerging trend may be attributed to specific smoking and drinking patterns in France (Ligier et al 2011).

**THE GLOBAL BURDEN OF ORAL DISEASE: KEY SUMMARY POINTS**

- Oral diseases are the most common diseases worldwide despite the fact that many of them are preventable. There is clear evidence that the practice of regular, twice-daily brushing with fluoride-containing toothpaste is the single most important factor that has led to the global reduction in dental decay.
- Dental decay affects nearly 100% of all adult populations and 60 - 90% of children in many countries.
- Severe periodontitis affects 5 - 20% of most adult populations worldwide, and it is a major cause of tooth loss among adults in both developed and developing countries.
- Evidence linking periodontal health and general health is accumulating, particularly with respect to diabetes. Research suggests a two-way relationship between periodontal disease and diabetes, where poorly controlled diabetes is a risk factor for developing periodontal disease, and the presence of periodontal disease may contribute to the development of diabetic complications.
- Oral cancer is the eighth most common cancer worldwide and the most common in men in Southeast Asia.
- Despite improvements in oral health in the past few decades, particularly in high-income countries, oral disease remains a global problem.
- There are widening inequalities in oral health both between and within countries.
- The prevalence of dental decay, tooth loss, oral cancer and the destructive form of periodontal disease follows the social gradient. These diseases are more prevalent among the most deprived populations. Even within the high income countries, high levels of oral disease exist among deprived and vulnerable people.
PUTTING THE MOUTH BACK INTO THE BODY
Links between systemic disease and oral manifestations have been identified in over 100 diseases, including diabetes, cardiovascular diseases, respiratory infections, cancer or nutritional problems. Lesions in the mouth may also be the first signs of some life-threatening diseases, including HIV/AIDS (Lindhe 2008; Kahabuka et al 2007; Coogan 2005).

Untreated decay can also lead to a severe infection, which may require emergency treatment in a hospital. Evidence from Canada shows this is a common reason for hospitalisation of children (BC Ministry of Health 2006). Severe dental decay in childhood has also been the main reason for hospitalisation of children aged 4 years or less in Australia, nearly all of whom require general anaesthesia for the extraction often of multiple teeth (Australian Institute of Health and Welfare 2005). There are numerous reports in the literature of the complications that can arise from untreated dental decay; the most important of which are infections that spread to other sites in the body. These include the development of a fatal brain abscess (Antunes et al, 2011) that could have been avoided by timely dental care. The case that attracted the greatest degree of public reaction and drew attention to the health inequalities in society was the death of Deamonte Driver in 2007 in the United States (Otto M, 2007). This twelve-year-old boy died from a brain abscess that could have been prevented by an inexpensive dental extraction if the child’s mother had been able to afford health insurance cover.

There are associations between oral disease and the other major chronic NCDs, principally cardiovascular diseases, cancers, chronic respiratory diseases and diabetes. They share common risk factors including tobacco use, harmful use of alcohol, an unhealthy diet, and lack of physical activity. Furthermore oral disease itself may constitute a risk factor for NCDs. It is for these reasons that there is now increasing acceptance that oral diseases cannot be dealt with in isolation from other systemic diseases (Glick et al 2012).

63% of all deaths worldwide currently occur as a result of NCDs, killing 36 million people each year (Glick et al 2012). Approximately one-quarter of all NCD deaths occur below the age of 60, accounting for nearly 9 million premature deaths per year. Moreover, the number of people affected by NCDs is expected to rise substantially in the coming decades, reflecting an increasing global population (World Economic Forum and the Harvard School of Public Health 2011).

In common with these major diseases of the twenty-first century, major social gradients exist in the prevalence of oral disease (Sheiham et al 2011). Reducing the burden of NCDs is now recognised as one of the great challenges facing society on a global scale (United Nations 2011).
THE MOUTH AND THE QUALITY OF LIFE: IMPLICATIONS OF AN AGING POPULATION

The populations of most countries are also ageing at a rapid pace. By 2050 it is anticipated that an increase in the population aged 60 years or over will represent approximately half of the total growth of the world population. The most rapidly growing age group consists of individuals aged 80 years or over, and the number of very old people is expected to more than quadruple over the next four decades from less than 90 million in 2005, to almost 400 million in 2050 (United Nations 2007).

These trends have major implications for both the general and oral health of older people (Harford 2009; Petersen and Ueda 2006). The risk of developing oral disease increases with age, as a consequence of lifelong exposure to risk factors. Poor oral health has a disproportionate impact on the lives of older people, compounded by socioeconomic and psychological factors (Petersen and Yamamoto 2005). The prevalence of NCDs also increases dramatically with age and, as infectious diseases are now more readily treated, these diseases are rapidly becoming leading causes of death worldwide. Furthermore, the burden of oral disease, and its impact on the general health of older people is considerable, particularly in terms of tooth loss, dental decay, periodontal disease, dry mouth, and oral cancer (Kandelman et al 2008; Petersen and Yamamoto 2005; Schou 1995). Older people are also more likely to suffer from poor nutrition and require multiple medications with adverse side-effects, both of which are damaging to oral health as well as general health (Kwan and Petersen 2010). These conditions have a major influence on the quality of life of older people. If people are to enjoy good oral health later in life, it is important to ensure that good oral care habits are practised from an early age. This is because the adverse effects of oral disease accumulate progressively across the whole life course. Increased life expectancy without enhanced quality of life is rapidly becoming a key public health issue in the more developed countries. It will also be of major concern to developing countries and countries with high population densities and emerging economies, such as China and India (Petersen et al 2010).

ORAL HEALTH, GENERAL HEALTH AND AGING: KEY SUMMARY POINTS

- Oral health is essential to general health and well-being. Good oral health is a fundamental human right.
- The mouth can be considered as the gateway to the rest of the body and the mirror too, reflecting what is happening deep inside.
- All the four main chronic non-communicable diseases namely cardiovascular diseases, cancers, chronic respiratory diseases and diabetes are related to oral conditions and furthermore, they share the same risk factors including unhealthy diet, tobacco use, and harmful alcohol use.
- The number of people affected by chronic diseases is expected to rise substantially in the coming decades.
- Inequalities existing in oral health mirror those in general health and thus oral diseases must not be considered in isolation.
- The burden of oral disease, and its impact on the general health of older people is considerable.
THE IMPACT OF POOR ORAL HEALTH ON QUALITY OF LIFE

Poor oral health can affect general oral functioning leading to pain, premature tooth loss, dry mouth, and sleep deprivation. The experience of pain, problems with speaking, eating and chewing, and embarrassment regarding the appearance of teeth may distract people from performing daily activities and affect their social and psychological well-being, and general quality of life (Slade et al 1998).

THE IMPACT OF POOR ORAL HEALTH IN CHILDHOOD: GENERAL HEALTH AND DEVELOPMENT

Children experiencing dental decay as infants or toddlers have a much greater probability of developing subsequent decay in both their baby (Foster et al 2006) and adult teeth (Peretz et al 2003). Not only does childhood dental decay affect teeth, but it can also lead to more widespread health issues. Research suggests that untreated decay can have an effect on children's overall wellbeing, growth, cognitive development and general health, for reasons that are discussed below. This is a crucial finding as the burden of untreated dental decay is particularly high in deprived children in low- and middle-income countries. Infants with gross dental decay grow at a slower pace than decay-free infants, and they may be severely underweight because of associated pain and their disinclination to eat (Sheiham 2006; Ayhan et al 1996; Acs et al 1992). A recent study from the Philippines shows how children requiring multiple extractions of severely decayed teeth had significantly lower body weights than children without tooth decay (Benzian et al 2011). Conversely, the treatment of severe dental decay significantly improves the growth of severely underweight young children (Morse et al 2012; MalekMohammadi et al 2009). However, further research is required to investigate the effects of severe dental decay on the growth and development of children; and the mechanisms by which this occurs.

THE IMPACT OF POOR ORAL HEALTH IN CHILDHOOD: EDUCATION AND LEARNING

Dental problems have been associated with children’s school performance and absenteeism (Jackson et al 2011). Studies have shown that children with poor oral health have increases school absenteeism (Pongpichit et al 2008) and decreased school performance (Blumenshine et al 2008; Muirhead and Marcenes 2004). Research from industrialised countries shows that students with toothache are almost four times more likely to have a low grade point average (Seirawan et al 2012). This has very significant long-term implications, because there is strong evidence that educational attainment has a profound effect on long-term health (Singh-Manoux et al 2002). Children with dental problems may be at a disadvantage in their social, physiological, and mental development (Blumenshine et al 2008) and they may not be able to gain the full benefit of their education if they are suffering pain and discomfort. In the Philippines toothache is the most common reason for absence from school, and in Thailand, 1,900 hours of school were lost per 1,000 children in 2008 through dental problems and their treatment. In Sri Lanka in 2005 53% of 6-year-olds reported having experienced oral pain in their lifetime (Beaglehole et al 2009). In countries such as the USA more than 51 million school hours are lost each year to dental-related illness (USHHS 2000). Furthermore, children from low-income families are twelve times more likely to miss days at school than those from higher income families (Adams and Marano 1995).
THE IMPACT OF POOR ORAL HEALTH IN CHILDHOOD: SELF-ESTEEM AND CONFIDENCE
The social impact of oral diseases in children is substantial. They have a considerable impact on self-esteem, and global surveys have demonstrated that children experience impaired social functioning due to oral disease, such as avoiding laughing or smiling due to their poor perceived appearance of teeth. Children also frequently reported apprehension about meeting others because of the appearance of their teeth, or that others made jokes about their teeth (Tsakos et al 2012; Chen et al 1997).

THE IMPACT OF POOR ORAL HEALTH IN CHILDHOOD: FAMILY AND HOME LIFE
Severe childhood decay can seriously compromise the quality of life and daily living of both children and their parents (Abanto et al 2011; Wong et al 2011; Pahel et al. 2007; Filstrup et al 2003). Among some of the reported negative impacts on daily life of poor oral health are: the inability to chew, difficulty in drinking hot or cold beverages, sleeping, and irritation (Abanto et al 2011; Oliveira et al 2008; Filstrup et al 2003). Studies undertaken in the USA, France and Brazil have also found that common impacts reported by parents were ‘pain in the teeth, mouth or jaws’, ‘irritation or frustration’, ‘difficulty eating’ and ‘trouble sleeping’ (Martins-Júnior et al 2012; Li et al. 2008; Pahel et al 2007). These findings are supported by studies which demonstrate that after dental treatment, significant improvement was noted in children’s pain and discomfort experience, sleep patterns, in their appetite and quantity of foods eaten (Anderson et al 2004; Acş et al 2001).

THE IMPACT OF POOR ORAL HEALTH: KEY SUMMARY POINTS
• Poor oral health can have considerable personal, social and economic consequences
• Children experiencing dental decay as infants or toddlers have a much greater probability of developing subsequent decay in both their baby and adult teeth
• Untreated decay can have an effect on children’s growth, cognitive development and general health
• Dental decay leads to millions of lost days of schooling for children and there is strong evidence that educational attainment has a profound effect on long-term health
• Severe childhood decay can seriously compromise the quality of life and daily living of both children and their parents impacting eating, sleeping and mood
05 THE ECONOMIC IMPACT OF ORAL DISEASE

DIRECT COSTS OF ORAL DISEASE

In some industrialised countries, the mouth is the most expensive part of the body to treat (Bauer et al 2009; Schneider et al 1998; Kohlmeier et al 1993) with expenditure on treatment often exceeding that for other major diseases such as cancer, cardiovascular disease, stroke, and dementia. These economic costs are significant. In 2003, the total spend on all aspects of care and treatment provided by dentists in the “old” European Union (15 countries) was estimated as 54 billion dollars in 2003, but this figure will have no doubt increased significantly since (Widström and Eaton 2004).

The provision of dental care in industrialised countries accounts for between 3 -12.5% of total health expenditure. However, even low-income countries such as Sri Lanka spend 3.5% of the total health budget on the provision of public dental care services (Beaglehole et al 2009). In Germany, the direct costs of dental decay compared to other major diseases were: dental decay 20.2 billion DM; cardiovascular disease 15.4 billion DM; and diabetes 2.3 billion DM (Kohlmeier et al 1993).

In Japan, among persons aged 64 and under, dental care accounted for a higher percentage of health expenditure than any other diseases in 2008. And for all age groups combined dental disease was the second most expensive of all diseases to treat. Only cancer care was more expensive (Statistics and Information Department, Ministry of Health, Labour and Welfare, Japan 2008).

In Australia dental disease is the second largest expenditure head, just below cardiovascular disease (Australia’s Health 2008). In the Netherlands dental diseases rank third among the most expensive diseases costing over 1000 million euros, with 60% of this cost attributable to dental caries (Slobbe et al 2006). Total expenditure for dental care in the United States was estimated to be over 100 billion dollars in 2009; representing 4.1% of the total health care spend that year (Glick et al 2009).

Given that oral disease constitutes a major risk factor in the development of NCDs, the economic impact of these conditions must also be considered. The potential cost of NCDs to economies, households and individuals in middle- and lower-income countries is significant. It is predicted that in the next 20 years NCDs will cost more than US$ 30 trillion, forcing millions of people below the poverty line. However, there is a growing body of evidence that demonstrates the potential of preventive strategies in reducing the burden of these diseases and minimising the consequential economic losses (World Economic Forum and the Harvard School of Public Health 2011). This mirrors the current thinking on preventive oral health strategies, which recognise that community-based prevention is generally cost-saving when compared with a treatment-focused approach, particularly for communities and individuals at high risk for disease (Tomar and Cohen 2010).

INDIRECT COSTS OF ORAL DISEASE

Dental decay is one of the most common chronic diseases worldwide and leads to significant absenteeism from work in adults, resulting in both short- and long-term impacts on economic productivity. In the USA, it has been estimated that employed adults lose more than 164 million hours of work each year due to dental disease or dental visits (USHHS 2000). Furthermore, research has shown that parents can lose up to two and a half days on average from work per year, because of their children’s dental problems (Seirawan et al 2012). Alongside this, fluctuations in socioeconomic circumstances may have a significant impact on oral health, where patients may delay consultation and treatment during economic downturns. This can have disastrous financial ramifications, as demonstrated by Californian statistics where the average cost of a check-up costs approximately $41, whereas the average cost of emergency treatment with hospitalisation increases substantially to over £5,000 (Glick et al 2012).

The indirect costs of oral disease are also discussed in Section 4 of this report dealing with the impact of poor oral health.

THE ECONOMIC IMPACT OF ORAL DISEASE: KEY SUMMARY POINTS

- The costs of health care continue to grow all over the world, and dental diseases are an enormous burden to both the individual and health care services
- In some industrialised countries, the mouth is the most expensive part of the body to treat
- Oral disease constitutes a major risk factor in the development of NCDs, and it is predicted that in the next 20 years NCDs will cost more than US$ 30 trillion
- Dental decay is a major cause of absenteeism from work in adults, it has been estimated that employed adults lose more than 164 million hours of work each year due to dental disease in the USA
WHY TOOTH BRUSHING MATTERS

The benefits of fluoride-containing toothpaste are firmly established and there is clear evidence for the practice of regular, twice-daily brushing with a fluoride-containing toothpaste in the prevention of dental decay in children and adults (Marinho et al 2004). It is generally accepted that this is the single most important factor that has led to the global reduction in dental decay (Marthaler 2004).

It is thus recommended that children brush their teeth at least twice a day to prevent dental decay and gum disease (Loe 2000; Kay and Locker 1998), as oral hygiene habits are developed early in life (Blinkhorn 1981).

TOOTH BRUSHING HABITS IN FRANCE

The Health Behaviour of school-aged Children (HBSC) survey of 39 countries and regions across Europe and North America undertaken between 2009 and 2010 demonstrated wide differences in (self reported) tooth brushing frequency within different age groups, girls and boys, levels of family affluence and between countries (Currie et al 2012). Girls were shown to brush their teeth more frequently, and older girls and younger boys were more likely to brush their teeth twice a day. Brushing more regularly was associated with higher family affluence. Recommended tooth brushing seems to be more common in higher-affluence north-western countries than in eastern and southern Europe. Analysis of the data shows how tooth brushing in France, in all age groups, was higher than the survey average for both boys and girls (Figure 4).

TOOTH BRUSHING HABITS IN INDIA AND INDONESIA

Little is known about the oral health behaviour of children in many Asian countries. A recent study of 852 schoolchildren aged 8–16 years from Udaipur, India, attending eight public schools showed how 30.5% of the total sample cleaned their teeth twice or more daily (Kumar et al 2012). This is in line with that of 38.5% reported among 212 11–12 year old school children in a missionary school of Bangalore, India (Harikiran et al 2008). However, it was observed to be 17% in 599 11–13 year olds of Bhopal city, India (Christensen et al 2003). Contrary to the European findings, in the Udaipur study no significant difference was reported between sexes for tooth cleaning frequency. Older children were also more likely to clean their teeth twice a day than the younger ones. Furthermore, frequency of tooth brushing was significantly lower amongst children of parents with a low level of education, and low annual income when compared to those of higher education levels, and annual income (Kumar et al 2012).
A study of 1906 12-year-old children in Yogyakarta Province, Indonesia demonstrated that 91.3% brushed their teeth at least twice a day. Girls were shown to brush their teeth significantly more often than boys did, mirroring findings in Europe. Children’s social backgrounds, such as place of residence and mother’s education were seen to play a significant role in influencing decay status and oral health behaviours (Amalia et al 2012).

ESTABLISHING GOOD HABITS
Families play a central role in promoting the oral health of children, and parental oral health behaviour is a known predictor of offspring’s dental decay experience in childhood (Bolin et al 1997) and oral health behaviours during adolescence (Astrom 1998; Astrom and Jakobsen 1996).

Dental decay in childhood is largely preventable through the good oral hygiene of mothers and children, and proper eating habits instituted by mothers early on (Plutzer and Spencer 2008; Twetman 2008; Fisher-Owens et al 2007). Providing mothers with information on the prevention of dental decay has also been shown to reduce the frequency of severe early childhood decay (Plutzer and Keirse 2011).

Research suggests that, in adolescence, aesthetic and psychosocial factors (e.g. family and peer pressure) are significant in motivating oral health behaviours, with tooth brushing characterised as a personal hygiene rather than a health-related behaviour (Stokes et al 2006; Macgregor et al 1997). Tooth brushing behaviour and frequency have been closely associated with a variety of factors including personal grooming, general cleanliness (e.g. hair/hand washing, frequency of bathing, use of deodorant) and especially a good personal appearance (Macgregor et al 1997; Macgregor and Balding 1987). Differences in the tooth brushing habits of 14 and 15 year olds have also been found to have been related to factors such as social groups, gender, self esteem, home life factors (e.g. time of getting up, going to bed, dietary habits) and reasons for brushing (Macgregor et al 1997). This mirrors research from Udaipur, India where it has been suggested that children who cleaned their teeth twice or more daily, went to bed earlier than those who cleaned their teeth less often (Kumar et al 2012).

Home routines, such as having breakfast and eating meals with the family, have been associated with more regular tooth brushing among adolescents (Levin and Currie 2010), as have school health-promotion initiatives (Kwan et al 2005). Conversely low-frequency tooth brushing tends to be accompanied by smoking, unhealthy eating patterns and low levels of physical activity (Honkala et al 2011).

Adolescents who brush their teeth more than once a day by 12 years of age are more likely to continue to do so throughout their teenage years and into adulthood. Furthermore, tooth brushing habits of adolescents have been shown to reflect their future education level as adults (Koiras et al 2003). However, awareness, knowledge and oral hygiene practices may vary between and within countries. For example, research amongst elderly and rural population groups in India, has shown how little importance is placed upon maintaining oral hygiene, and practices, such as simple mouth rinsing, finger brushing, and ‘Datoon’ or ‘Neem’ (tree twig chewing) are common place (Singh et al 2012). Unfortunately, the situation may be similar within younger population groups in India. A study of 1356 school children in Chandigarh, India, revealed that 80.2% were using a non-fluoridated toothpaste, and 99% did not understand the importance of fluorides in preventing tooth decay (Goyal et al 2007).

FACTORS IMPACTING TOOTH BRUSHING HABITS: KEY SUMMARY POINTS

- Oral diseases can largely be prevented by brushing teeth twice a day with fluoride toothpaste and by limiting the frequency of sugar consumption
- A survey of 39 countries and regions across Europe and North America demonstrated wide differences in self-reported tooth brushing frequency. Girls were shown to brush their teeth more frequently, and more regular brushing was associated with higher family affluence
- Dental decay in childhood is largely preventable by good oral hygiene of mothers and children, instituting proper eating habits early on, and providing mothers with information on oral health
- Family-related factors such home life and routines have all been associated with tooth brushing frequency in adolescents
- Adolescents who brush their teeth more than once a day by 12 years of age are more likely to continue to do so throughout their teenage years and into adulthood
- Awareness, knowledge and oral hygiene practices may vary between and within countries
Throughout this report we have emphasised the point that the major oral diseases can be prevented and we have stressed the importance of good oral hygiene and diet in that regard. In Section 6 we addressed the importance of establishing good tooth brushing habits. However, it is also clear that we have been remarkably ineffective in reducing the burden of oral disease and translating what we have learned from research into practice (Williams 2011). Watt (2007) has summed up the situation thus: “Despite significant overall improvements in oral health in recent decades across the developed world, social inequalities in oral health have remained. Even in countries with well-developed dental health care systems, and where community water fluoridation programmes exist, oral health inequalities, although less marked, still persist.” It has long been recognised that the poorest oral health is found among the socially disadvantaged (Locker 2000) and these are the most difficult group to reach in society. As discussed earlier, there is now strong evidence to show that the major oral diseases are socially patterned, sharing the same social determinants as the major non-communicable diseases, and that there is a gradient of risk for oral diseases across all socioeconomic groups. This insight is critical for the way we need to think about the burden of oral disease.

Watt (2007) has argued that, if we are to address the challenge of poor oral health based on the evidence we now possess, we need a paradigm shift away from the current predominant biomedical and behavioural ‘downstream’ approach to oral health towards one that addresses the underlying social determinants of oral health, using a combination of complementary public health strategies. Watt is particularly critical of approaches to health promotion based on lifestyle interventions that fail to appreciate the fundamental underlying importance of social determinants, showing not only that the results of such approaches are disappointing, but also that they actually increase health inequalities. He argues strongly for the adoption of ‘upstream’ integrated interventions that address the determinants of health; that emphasise the importance of promoting and maintaining good oral and general health. Such an approach calls for oral health programmes to be integrated into other health interventions using a common risk factor approach.

The importance of tobacco, alcohol and unhealthy diet as common risk factors was discussed in Section 3 of this report. The common risk factor approach (CRFA), involving their avoidance of has been widely adopted, but such strategies have been remarkably ineffective. This may be because dental policy makers and oral health promoters have interpreted the CRFA too narrowly, and Watt and Sheiham (2012) suggest that a behavioural preventive approach alone will have minimal impact in tackling oral health inequalities and indeed may widen inequalities across the population. They argue that “future action to address oral health inequalities in middle- and high-income countries requires a radical policy reorientation towards tackling the structural and environmental determinants of chronic diseases”.

Addressing the structural, socioeconomic determinants of health is principally the responsibility of national policy makers and professional organisations (Watt and Sheiham 2012). However, those involved in promoting oral health and reducing inequalities have a major role to play. To be effective we will need a radical reorientation in our thinking, away from what has been described as downstream victim blaming (Watt 2007) to upstream interventions that involve the incorporation of strategies to improve oral health into wider health promotion strategies. Watt (2007) has proposed a number of complementary public health actions that can be implemented at local, national or international levels to promote sustainable oral health improvements.
Local level interventions might include:
- Encouraging schools to become part of the Health Promoting Schools Network
- Developing oral health and nutrition policies in preschools and nurseries
- Encouraging sales of subsidised toothbrushes and toothpastes through community clinics
- Encouraging nurseries and schools to provide subsidies on healthy snacks and drinks
- Encouraging the engagement of community action groups in oral health projects
- Supporting the development of local infant feeding policies and ensure oral health messages included
- Encouraging development of oral health policies in older peoples’ residential homes and care s

National level interventions proposed include:
- Supporting regulation on content and timing of television advertisements promoting children’s foods and drinks
- Encouraging tighter legislation on food labelling and food claims on products
- Encouraging greater availability of sugar-free paediatric medicines
- Supporting removal of VAT and other taxes on fluoride toothpastes and toothbrushes
- Supporting legislation on water fluoridation
- Supporting food and nutrient standards for school meals, and other foods and drinks sold in school
- Encouraging safety standards for school play areas and other leisure facilities
- Supporting legislation on wearing of seat belts, helmets and mouth guards

STRATEGIES FOR BETTER ORAL HEALTH: KEY SUMMARY POINTS

- We must move from victim blaming to upstream action
- We must tackle the social determinants of oral health inequalities
- We should consider a range of options for health promotion across the spectrum from upstream to downstream
- We need to develop appropriate strategies based on a range of complementary policies and actions across this spectrum
- Oral health programmes need to be integrated into other health interventions using a common risk factor approach