

Oral conditions, such as tooth decay, periodontal disease and oral cancer, are among the most common and widespread diseases of humankind. They are generally related to the same preventable risk factors associated with over 100 noncommunicable diseases. Yet, international attention to oral diseases does not match the high number of cases, nor the impact these diseases have on individuals, populations and society.

The first edition of the *Oral Health Atlas* focused on 'mapping a neglected global health issue'. The new edition of this atlas continues to highlight the extent of the problem worldwide and reflects on policies and strategies addressing the global burden of oral disease. *The Challenge of Oral Disease – A call for global action* is a valuable resource for public health experts, policy makers, the oral health profession and anyone with an interest in oral health.

The wide range of oral health topics presented include:

- the impact and burden of oral diseases, such as tooth decay, periodontal disease, oral cancer and more
- major risk factors and the common risk factor approach
- inequalities in oral health
- oral disease prevention and management
- oral health challenges
- ensuring oral health is on global health and development agendas.

# The CHALLENGE of ORAL DISEASE

A CALL FOR GLOBAL ACTION

# **THE CHALLENGE OF ORAL DISEASE**

## **A call for global action**

**The Oral Health Atlas**  
SECOND EDITION



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B-H: Bosnia and Herzegovina  
Bolivia: Plurinational State of Bolivia  
Brunei: Brunei Darussalam  
Congo: Republic of the Congo  
Dem. Rep. Congo: Democratic Republic of the Congo  
East Timor: Democratic Republic of Timor-Leste  
FYROM: The former Yugoslav Republic of Macedonia  
Iran: Islamic Republic of Iran  
Laos: Lao People's Democratic Republic

Liecht.: Liechtenstein  
Lux.: Luxembourg  
Moldova: Republic of Moldova  
Mont.: Montenegro  
Neth.: The Netherlands  
North Korea: Democratic People's Republic of Korea  
Russia: Russian Federation  
St Vincent & Grenad.: Saint Vincent and the Grenadines  
Slov.: Slovenia  
Slovakia: Slovak Republic  
South Korea: Republic of Korea

Switz.: Switzerland  
Syria: Syrian Arab Republic  
Tanzania: United Republic of Tanzania  
UAE: United Arab Emirates  
UK: United Kingdom of Great Britain and Northern Ireland  
USA: United State of America  
Uzbek.: Uzbekistan  
Venezuela: Bolivarian Republic of Venezuela

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FDI World Dental Federation represents over 1 million dentists worldwide through the membership of national dental associations (NDA) in some 150 countries. Through its four-part mission in NDA capacity building, knowledge transfer, continuing education and oral health advocacy, it seeks to realize its vision of ‘leading the world to optimal oral health’, acknowledging that oral health is fundamental to general health and wellbeing.

A prerequisite of progress towards optimal oral health is to understand where we stand today. It was with this in mind that FDI published a first *Oral Health Atlas* in 2009, with the stated aim of ‘mapping a neglected global health issue’. Dense, informative and authoritative, yet accessible to the lay reader, it provided a novel and innovative approach towards a greater understanding of oral diseases, their epidemiology and their risk factors, and highlighted specific areas of concern.

As a unique tool in presenting a complex issue to a variety of audiences, the atlas was well received by dentists and dental researchers as well as by academics, health officials and other health practitioners. Encouraged by the book’s success, FDI decided to embark on a new publication, allying the virtues of the original atlas with a new activism. The focus was now not only on identifying the issues, but also on bringing about change. *The Challenge of Oral Disease – A call for global action* is therefore far more than a source of important information; it is an essential tool for FDI oral health advocacy.

FDI views oral health as a fundamental right, and echoes the 2010 Adelaide Statement on Health in all Policies in its own principle of ‘oral health in all policies’. This new publication seeks to enable this concept by including, where possible and appropriate, a series of action points and recommendations. The overall aim is to assist leaders and policy makers, who may not be specialists in the field of health, in integrating considerations of oral health, wellbeing and equity during the development, implementation and evaluation of policies and services.

Dr Tin Chun Wong  
FDI President 2013–2015



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The first edition of the *Oral Health Atlas*, published in 2009, aimed at ‘mapping a neglected global health issue’. The extent of neglect has not changed in the intervening period, yet there are new and encouraging opportunities for action addressing oral diseases on a global scale. Recognizing these opportunities, the title of this second edition has been changed to *The Challenge of Oral Disease – A call for global action*.

This completely rewritten text is explicitly directed at policy makers and key opinion leaders. It has the clear purpose of acting as an advocacy resource for all oral healthcare professionals and those concerned about the unacceptable global burden of oral disease. The book brings together information, data and facts on a broad range of topics related to oral health. It looks at the state of global oral health through a public-health and population-focused lens, and clearly aims at supporting advocacy and action.

As this book shows, there are serious gaps in recent epidemiological data on the major oral diseases, particularly in low- and middle-income countries. Thus, general awareness of oral diseases among policy makers, health planners and the health community at large remains low. Existing interventions to prevent and control oral diseases are too often regarded as an expendable luxury, rather than as a fundamental human right for everyone. Consequently, a large proportion of the global burden of oral disease remains unattended, and oral diseases receive only a low allocation of resources for surveillance, prevention, care and research.

Raising awareness of the requirement to address the burden of oral disease among policy makers is one of the main aims of this publication. It presents an overview of the main oral diseases and the burden they represent. It lays out current challenges faced by the oral health profes-

sion and presents a range of possible courses of action that can – and should – be taken to alleviate the global burden of oral disease.

New chapters in the book position oral health within the broader international development picture, in which significant initiatives such as the United Nations (UN) Sustainable Development Goals (SDGs), the recognition of noncommunicable disease (NCDs) as an increasing global burden, and the Minamata Convention on Mercury provide new and powerful opportunities for advocacy, integration and cross-sectoral approaches.

Complemented by a brief overview of the historical context of oral health and disease, the atlas closes with detailed ‘Comments on data and sources’ that draw attention to the extent of gaps in oral health information.

FDI’s vision of ‘leading the world to optimal oral health’ requires a move from the current predominant curative care model, focused on individual clinical patient services, towards population-wide preventive interventions.

This challenging paradigm shift will require a concerted effort from all stakeholders concerned with oral health. It will also require the forging of new partnerships with others from within and outside healthcare. International efforts to reduce the burden of other NCDs have shown that such bold moves are possible with strong leadership and broad political support. It is now time to ensure that oral health is integrated into these efforts.

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# Healthy teeth, healthy life

**Healthy primary and permanent teeth are important for health and wellbeing throughout life.**

A healthy and well-functioning dentition is important during all stages of life since it supports essential human functions, such as speaking, smiling, socializing and eating. Teeth help to give the face its individual shape and form.

The normal set of teeth comprises 20 primary teeth, which are replaced by 32 permanent teeth. Tooth eruption begins when babies are around 6 to 10 months old, usually starting

with the lower primary incisors. By the age of two and a half, all primary teeth have erupted.

Healthy primary teeth maintain the space for their permanent successors developing in the jaw underneath. Their premature loss, from tooth decay or injury, often results in loss of space for their successors and may lead to crowding problems with the permanent dentition.

At about six years of age, the lower permanent incisors and the first permanent molars erupt. The transition period from primary to permanent dentition typically lasts from 6 to 12 years of age. By age 21, ideally all 32 permanent teeth have erupted.

During the life course teeth and oral tissues are exposed to many environmental factors that may

lead to disease or even tooth loss. Tooth decay and periodontal disease are the most common oral diseases, yet they are largely preventable.

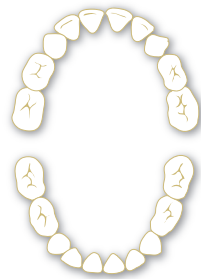
Proper self- and professional oral care, combined with a healthy lifestyle and avoiding risks, such as high sugar consumption and smoking, make it possible to retain a functioning dentition through life.

## ORAL HEALTH FOR LIFE

### The developing dentition



**Age: 6 months old**  
Teething begins.



**Age: 2½ years old**  
All primary (upper and lower) teeth have erupted.

**Age: 6 years old**  
Permanent teeth begin to appear.



**Age: 12 years old**  
Most permanent teeth have erupted.

**Age: 21 years old**  
Third molars (wisdom teeth) are the last to erupt.



Cleaning or wiping can start with the eruption of a child's first teeth. Pacifier bottles with sugary drinks or fruit juices can cause early childhood tooth decay. Better to use plain water instead.



Children can start supervised tooth brushing twice a day with a pea-sized amount of fluoride toothpaste. Regular dental check-ups can start early in life.



Establish good dietary habits, limiting amount and frequency of sugary snacks.



Develop a life-time habit of twice-daily brushing with fluoride toothpaste.



Start to wear mouthguards for contact sports.



Avoid sweets, tobacco and alcohol.



Good oral hygiene and healthy habits, together with regular dental check-ups, help to avoid tooth decay and periodontal disease. Pregnant women should take extra care of their oral health.



Dry mouth as a result of reduced saliva production may increase risk of diseases. Regular check-ups may help keep a healthy mouth and good quality of life.

### Good habits for life



What is oral health and why consider oral diseases as a serious public health threat? Oral diseases may directly affect a limited area of the human body, but their consequences and impacts affect the body as a whole. The World Health Organization (WHO) defines oral health as ‘a state of being free from mouth and facial pain, oral and throat cancer, oral infection and sores, periodontal disease, tooth decay, tooth loss, and other diseases and disorders that limit an individual’s capacity in biting, chewing, smiling, speaking, and psychosocial wellbeing.’

This widely recognized definition is complemented by the acknowledgement of oral health as an integral element of the right to health, and thus of the basic human rights enshrined in the UN Universal Declaration of Human Rights adopted by all nations.

A healthy mouth and a healthy body go hand in hand. Conversely, poor oral health can have detrimental consequences on physical and psychological wellbeing. Yet, the high burden of oral diseases represents a widely underestimated public health challenge for almost all countries worldwide. Oral diseases are often hidden and invisible, or they are accepted as an unavoidable consequence of life and ageing. However, there is clear evidence that oral diseases are not inevitable, but can be reduced or prevented through simple and effective measures at all stages of the life course, both at the individual and population levels.

**“Oral health is essential to general health and quality of life.”**

WHO fact sheet on oral health, 2012

Untreated tooth decay is now known to be the most prevalent of the 291 conditions studied between 1990 and 2010 within the frame of the international Global Burden of Disease Study. This is the most authoritative estimation of global disease burden and serves as a basis for health policy planning and resource allocation. Severe periodontitis, which is estimated to affect between 5 and 20 percent of populations around the world, was found to be the sixth most common condition. Oral cancer is among the 10 most common cancers in the world, and even more prevalent in South

Asia, with numbers expected to rise due to increasing tobacco and alcohol consumption.

Approximately 50 percent of the 35 million people living with HIV suffer from oral fungal, bacterial or viral infections. Tens of thousands of children are still affected by noma in the poorest areas of Sub-Saharan Africa. Moreover, one in every 500 to 700 children is born with a cleft lip and/or palate. And oral and facial trauma, associated with unsafe environments, sports and violence, exacts a high toll, particularly on children.

These examples illustrate the huge burden of oral diseases that afflict humankind and which require population-wide prevention and access to appropriate care. The many links between general and oral health, particularly in terms of shared risk factors and other determinants, provide the basis for closer integration of oral and general health for the benefit of overall human health and wellbeing.



# Oral health and general health

**Oral health and general health are closely related and should be considered holistically.**

Oral health is about more than healthy teeth and a good-looking smile. The mouth is a mirror of the body, often reflecting signs of systemic diseases. Examination of the mouth can reveal nutritional deficiencies and unhealthy habits such as tobacco or alcohol use. Oral lesions may be the first signs of HIV-infection, and changes in tooth appearance can indicate serious eating disorders.

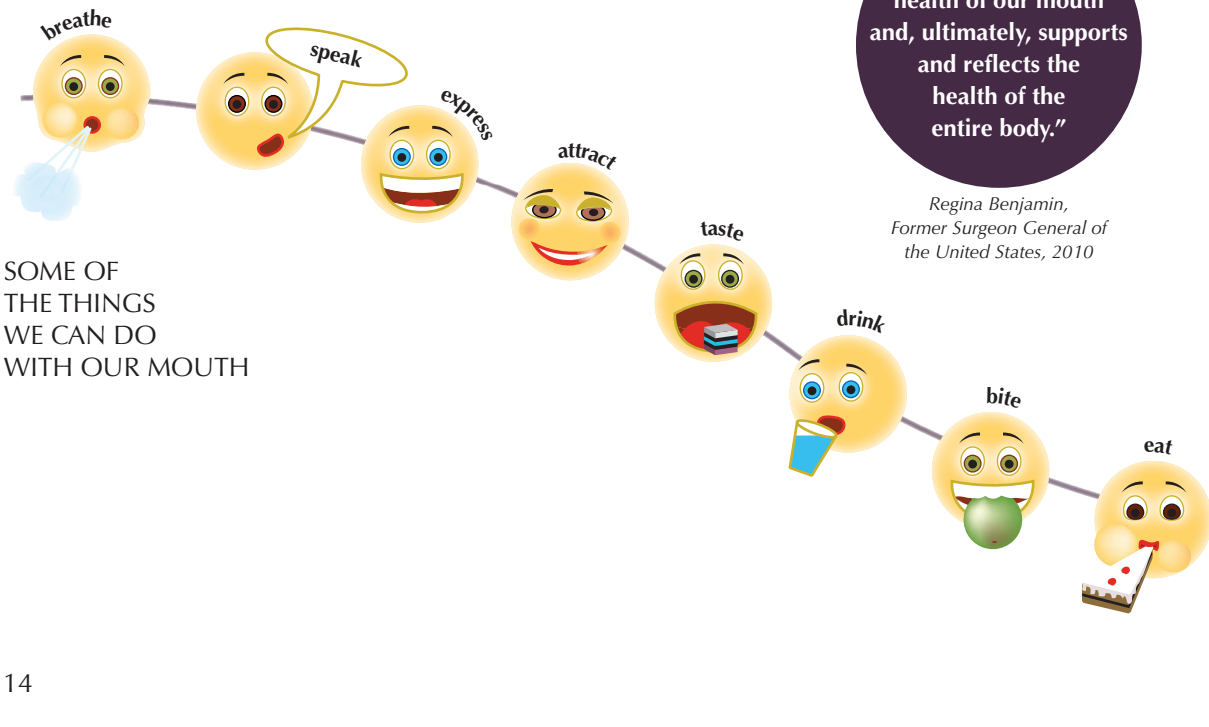
Many general conditions increase the risk of oral diseases, such as an increased risk of periodontal disease in patients with diabetes. Equally, poor oral health can adversely affect a number of general health conditions and their management.

Most oral diseases share common risk factors with NCDs such as cardiovascular diseases, cancers, diabetes and respiratory diseases. These risk factors include unhealthy diets (particularly those high in added sugars), tobacco

and alcohol use. They result in a very similar pattern of inequalities in oral and general disease burden between different population groups.

With the global improvement in life expectancy, a life-course approach to oral health will become more important. Different ages in life have different oral health needs, and the specific problems of older people, who are often also suffering from other diseases, are becoming more prevalent. Knowledge and awareness of the close associations between oral and general health are thus important for holistic care, as is collaboration between oral and general health professionals.

The close bi-directional relationship between oral and general health, and its impact on an individual's health and quality of life, provides a strong conceptual basis for the integration of oral healthcare into general healthcare approaches.

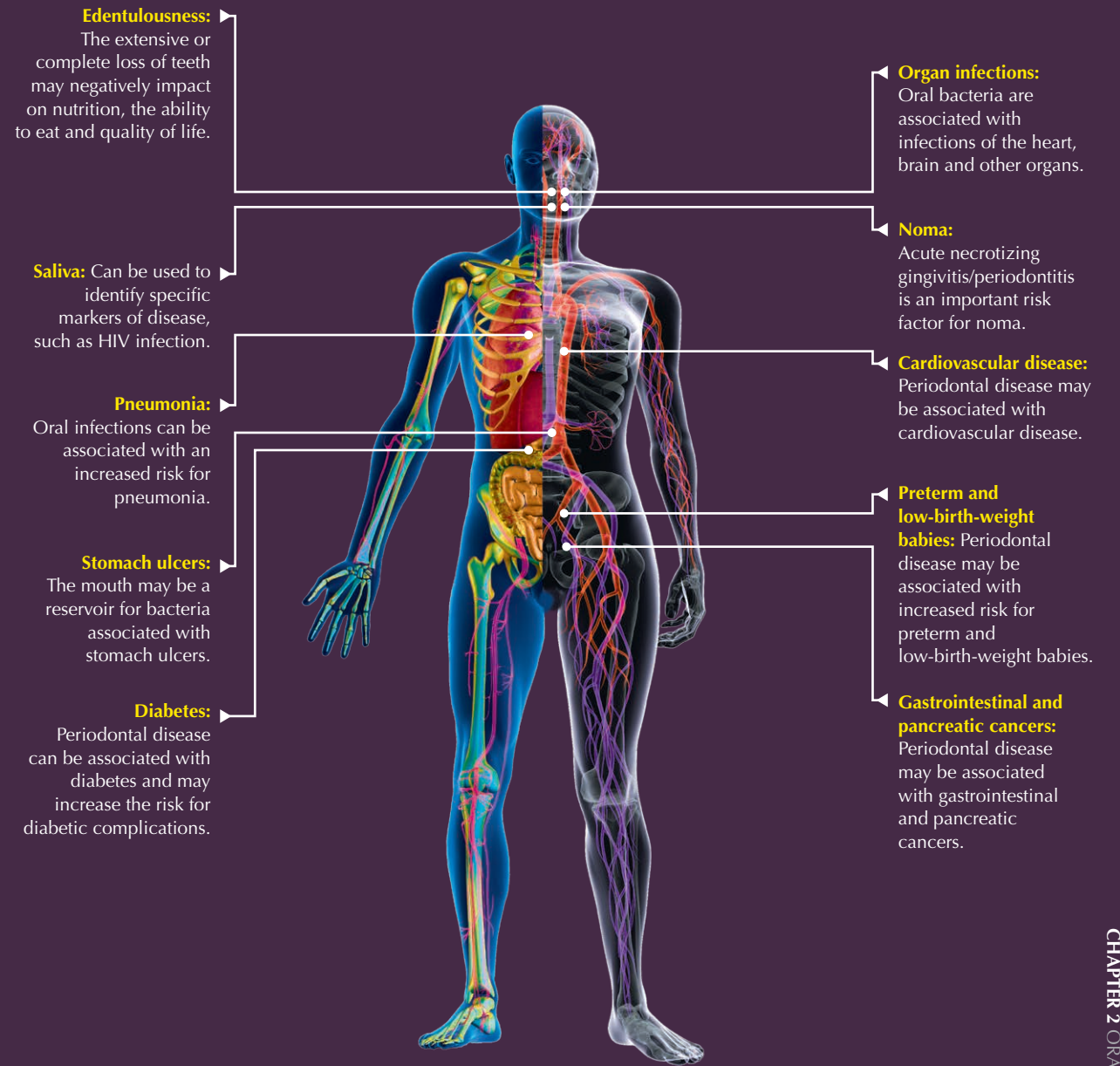


SOME OF THE THINGS WE CAN DO WITH OUR MOUTH

**"...oral health refers to the health of our mouth and, ultimately, supports and reflects the health of the entire body."**

*Regina Benjamin, Former Surgeon General of the United States, 2010*

## SELECTED ASSOCIATIONS BETWEEN ORAL CONDITIONS AND GENERAL HEALTH



# Tooth decay

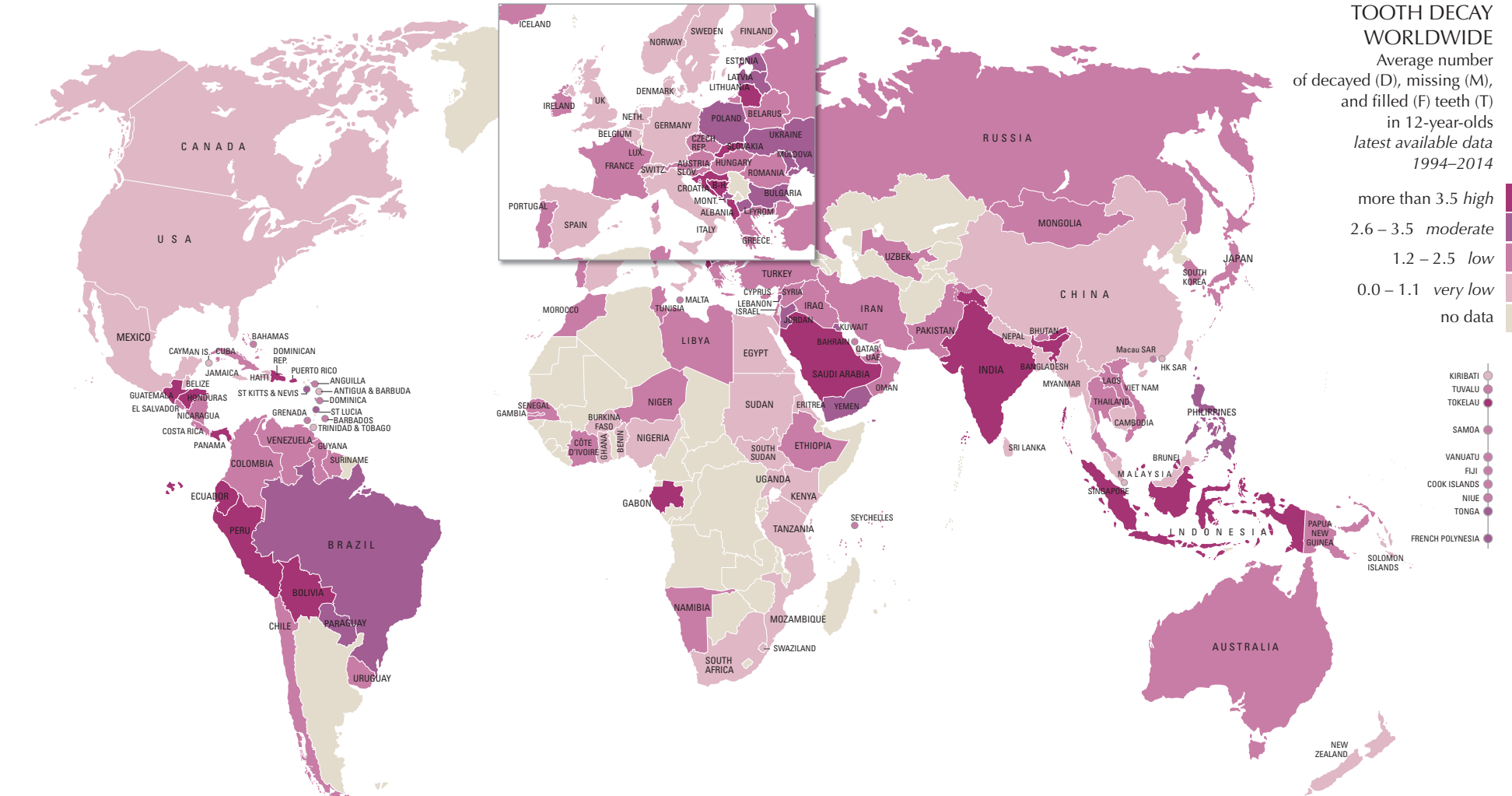
Untreated tooth decay is the most common chronic disease, due to exposure to sugar and other risks, the lack of effective prevention and limited access to appropriate oral healthcare.

## Burden of the disease

Tooth decay (dental caries) is the most widespread chronic disease worldwide and constitutes a major global public health challenge. It is the most common childhood disease, but it affects people of all ages throughout their lifetime. Current data show that untreated decay of permanent teeth has a global prevalence of over 40 percent for all ages combined and is the most prevalent condition out of 291 diseases included in the Global Burden of Disease Study. Untreated tooth decay frequently causes oral pain and it affects up to seven in ten children in India, one in three teenagers in Tanzania and almost one in three adults in Brazil. Untreated tooth decay can cause difficulties in eating and sleeping, may impact child growth and is a leading cause of absence from school and work.

The burden of tooth decay for 12-year-olds is highest in middle-income countries, with about two-thirds of decay remaining untreated. Whilst low-income countries have lower levels of tooth decay, this goes almost entirely untreated, reflecting weak oral healthcare systems. Even in high-income countries more than half of tooth decay is left untreated. Tooth decay shares the same social determinants and resulting inequalities as many other oral diseases.

Despite the widespread nature of tooth decay, reliable, standardized global data are limited. This is largely because oral health data are not integrated in national disease surveillance, particularly in low- and middle-income countries. Separate national oral health surveys are complex and costly to conduct, and hence not prioritized. This lack of up-to-date

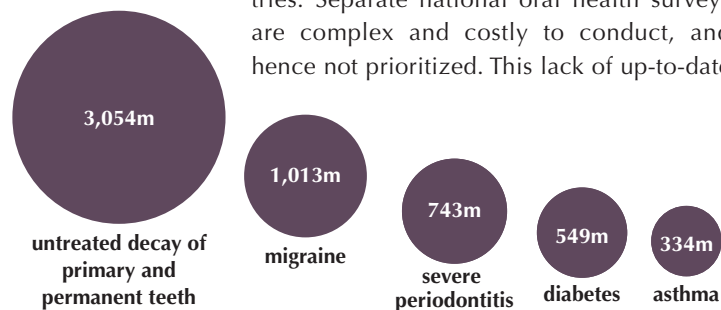


**TOOTH DECAY WORLDWIDE**  
Average number of decayed (D), missing (M), and filled (F) teeth (T) in 12-year-olds  
latest available data  
1994–2014

more than 3.5 *high*  
2.6 – 3.5 *moderate*  
1.2 – 2.5 *low*  
0.0 – 1.1 *very low*  
no data

- KIRIBATI
- TUVALU
- TOKELAU
- SAMOA
- VANUATU
- FIJI
- COOK ISLANDS
- NIUE
- TONGA
- FRENCH POLYNESIA

ESTIMATED NUMBER OF PEOPLE AFFECTED BY COMMON DISEASES 2010

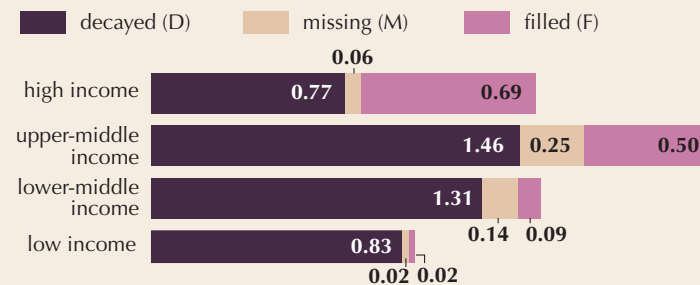


epidemiologic information constrains the development of appropriate approaches to reduce the disease burden.

Tooth decay is the most prevalent of conditions, affecting almost half (44%) of the world population in 2010, followed by tension-type headache (21%), migraine (15%), severe periodontitis (11%), diabetes (8%) and asthma (5%).

## GLOBAL DISTRIBUTION OF TOOTH DECAY

Average number of affected teeth for 12-year-olds by country income group  
2000 or latest available data



## The DMFT Index

The DMFT index is generally used to report tooth decay in epidemiological studies. It records the number of decayed (D), missing (M) and filled (F) teeth (T). While DMFT is not the only measure and has limitations, the oral health status of populations is often summarized as a DMFT score (usually of 12-year-olds). A DMFT score of 1.0 means that 1 of the 32 adult teeth is either decayed, missing or filled. Scores for individuals are full numbers, for populations they can have decimal values.

# Tooth decay

**Tooth decay is principally caused by sugar consumption and can largely be prevented by reducing sugar intake, appropriate fluoride use and promoting good oral hygiene.**

## Development of the disease

Tooth decay (dental caries) is a multifactorial disease, caused by the interaction between the tooth surface, the bacterial biofilm (dental plaque) and the presence of sugars from food. Biofilm bacteria metabolize sugars and produce acids, which over time break down tooth enamel.

Decay usually starts hidden from view in the fissures of the teeth or in the tight spaces between them. In its early stages the disease can be arrested and even reversed, but in the later stages a cavity forms. Then treatment becomes necessary to restore tooth function, involving the removal of decayed tissue or the placement of a filling or crown. If left untreated, decay can lead to extensive destruction of the tooth, pain, and infection. The latter can result in abscess formation or septicaemia. At this stage, root canal treatment or extraction becomes necessary.

Most of the factors involved in tooth decay are modifiable, providing entry points for

individuals and oral health professionals to take action to prevent or reduce the severity of disease.

Reducing acid attacks on the tooth enamel can be achieved by reducing the total amount and frequency of sugar consumed. Action to protect the tooth surface can be taken by ensuring adequate exposure to fluoride, for example by using fluoride toothpaste, or fluoridating water supplies. Action on the microbial biofilm can be taken by ensuring good oral hygiene practices.

In addition, a range of external factors, such as where and how people live, also influence the development of tooth decay. This means that although the decay process starts at the surface of the tooth the problem cannot be solved by concentrating on the teeth alone. It also necessitates action on the community level to address the broader determinants underlying the disease process.



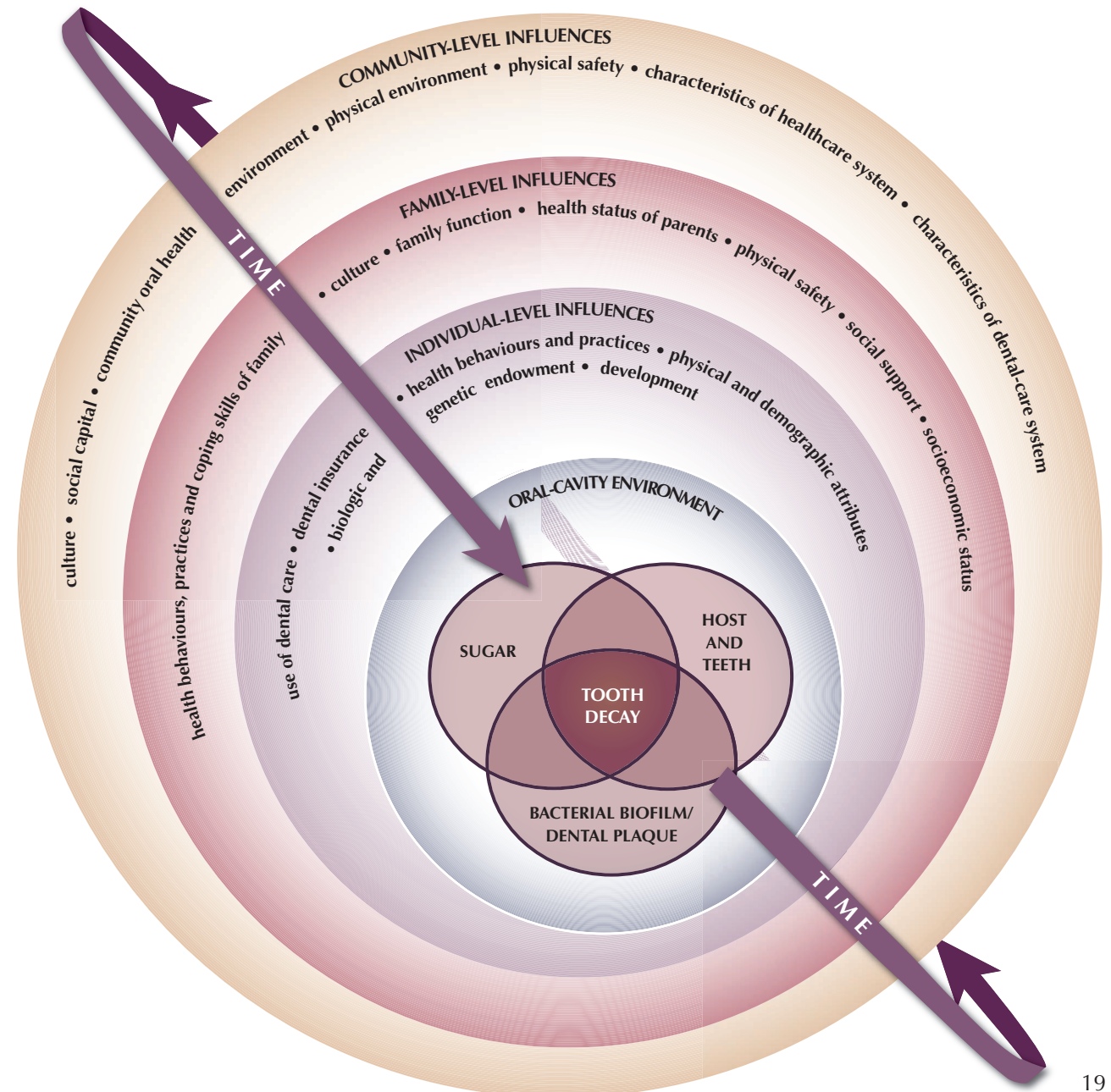
### DENTAL PLAQUE

Dental plaque is a biofilm consisting of approximately 600 different species of bacteria. Several of the bacterial species have been associated with causing tooth decay including *Streptococcus mutans*.

Tooth decay develops over time and is triggered by acid production resulting from the breakdown of sugars. However, a wide range of other factors influence the development of tooth decay and its severity. These factors act over time at the level of the community, the family and the affected individual.

## TOOTH DECAY IS A MULTIFACTORIAL DISEASE

*Modified from Fisher-Owens, 2007*



## Tooth decay



### — Patient testimonies

"I am a very busy person. My job is highly demanding and many people count on me to produce results on time. Time is indeed money. For a while, I had some toothache come and go. The pain was manageable and I didn't have time to go see the doctor, so I would take a painkiller when it hurt and that would do the trick. Then one day, the pain got so acute that I started having a fever and painkillers were not working anymore. I rushed to the dentist who told me that my tooth was in such bad shape that I needed a root canal treatment. Simple tooth decay that could have been quickly cured ended up costing me numerous working hours (and money) because I waited too long. This was a mistake I will not make again."

Entrepreneur, Tokyo, Japan,  
33 years old

"Simple tooth decay that could have been quickly cured ended up costing me numerous working hours (and money) because I waited too long. This was a mistake I will not make again."

"Our son had just turned 10 when he was diagnosed with type 1 diabetes. It was difficult to hear, but my husband and I decided to learn as much as possible about the disease and ways to stabilize it. Our doctor then told us about the importance of avoiding chronic infections and minimizing the risk of tooth decay. So we started taking our son for regular dental checkups and we honestly feel more relieved now knowing that we are taking the right preventive measures to keep our son in good health. Luckily our health insurance covers oral healthcare too so we can do what is necessary for our son's wellbeing and overall health."

Teacher, Vancouver, Canada,  
34 years old

"I've always had a job. Whether it was waitressing or retailing... I've always had a job and it's usually been in constant contact with people. This all changed when I got pregnant with my firstborn. I decided to take some time off from work to fully enjoy motherhood. I spent about four years at home with the kids. During this time, though, I developed the habit of snacking and drinking soda. I must say this had a tremendous impact on my life. I decided to go back to work, only my employer said he wouldn't take me because I had developed bad teeth. I didn't realize this had become so visible, but my bad eating habits had caused a lot of tooth decay. I was ashamed and devastated to learn I couldn't continue working because of the way I looked - especially in a business where there is social pressure to look good. This was a wake-up call to make drastic changes in my lifestyle for the sake of my teeth, my job, my children and my own health."

Retailer, Paris, France, 54 years old

## What can be done? ←

### Reduce dietary sugar intake

Untreated tooth decay is the most common of the 291 conditions included in the 2010 Global Burden of Disease Study, despite the fact that it is largely preventable through simple and cost-effective interventions.

The highest levels of tooth decay are found in middle-income countries, where sugar consumption is on the rise and health systems are not able to provide appropriate prevention or access to oral healthcare. The consequences of untreated tooth decay, particularly for children, are negative impacts on nutrition and growth, loss of days in school and at work, reduced overall productivity and significant impacts on quality of life and social interactions.

A combination of approaches is required to address the global tooth decay burden, including:

### Integration of oral health and NCDs

Full integration of oral health into population-wide prevention and health-promotion strategies is necessary for NCD reduction. This is because curative interventions are neither realistic nor sustainable approaches to

reducing the burden of tooth decay. Greater emphasis on promoting good dietary habits and a focus on reducing sugar consumption will be essential.

### Universal access to affordable and effective fluoride

Exposure to fluoride is among the most cost-effective measures to prevent tooth decay and improve oral health. Regular use of fluoride toothpaste is the most important way to ensure a good preventive effect.

### Universal access to primary oral healthcare

Existing inequalities in disease burden can only be reduced with universal access to primary oral healthcare, covering at least relief of pain, promotion of oral health and management of oral diseases, including tooth decay.

### Surveillance, monitoring and evaluation

Global and national surveillance of oral diseases must be an integral part of routine epidemiological surveillance. Monitoring risk factors and oral health needs is fundamental to developing appropriate interventions and programmes and to evaluating their effectiveness.

# Periodontal disease

Periodontal disease is one of the commonest diseases of humankind, but is largely preventable through good oral hygiene and preventive policies addressing common risk factors.

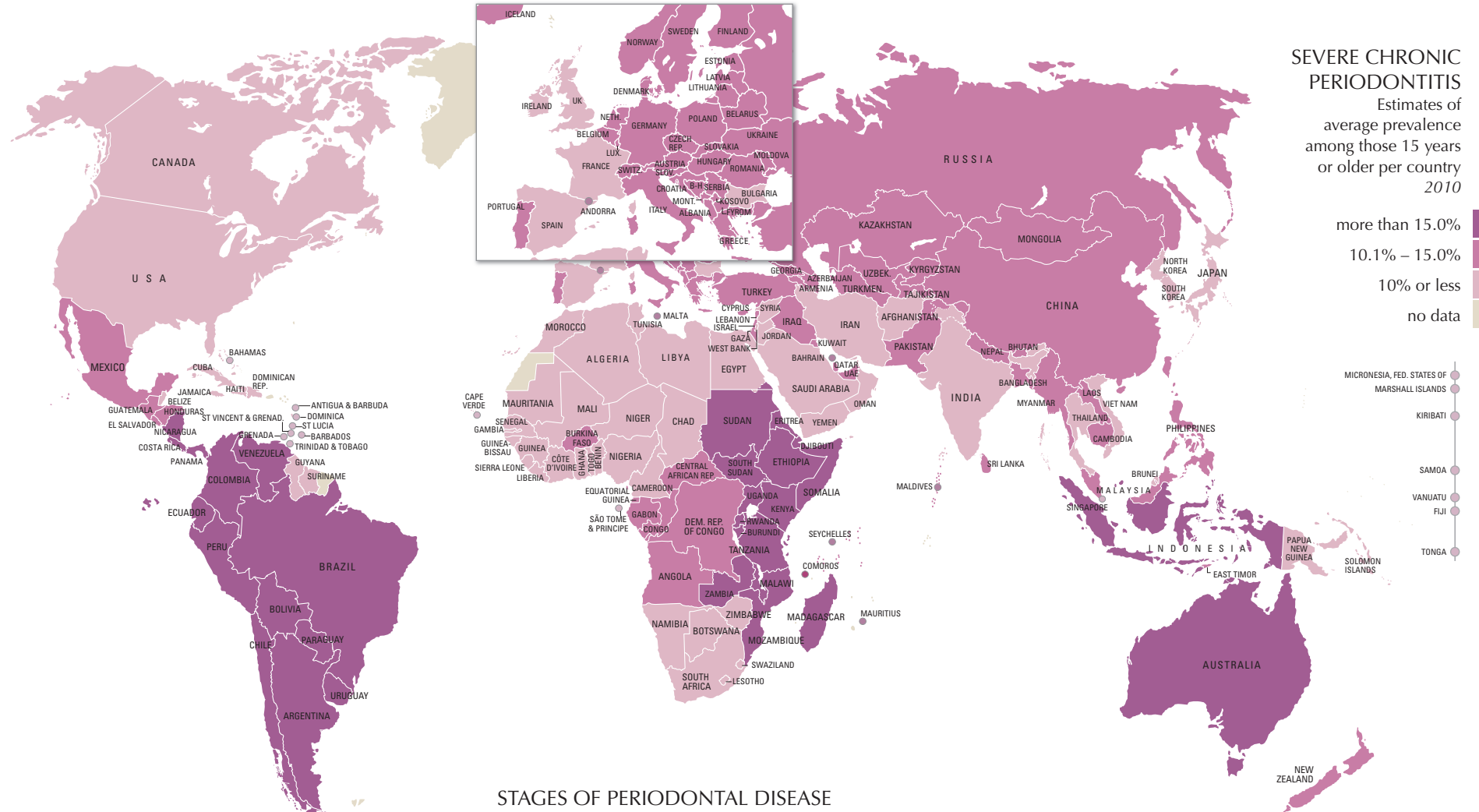
## Nature of the disease process

Periodontal (gum) disease begins as gingivitis (chronic inflammation of the gums), which is very widespread and for the majority of patients completely reversible. It may progress to periodontitis, a more serious condition that destroys tooth-supporting tissues and bone. In about 15 percent of the population the disease can progress further to severe periodontitis that leads rapidly to tooth loss.

The disease process is still poorly understood, but it tends to progress through phases of rapid, irreversible tissue destruction. By the age of 65 to 74 years about 30 percent of people have lost all their teeth, with periodontal disease being the main cause. Severe periodontal disease has serious consequences for those affected, including problems with chewing and speaking, which adversely affect general wellbeing and quality of life. The disease represents a major global oral disease burden with significant social, economic and health-system impacts.

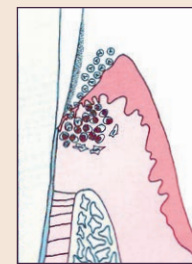
Specific bacteria are the essential cause of periodontal disease. Other important risk factors include tobacco use, unhealthy diet, genetic factors, stress and excessive alcohol consumption. Periodontal disease may also be associated with systemic diseases such as diabetes, cardiovascular diseases, adverse pregnancy outcomes and respiratory diseases.

Because of the shared risk factors and its two-way relationship with some systemic diseases, periodontal disease is receiving global attention from healthcare professionals, governments, and insurance and pharmaceutical companies. Yet, many people do not know about it and the measures to prevent it. Specialized periodontal care is not generally available; when it is, it is unaffordable for many. As with tooth decay, prevalence and severity data on a global level are scarce.



## STAGES OF PERIODONTAL DISEASE

### Chronic gingivitis



Inadequate oral hygiene leads to accumulation of dental plaque containing harmful bacteria and bacterial products that cause chronic inflammation of the gum adjacent to the tooth surface. However, the cells of the immune system counter these damaging effects and the inflammation remains localized. For many patients, the disease never progresses beyond this point and is reversible in many cases.

### Destructive periodontitis



The defence of the local immune system breaks down and the inflammation process advances. Tooth-supporting tissues are irreversibly destroyed and result in pocket formation, with loss of supporting bone. In advanced stages affected teeth may become loose and be lost.

### Links with general health

Products from inflammation around the tooth and the bacteria in dental plaque enter the bloodstream and may cause systemic harm. Diseases with an impact on the immune system, such as diabetes, increase the risk of more serious forms of periodontal disease.

## Periodontal disease



### Patient testimony

"I started smoking in my early 20s. What began as a social habit quickly turned into a daily routine. Smoking was a fashionable trend at the time, so I didn't think I had anything to worry about. I was going to university, I was meeting people and going out... I was enjoying life. Then I met my husband-to-be when I started working. We got married after three years together, and before I knew it we were expecting our first child. My pregnancy was a joyful time in my life, which was sadly shadowed by some complications linked to my baby's premature birth. During my visits to the doctor, I remember him warning me already about smoking and the negative effects it had on my general health, my pregnancy and the baby's health. I told myself I would smoke less and quit eventually, but never really managed to.

I was around 40 when I started noticing gaps between my teeth. They were not painful, so I

didn't think it was anything serious. I figured it was one of the perks of getting older. Then, just recently, my teeth started moving and looked longer than they did before. I saw that my gums were swollen and often bleeding when I brushed my teeth. Then, some of my front teeth started becoming mobile. I felt scared, so I rushed to the dentist where she told me I had suffered major bone loss and had severe periodontal disease.

I was scared of what that meant: Would I lose all my teeth? Would I be able to chew again? Would this affect the way I talk? Could I afford the dental treatment? I am coping with the disease as best as I can, but looking back, I regret not making different lifestyle choices. I wish I had taken my doctor's advice to stop smoking when it could have made a difference. I wish I knew back then what I know about health today."

Retired, Kiev, Ukraine,  
60 years old

"I was scared of what that meant: Would I lose all my teeth? Would I be able to chew again? Would this affect the way I talk? Could I afford the dental treatment?"

## What can be done?

Periodontal disease is a major public health problem that challenges health systems around the world. It largely goes unnoticed by patients until it reaches an advanced stage. Public awareness of the disease and the importance of proper oral hygiene is low, so opportunities for early intervention and effective management are often missed.

Periodontal disease shares common risk factors with other major NCDs, with a strong relation to tobacco and alcohol use, high sugar consumption, obesity and unhealthy diet. It may also be associated with systemic diseases, including diabetes. In about 10 to 15 percent of patients, common gingivitis may progress to severe periodontal disease, and increasing attention is being given to identifying this high-risk group before their disease has progressed to the stage where tooth loss is inevitable. As with all chronic diseases, effective lifelong self-care, together with appropriate professional oral care, is key to preventing disease progression and tooth loss.

In addition, population-wide strategies to address severe periodontitis are required:

### Healthy living and prevention

The promotion of a generally healthy lifestyle, with low exposure to risk factors such as tobacco or alcohol use, together with good personal oral hygiene, awareness and

regular check-ups, are important elements in prevention of periodontal disease. There is a strong social gradient in the prevalence of periodontal disease, which requires interventions addressing the wider determinants of health.

### Early detection and management

Through regular visits to the dentist, periodontal disease can be detected at early stages and appropriate measures for disease control can be taken. More advanced cases may require specialized care.

### Strengthening inter-professional collaboration

A holistic approach to managing periodontal disease by integrating it into the prevention and management of NCDs is called for, with stronger collaboration between oral health professionals and physicians, general practitioners and other appropriate health professionals. Equally, periodontal disease may be a symptom of underlying systemic diseases that require care. Improved periodontal health may contribute to better management of systemic diseases such as diabetes.

### Integrated disease surveillance

Integrating indicators for periodontal disease, together with other oral diseases, into routine surveillance will help to fill major knowledge gaps about disease prevalence and severity for many countries worldwide.

# Oral cancer

Oral cancer is among the 10 most common cancers, but reducing tobacco and alcohol consumption can largely prevent it. Survival rates can be improved with early detection.

## Burden of the disease

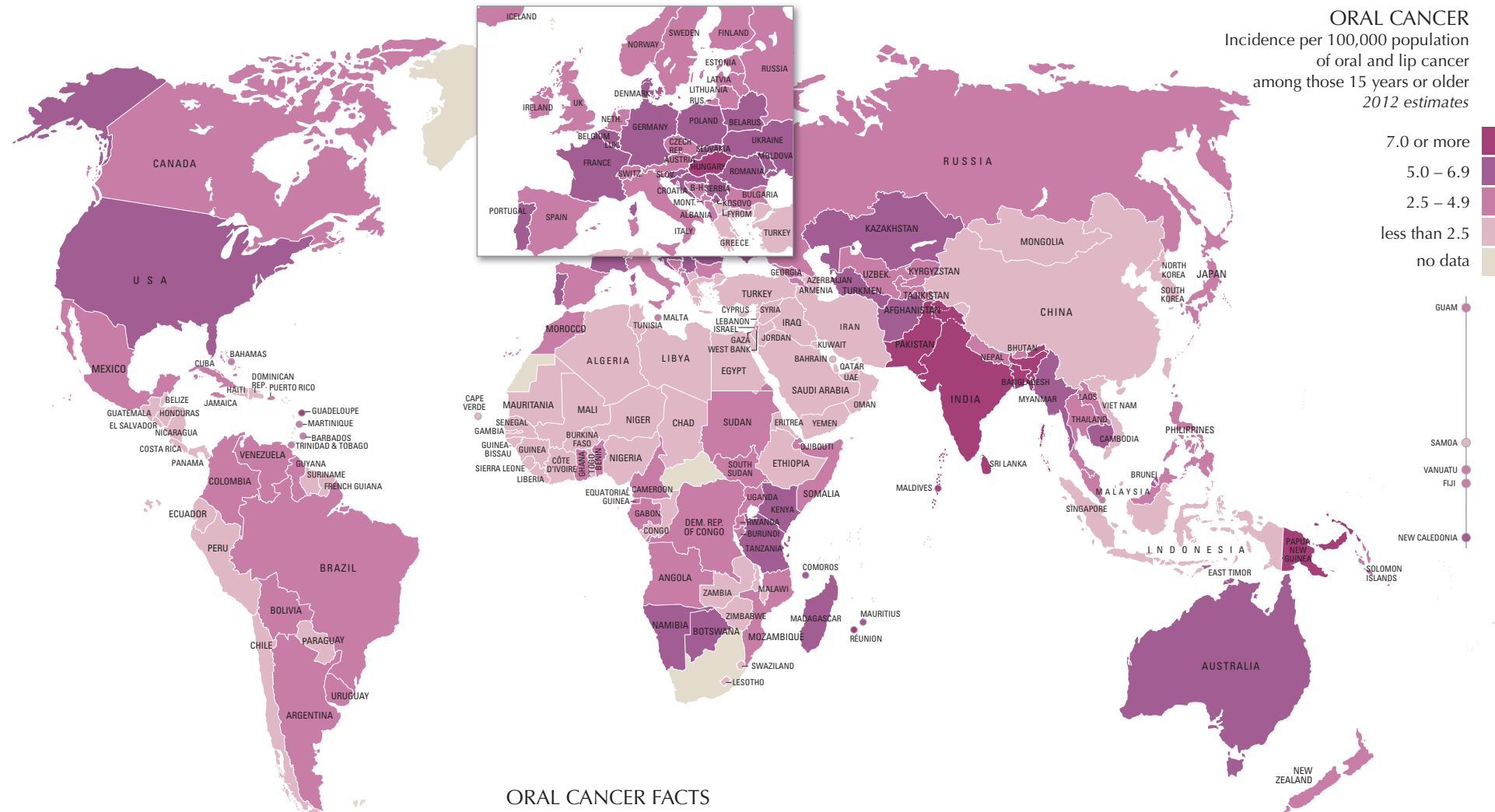
Oral cancer is a disease with high mortality and is among the 10 most common cancers, depending on country or world region. It is estimated that 300,000 to 700,000 new cases occur every year, but reliable surveillance data are missing. South and Southeast Asia are among the regions with the highest rates of new cases, but Eastern Europe, France and parts of Africa and Latin America also suffer from a high disease burden. Oral cancer is generally a disease of middle-aged men, but women and younger people are increasingly affected. The disease typically presents as an ulcer that does not heal; other symptoms may include pain, swelling, bleeding and difficulty in chewing and swallowing.

Up to 70 percent of oral cancers are preceded by precancerous oral lesions, such as persistent red or white patches in the mouth. The cancer may go unnoticed during its early stages, so it is often advanced when the patient finally seeks care. Consequently, the average 5-year survival rate is only 50 percent. Common locations are the tongue, the insides of the cheeks and the floor of the mouth. Treatment usually consists of a combination of surgical removal, radiotherapy or chemotherapy; however, survival rates for oral cancer are among the lowest of all cancers and have remained unchanged in recent decades.

The main causes of oral cancer are tobacco and alcohol use, accounting for about 90 percent of oral cancers. Chewing tobacco, often with other carcinogenic substances in betel quid, is a common cause in Asia, while human papillomavirus (HPV) infection is an emerging risk factor, particularly in high-income countries.

Oral health professionals are in a strong position to screen high-risk patients for early signs of oral cancer, yet the opportunity for a simple oral examination is frequently missed.

Timely referral to multi-disciplinary treatment centres is a key factor in determining patient outcomes, but this is a challenging goal in low- and middle-income countries where the necessary facilities are unavailable, inadequate or unaffordable.



## ORAL CANCER FACTS

Facts about oral cancer	Risk factors	Profile of those at highest risk
<p>The average <b>5-year survival rate</b> of patients with oral cancer is about 50%.</p> <p><b>50%</b></p>	<p><b>Cigarette smoking</b> is the most common form of tobacco use, but all forms of tobacco are linked with increased risk of oral cancer: <b>regular use of pipes, cigars, waterpipes</b>, as well as all forms of <b>smokeless tobacco</b> (snus, chewing tobacco, etc.).</p>	<p>A typical <b>high-risk profile</b> for oral cancer is a <b>man</b>, over age <b>40</b>, who uses <b>tobacco</b> and/or is a heavy user of <b>alcohol</b>.</p>
<p>About <b>95% of all oral cancers</b> occur in persons over 40 years of age.</p> <p><b>95%</b></p>		
<p>The average age at the time of diagnosis is about <b>60</b>.</p> <p><b>60</b></p>	<p>All three forms of <b>alcohol</b> (beer, spirits and wine) have been associated with oral cancer, although <b>spirits</b> and <b>beer</b> have a higher associated risk.</p>	<p>However, the <b>male-female ratio</b> has <b>dropped</b> from 6 to 1 in 1950 to about 2 to 1 at present.</p> <p><b>1950</b>      <b>2015</b></p>

# Oral cancer



## ■ Patient testimonies

“Head and neck cancer can be caused by many things, including HPV virus, smoking, alcohol, drug abuse, genes, environment and stress.

I do not know what caused my particular cancer. If I did I'd have a Nobel Prize. I do know that I am here today because of all the incredible advances in cancer research and treatment.

Early awareness is a key factor. If this episode contributes to public awareness, all the better.”

Michael Douglas  
American Actor and Producer, 2013

“Early awareness is a key factor. If this episode contributes to public awareness, all the better.”

“It was a terrible shock. I mean, I just went into total silence for a few days. Early detection made all the difference. I'm one of the lucky ones.”

Rod Stewart  
British Rock Singer Songwriter, 2002

“Early detection made all the difference. I'm one of the lucky ones.”

## What can be done? ←

Oral cancer is a common cancer worldwide, and the typical patient is a middle-aged man. In some countries in South Asia oral cancer is the second most frequent cancer for men and is the most common cause of their premature death. Generally, death rates for oral cancer exceed those of many other cancers; only half of all patients survive the first five years after diagnosis. Despite advances in diagnosis and treatment, this number has not changed in the past decades. In addition, the impacts of oral cancer, even after treatment, result in severely reduced quality of life for those who survive.

Generally, the following areas need to be strengthened and improved globally:

### Early detection and timely referral

Early detection improves treatment outcomes through timely referral for specialist care. Yet, delays in referral persist, even in high-income countries, and opportunities for screening patients at risk are frequently missed. While general population screening is not recommended, there is good evidence for its effectiveness for patients with risk factors such as smoking or high alcohol consumption. Primary healthcare workers can even perform screening after minimal training.

### Availability of effective and appropriate specialist care

Oral cancer requires specialist care in dedicated centres providing advanced surgery,

chemotherapy or radiotherapy. Rehabilitation after therapy is best performed by multi-disciplinary teams so that the patient's quality of life is as good as possible. Such approaches are unavailable in many low- and middle-income countries, particularly in South Asia, where existing facilities are overwhelmed with new cases. Furthermore, the cost of care is beyond the means of many patients and their families.

### Integrative policies to address risk factors, determinants and inequalities

Building on the Common Risk Factor Approach, and integrating prevention and control of oral cancer in general cancer and NCD approaches is the best avenue to address the growing problem in the long-term. Incidence, survival rates and quality of life of oral cancer patients show huge inequalities based on socioeconomic status.

Inclusion of oral cancer care in universal health coverage, the strengthening of health systems and a comprehensive approach to risk-factor reduction may help in addressing these inequalities.

### Disease surveillance

Oral cancer needs to be integrated in routine disease surveillance used for other cancers, including specialized oral cancer registries. Capacities in oral pathology and histological diagnosis need to be strengthened.



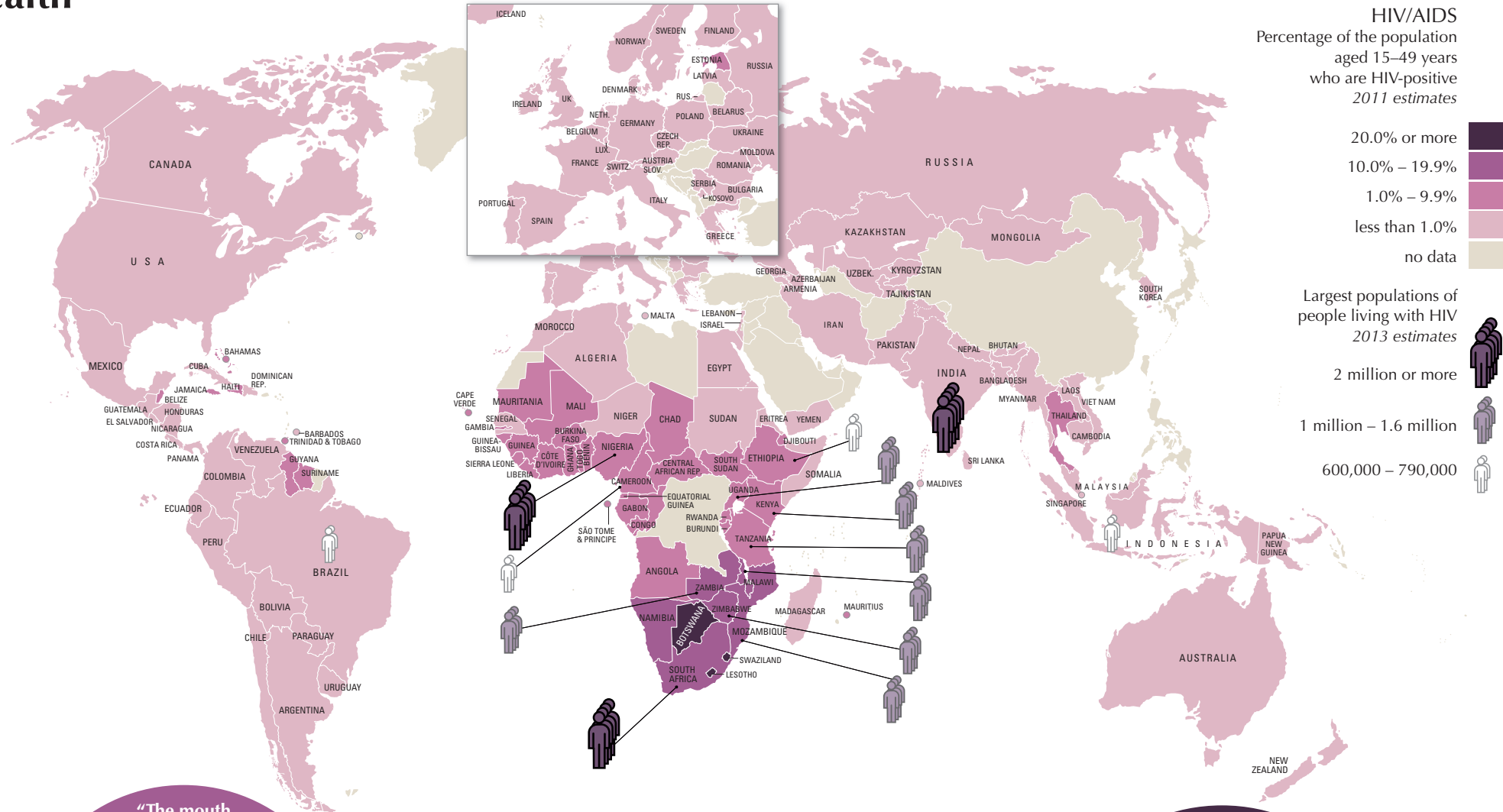
# HIV/AIDS and oral health

**First signs of HIV infection often appear in the mouth and can seriously impact quality of life and nutrition. The involvement of oral health professionals in effective multi-disciplinary care is essential.**

Globally, 35 million people were estimated to live with HIV-infection in 2013, many of whom were surviving thanks to life-saving Highly Active Antiretroviral Therapy (HAART). More than half of HIV-positive people develop oral symptoms early in the course of the disease, including fungal, bacterial and viral infections; severe periodontitis; hairy leukoplakia; warts; dry mouth; Kaposi sarcoma; and lymphoma. These can all cause pain and discomfort, leading to difficulty in chewing, swallowing and tasting food, which has significant negative impacts on quality of life.

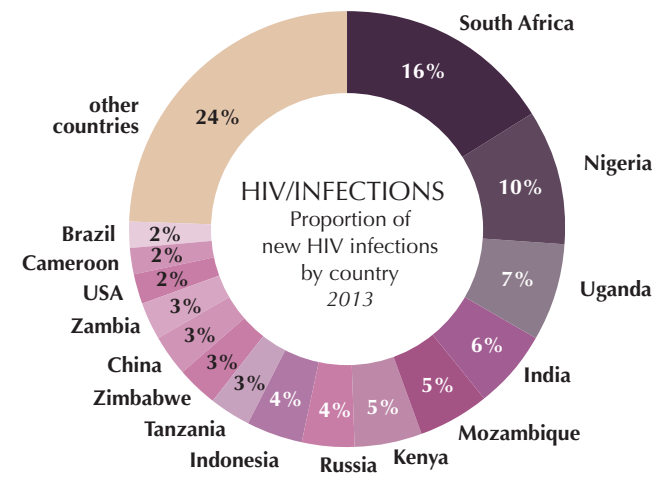
Those with HIV/AIDS continue to experience social stigma and discrimination. Dentists and other oral healthcare professionals have an obligation to provide ethical, equitable care to all patients, irrespective of their HIV status. HIV-related oral lesions can be used to diagnose HIV infection, monitor the disease progression, predict immune status and contribute to timely therapeutic intervention. The treatment and management of oral HIV lesions can considerably improve quality of life and wellbeing. Dentists and oral healthcare professionals can also ensure that patients with oral manifestations are referred for testing of HIV/AIDS, have appropriate medical follow-up, and are monitored for compliance with HAART.

Healthcare providers can enhance surveillance of oral lesions associated with HIV infection by conducting a simple, quick and inexpensive oral examination as part of patient care. This can be the first step in detecting, preventing and treating this life-threatening disease. Working together as a team, health professionals from different backgrounds can effectively address the needs of people and communities they care for.



**“The mouth can reveal so much about overall health and disease, notably HIV infection, mandating regular, thorough oral soft-tissue exams by appropriate professionals. As well as showing features of HIV infection in the form of a number of lesions...the mouth can be a useful way to test for HIV infection through saliva-based assays.”**

*John S. Greenspan, Oral Pathologist/AIDS Expert, 2015  
Deborah Greenspan, Oral Medicine Specialist/AIDS Expert, 2015*



**“My doctor advised me to test for HIV, but I was terrified. The stigma surrounding HIV in [Botswana] is still so massive. Too many people still link HIV to witchcraft. Too many people think the virus is incurable. They don’t understand that HIV can be beaten with proper testing and the right kind of treatment. Yes, I am HIV-positive, but now that I can take my medicines I feel alive again.”**

*Paul Kebakile, Gaborone, Botswana, 2003*

# Noma

**Noma mainly affects children in Sub-Saharan Africa. It is a rapidly progressive, destructive and frequently lethal disease of poverty and neglect.**



**Top to bottom:** Acute case of noma; destruction resulting from noma; same patient after reconstructive surgeries.

Noma is a neglected disease mainly affecting children under six years old in Sub-Saharan Africa. It is characterized by rapidly progressing, severe gangrenous destruction of the soft and hard tissues of the mouth and face. Though rare, it devastates the lives of those affected. If left untreated, 70 to 90 percent of affected children die.

Survivors suffer lifelong disfigurement and are often left unable to speak or eat due to massive tissue destruction. The condition carries significant social stigma for victims and their families, increasing the risk of poverty for the household.

Poverty and malnutrition are the main risk factors for noma. Other predisposing factors include poor oral hygiene and diseases such as HIV, malaria and measles. The highest disease burden occurs in Burkina Faso, Mali, Niger, Nigeria, Senegal and Ethiopia, which are collectively labelled 'the noma belt of the world'.

High mortality rates and the lack of reliable documentation mean that accurate epidemiologic data are lacking. If diagnosed at an early stage, simple and effective treatment is possible. However, cases are often advanced by the time they present. If they survive, patients require costly and complex surgery and this is often unavailable. Informing population groups at risk, especially mothers, about the disease is vital if early detection and prevention are to be achieved.

The WHO Regional Programme for Noma Control, coordinated by the Regional Office for Africa, supports governments in developing national strategies against noma, initiating capacity-building interventions, and implementing public-awareness campaigns.

Preventive efforts addressing extreme poverty, malnutrition, and childhood diseases must be political priorities for the eradication of noma. This has been recognized by the UN Human Rights Council, which has urged member states to better protect the human rights and the right to food for children.

**"More than a disease, noma is a tragedy. As a problem confronting public health, WHO strongly believes that it belongs to the political agenda of affected countries. But it goes further still, as an issue that transgresses the boundaries of human rights and equity."**

*Matshidiso Moeti,  
WHO Regional Director for Africa,  
2012*

**"The eradication of noma needs concerted efforts to alleviate poverty, promote improved nutrition of both pregnant women and infants, and help to teach parents to recognize early signs of the disease."**

*Geneva Study Group on Noma,  
2013*

## ESSENTIAL ACTIVITIES IN ENHANCING DETECTION AND MANAGEMENT OF NOMA

With appropriate prevention, awareness and early interventions noma can be effectively prevented. The WHO Regional Office for Africa is coordinating the Regional Programme for Noma Control and provides technical support to eight countries in the African

region. International NGOs, many of them members of the NoNoma Federation, are involved in collaboration with the Ministries of Health of countries affected in prevention, care and rehabilitation of noma patients, as well as resource mobilization.

Support comprehensive measures that contribute to reducing poverty, malnutrition and other environmental and behavioural risk factors of noma for children.



Strengthen early detection of noma cases based on integrated community health strategies.



Provide rapid and appropriate primary care for patients with early stages of noma.



Ensure referral of patients with advanced noma to specialist care.



Strengthen integrated surveillance systems through documentation and reporting of noma cases.



# Congenital anomalies

**Cleft lip and/or palate are the most frequent birth defects of the face and mouth, creating a heavy burden in terms of mortality, disability, quality of life and financial cost.**

Congenital anomalies of the face and mouth are frequent, with cleft lip and/or palate (orofacial clefts – OFC) accounting for two-thirds of the total. Clefts occur either alone (70 percent) or as part of a syndrome, affecting more than 12 in 10,000 newborns worldwide. For example, in India alone it is estimated that approximately 100 babies with clefts are born every day and the majority of these infants do not survive; in the USA a baby with a cleft is born every 75 minutes.

Less serious but more prevalent genetically determined conditions, such as malocclusion, occur in around 50 percent of the world's population. Other minor congenital dental anomalies, such as hypodontia (missing teeth) and extra teeth, have a general population incidence of up to 20 percent, and 2–3 percent respectively.

Although genetic predisposition is an important factor for congenital anomalies, other modifiable risk factors also play a role. Poor nutrition, smoking, alcohol and obesity during pregnancy are all documented additional risk factors, highlighting the importance of preventive

policies and counselling services, especially targeting future mothers.

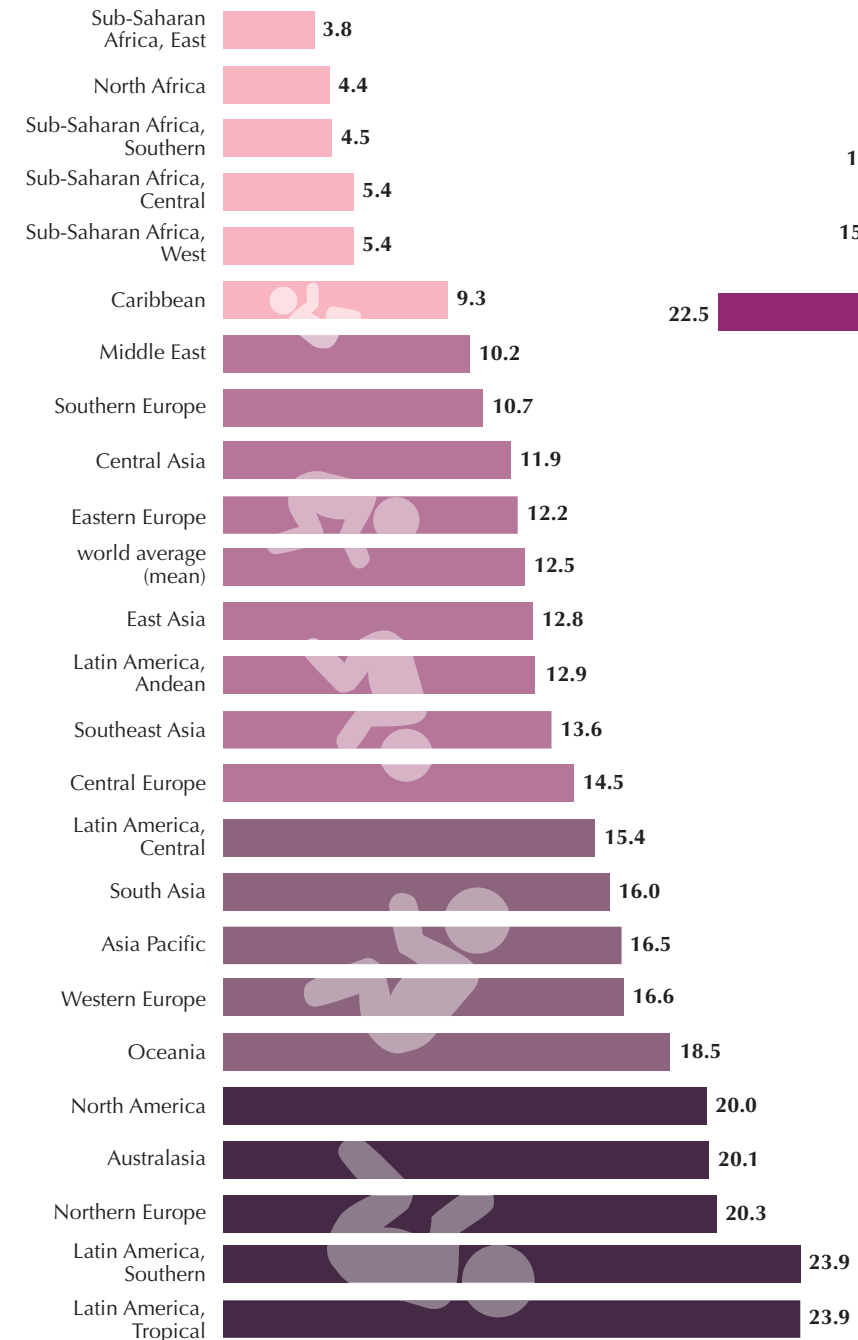
Restoring normal eating, speaking and appearance in patients with cleft lip and/or palate is possible and can avoid social stigma, but it requires early multi-disciplinary interventions. Specialist nursing, plastic surgery, paediatric dentistry, speech therapy, orthodontics, genetics and psychological services are all important for complete rehabilitation of patients with such anomalies. Many of these services are not available in low- and middle-income countries, although in some places specialized NGOs assist in providing at least the primary surgery. Cleft surgery was recently included in the list of cost-effective essential surgery services recommended by WHO.

The direct cost of cleft care in the USA is estimated at around US\$200,000 per patient, and the annual global cost of care for 175,000 patients would be US\$35 billion. Including the indirect costs would probably double the financial burden that adds to the tremendous psychological burden for the patient and families affected.

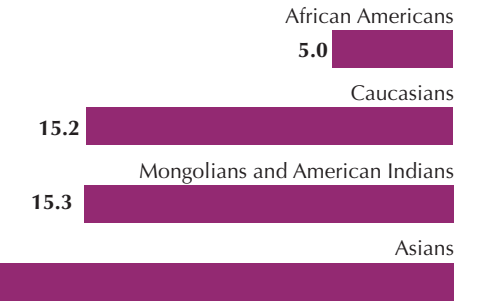
**“Lack of access to advice and surgical provision can result in death of the child or commit an otherwise healthy individual to lifelong disfigurement and functional impairment, as well as educational and social exclusion.”**

*Sarah Hodges,  
Paediatric Anaesthesiologist,  
2009*

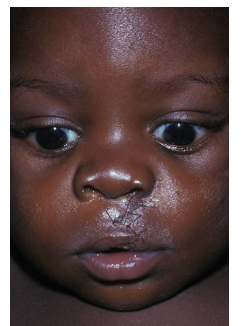
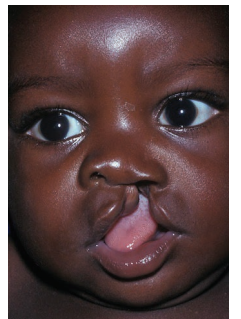
**GEOGRAPHICAL PREVALENCE OF OROFACIAL CLEFTS**  
Per 10,000 births  
by region  
2010



**ETHNIC DIFFERENCES IN INCIDENCE OF OROFACIAL CLEFTS**  
Incidence per 10,000 live births  
for different ethnic groups from 17 countries  
2006



**TREATMENT OF OROFACIAL CLEFTS**  
If lip and palate clefts are properly treated by surgery, complete rehabilitation is possible.



RECOMMENDATIONS

**POLICIES TO IMPROVE TREATMENT OF CONGENITAL ANOMALIES**

- 1 Strengthen national registries for birth defects and OFC, as they are crucial for planning services and evaluating primary preventive interventions.
- 2 Encourage combined efforts in essential healthcare, primary prevention and education to improve access to care for children with OFC.
- 3 Require a more comprehensive approach for NGOs involved in care for OFC, which goes beyond primary surgery services.
- 4 Ensure that primary prevention takes account of genetic and environmental factors if the causes of OFC are to be addressed effectively.
- 5 Ensure that primary prevention and essential surgery services for birth defects (including OFC) are available in the context of integrated healthcare.

# Oral trauma

**Oral trauma is common and can be prevented by improving public health policies and raising awareness of risks related to violence, sports and road safety.**

Oral injuries account for 5 percent of all injuries, and craniofacial trauma is responsible for about half of the estimated total 8.5 million trauma deaths worldwide. They include fractures of the jaws and other facial bones, as well as fractures, dislocations and loss of teeth. Risk factors include traffic and bicycle accidents, falls, physical violence, contact sports and tongue and lip piercings. Oral injuries have significant physical, psychosocial and economic impacts and are a major public health problem, particularly affecting children and young adults.

Craniofacial injuries are often complex and occur together with other bodily injury, requiring costly and time-consuming treatment. Approximately half of all trauma involving permanent teeth requires dental treatment. The annual direct treatment costs of dental trauma in Denmark have been estimated at US\$2–5 million/million population.

Prevention of oral injuries is important, and improving the safety of the environment is a key element. Improving road safety, and introducing helmets, facemasks and mouthguards are important measures in reducing the frequency and severity of dental and craniofacial trauma.

Violence and child abuse are important causes of oral injuries and have serious, lifelong consequences. Dentists may be the first or only point of contact for victims in a healthcare setting. Oral health professionals should therefore be able to recognize signs of abuse, which commonly affect the head, neck or face. Awareness and education on these matters needs to be strengthened, and oral health professionals made aware of their legal and ethical responsibility to report cases of abuse.

**“The bottom line is that domestic violence is a very difficult issue. We have to be able to train and educate our future generation of healthcare providers on the role dentistry plays in this very serious public health issue.”**

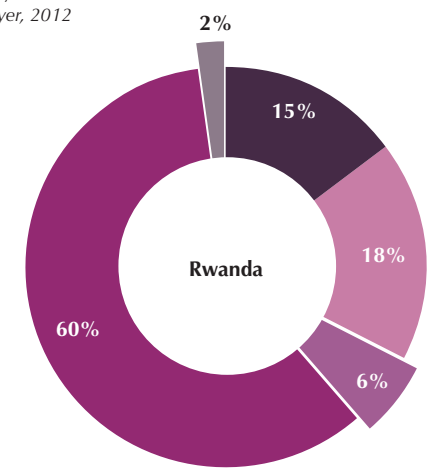
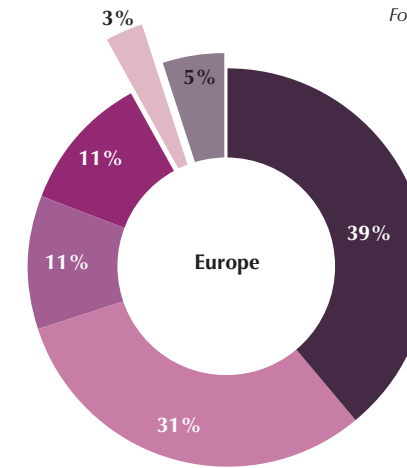
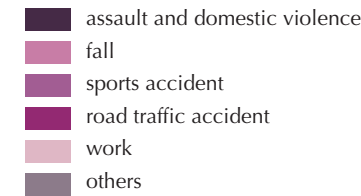
*Leslie Halpern, Oral and Maxillofacial Surgeon, 2008*

## RECOMMENDATIONS POLICIES TO PREVENT AND REDUCE SEVERITY OF ORAL TRAUMA

- 1 Enforce regulations to increase road safety through the mandatory use of seat belts, child seats, motorcycle and bicycle helmets, and the prevention of drunk-driving.
- 2 Implement appropriate strategies to reduce violence and bullying at school.
- 3 Enforce the mandatory use of helmets or mouthguards to improve safety for contact sports.
- 4 Strengthen the role of dentists in diagnosing trauma as a result of violence and child abuse.
- 5 Ensure appropriate emergency care for improved post-trauma response.

## MAIN CAUSES OF ORAL TRAUMA

Comparison of Europe and Rwanda  
Europe 2014, Rwanda 2003



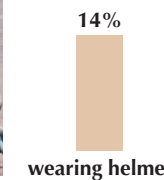
**“Dental injuries happened quite often during my hockey career. The most serious was when I received a cross check directly to the teeth ... The team dentist looked at me then proceeded to place a tongue depressor behind my front teeth and pull them back ... From that day on I started to wear a mouthguard and would never get on the ice without it.”**

*Mike Bossy, Former NHL Player, 2012*



## MAXILLOFACIAL FRACTURES FROM MOTORCYCLE ACCIDENTS IN KERALA, INDIA

Incidence of fractures in motorcyclists wearing or not wearing helmets  
2014



wearing helmet



53%



not wearing helmet





Oral diseases, like all other diseases, share a wide range of risk factors. Some, such as age, sex and hereditary conditions, are intrinsic to the individual and cannot be changed or modified. Others, which are subject to behaviours and lifestyle, are considered to be modifiable risk factors, because individual action and modification of a particular habit or behaviour is possible. In reality, this change may be difficult to achieve without additional supportive interventions. The modifiable risk factors of oral diseases include an unhealthy diet, particularly one high in sugar, tobacco use, and unhealthy alcohol consumption. These key risk factors are also shared with most of the other major NCDs. This chapter details all of these key risk factors, highlights their damaging potential and shows the magnitude of their impact on oral health on a global scale. Specific recommendations to curb these risks from a public health and population perspective are provided.

As an illustration, the risk for oral cancer is increased 15-fold when alcohol and tobacco consumption are combined. Tobacco use is implicated as the cause of 50 percent of periodontal disease. Free sugars are the main cause of tooth decay in children and adults. Moreover, several major risk factors occur together in the same group of individuals. For example, smokers are more prone to eat a diet high in fats and sugars and low in fibre, and to exercise less than non-smokers. Additionally, alcohol and smoking frequently go hand-in-hand. Such individual behaviours and lifestyle choices not only have a negative influence on oral health, but they very often also impact the overall quality of life.

A range of external factors that can be mitigated to only a small extent by individual

behaviours also determine oral health. These determinants include poor living conditions, low education, unemployment, limited access to safe water and sanitary facilities, and limited access to oral healthcare. General socioeconomic, cultural and environmental conditions also affect individuals' oral health, but these are beyond the influence of any given individual. Tobacco control legislation and water fluoridation programmes are examples of so-called 'upstream' measures to address such factors. Across the whole social gradient, from the richest to the poorest, those in lower positions suffer worse health and poorer access to appropriate care than those immediately above them. In all societies the poorest have the worst health, the worst access to care and the worst health outcomes. These inequalities can be observed both between and within regions and countries.

All too often, approaches and policies focus on changing individual behaviour, particularly with regard to so-called lifestyle choices. However, all our choices are strongly influenced by many factors, including socioeconomic circumstances and social norms. Consequently, strategies based on the lifestyle approach are often of limited effectiveness and may even increase the very health inequalities they were designed to reduce.

Tackling risk factors should always take the broader determinants of risk behaviour into account and try to address these underlying reasons, as a basis for supporting individuals to adopt healthier behaviour. The principle of the Ottawa Charter for Health Promotion applies perfectly here: Making the healthier choice the easier choice!

## Social determinants and common risk factors

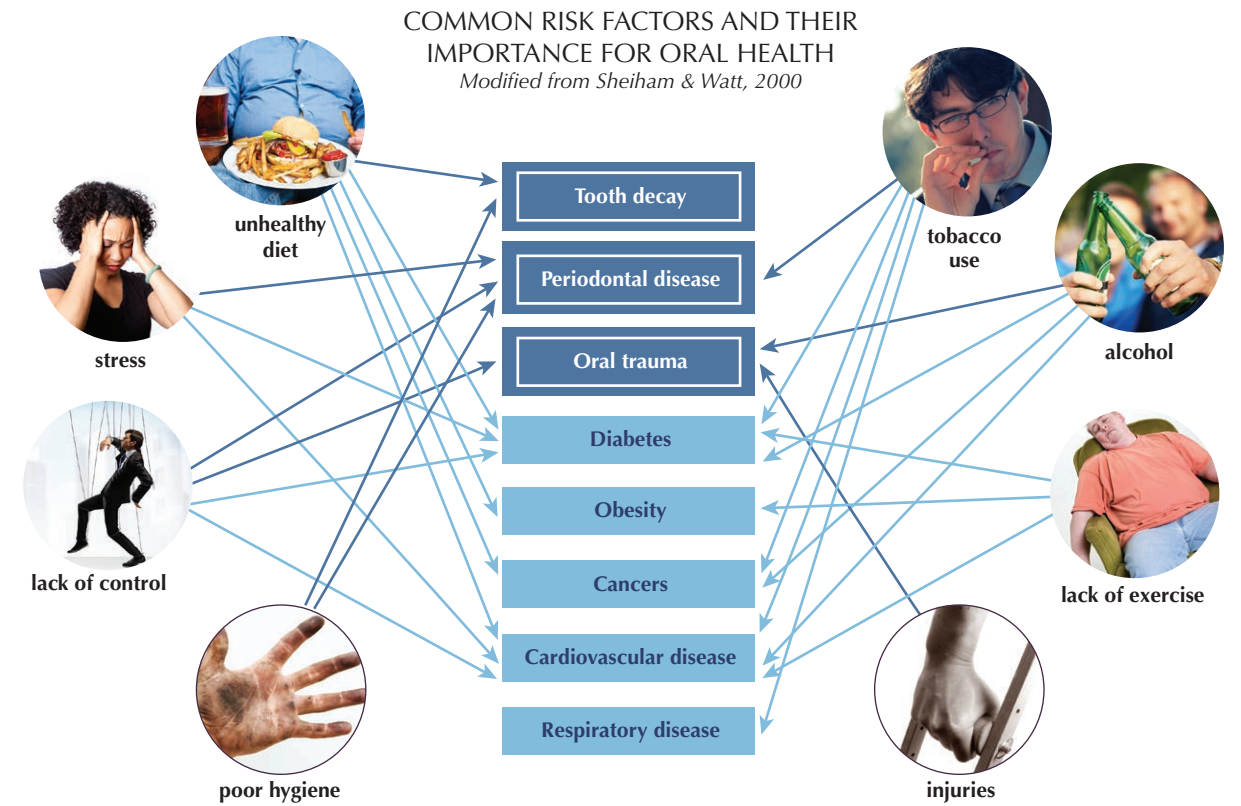
Both the general and oral health of whole populations are largely determined by social factors and their interaction with a set of common risk factors, namely sugar, tobacco, alcohol and poor diet.

All major NCDs, including most oral diseases, share the same social determinants and a small number of common risk factors – sugar, tobacco, alcohol and poor diet – which are considered on the following pages. These shared risk factors provide the conceptual basis for the Common Risk Factor Approach, which is one of the most important concepts for oral disease prevention. At the same time it paves the way for the close integration of oral health into strategies addressing NCDs.

The social determinants of health are the circumstances into which people are born, grow, live, work and age. These circumstances, which largely determine the behaviours people adopt and the choices they make, are in turn shaped by a wider set of forces: economics, social policies, education, politics

and many more. The unequal distribution of all these determining factors accounts for the persisting and growing global differences in health status and disease burden. These inequalities in general and oral health within and between populations pose significant challenges for policy makers and those in public health.

Prevailing interventions that focus on modifying health behaviours and lifestyle choices have only limited success and have been criticized because they ignore the wider social influences that determine these choices. Only a broader integrative strategy that takes account of the common risk factors and the root determinants of health will result in fair and equitable approaches to promoting better oral health and general health.

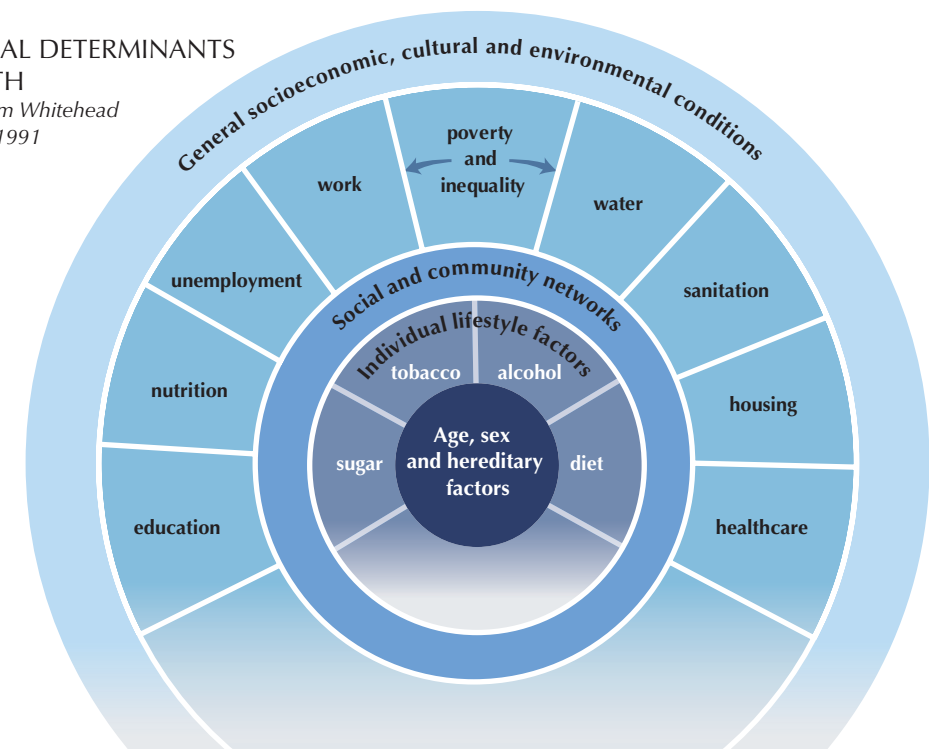


### RECOMMENDATIONS POLICIES TO ADDRESS SOCIAL DETERMINANTS

- 1 Support approaches aimed at reducing poverty, increasing social inclusion, improving the general levels of education and employment, reducing barriers to healthcare, promoting affordable housing, safe water and sanitation, and protecting minority and vulnerable groups for sustainable improved health and oral health status.
- 2 Systematically include health and oral health in all policies to reduce negative effects from policy decisions made in other sectors on health equity and contribute to increasing synergies for better health status of populations.
- 3 Maximize opportunities to work effectively across disciplines and sectors to reduce inequalities in social determinants and people's health.
- 4 Target resources to address health inequalities and support those with the greatest and more complex needs to reduce inequalities.
- 5 Enforce measures reducing exposure to risk factors to health and oral health through the regulation of unhealthy foods and the reduction of tobacco and alcohol use.

### THE SOCIAL DETERMINANTS OF HEALTH

*Modified from Whitehead & Dahlgren, 1991*



# Sugar

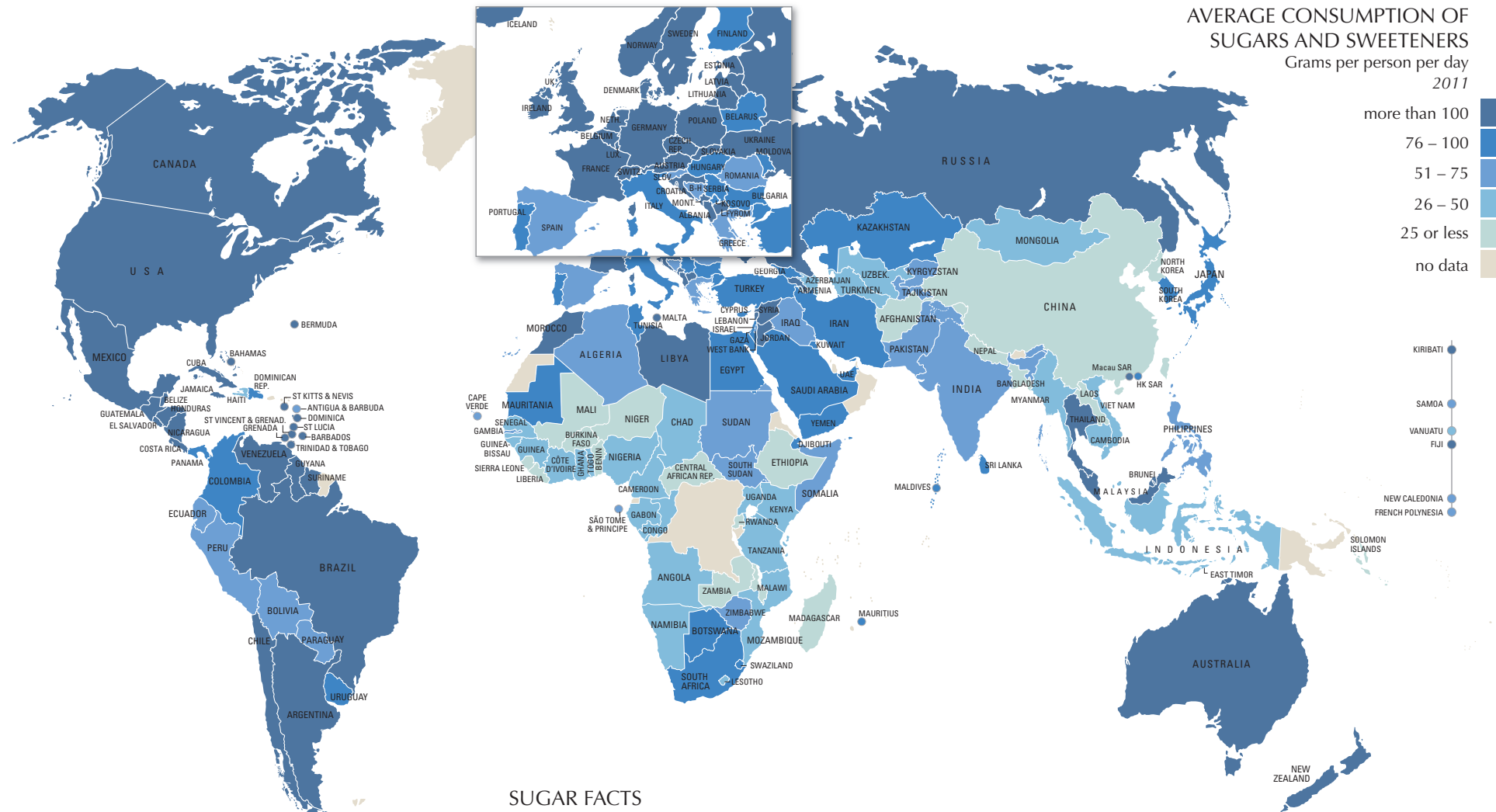
**Sugar is a leading risk factor for tooth decay. Reducing its consumption as part of a healthy diet promotes better oral health and may reduce diabetes, obesity and other NCDs.**

Sugars are part of the bigger family of sweeteners – substances that are either naturally part of or added to food and drinks and create the sensation of sweetness. They are an important, essential source of daily energy intake, but their excessive consumption has severe consequences. As part of a high-calorie diet, they have increasingly been recognized as causes for major NCDs such as diabetes and obesity.

The nomenclature used for sugars and sweeteners is complex. Free sugars – all sugars added to foods by the manufacturer, cook or consumer, plus sugars naturally present in honey, syrups and fruit juices – are the only cause of tooth decay in children and adults. Sugar consumption shifts the healthy mix of bacteria present in the mouth towards bacteria that convert sugars into the acids that demineralize tooth enamel. Repeated episodes of sugar intake throughout the day increases the frequency of acid attacks and the risk of developing tooth decay.

Sugar consumption is influenced by many biological, behavioural, social, cultural and environmental factors. Worldwide consumption has tripled over the past 50 years, and this increase is expected to continue, particularly in emerging economies. To curb the growing epidemic of tooth decay and other NCDs, WHO recommends limiting the daily consumption of free sugars to 5 percent or less of total energy. This is equal to 25 grams or 5 teaspoons of sugar per day.

A number of measures are being explored to reduce global sugar consumption. These include additional taxes on products with high sugar content, reducing the overconsumption of sugar-sweetened beverages, limiting sugar content of foods and drinks, introducing regulations for transparent labelling of food ingredients, and constraining the marketing to children and adolescents of food high in sugars.



## RECOMMENDATIONS

### POLICIES FOR SUGAR REDUCTION

- 1 Enforce higher taxation on sugar-rich food and sugar-sweetened beverages.
- 2 Ensure transparent food labelling for informed consumer choices.
- 3 Strongly regulate sugar in baby foods and sugar-sweetened beverages.
- 4 Limit marketing and availability of sugar-rich foods and sugar-sweetened beverages to children and adolescents.
- 5 Provide simplified nutrition guidelines, including sugar intake, to promote healthy eating and drinking.

### SUGAR FACTS

Sugar consumption	WHO-recommended daily sugar intake for children and adults	Sugar content per 100g of various foods
<p>Average sugar and sweetener consumption per person per day in 2011:</p> <p>109g global</p> <p>166g USA</p>	<p><b>Strong recommendation</b></p> <p>No more than 10% of total energy intake: ~50g or 10 teaspoons.</p> <p>10%</p>	<p>Chocolate-coated biscuits <b>45.8g</b></p> <p>Frosted cornflakes <b>37g</b></p> <p>Tomato ketchup <b>27.5g</b></p> <p>Stir-in sweet and sour sauce <b>20.2g</b></p> <p>Salad cream <b>16.7g</b></p> <p>Fruit yoghurt <b>16.6g</b></p> <p>Coca-Cola <b>10.9g</b></p> <p>Sweetened fruit juice <b>9.8g</b></p>
<p>Only <b>19</b> countries consume less than <b>25g</b> per person per day.</p> <p>&lt;25g</p>	<p><b>Additional recommendation</b></p> <p>No more than 5% of total energy intake: ~25g or 5 teaspoons.</p> <p>5%</p>	
<p><b>65</b> countries consume more than <b>100g</b> per person per day.</p> <p>&gt;100g</p>		

# Tobacco

Globally, tobacco use is the leading preventable cause of death and disease, including oral conditions. Oral health professionals have an important role in reducing tobacco use.

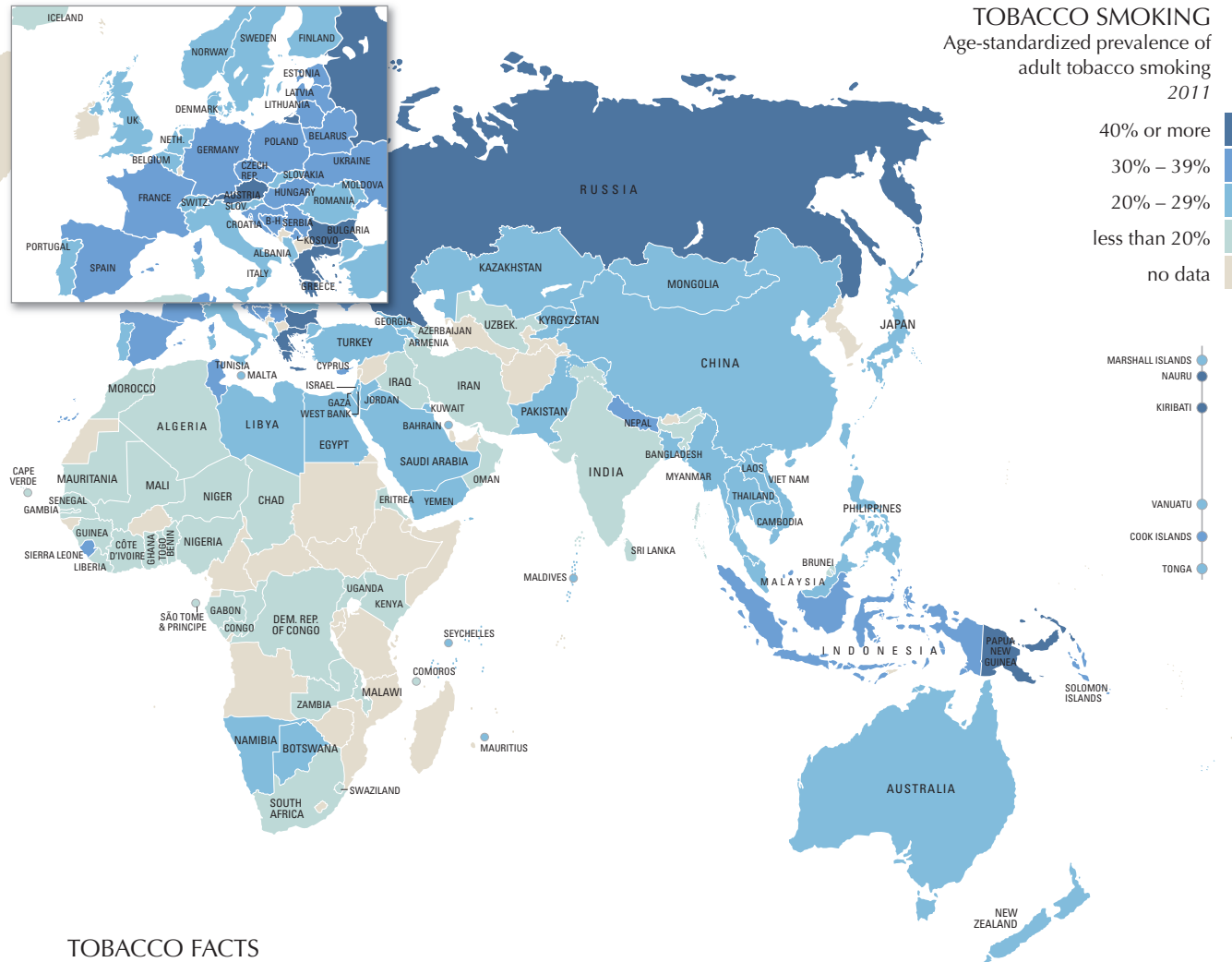
Tobacco use is the most common cause of preventable death globally. Cigarettes kill half of all lifetime users and in the 20th century tobacco use caused 100 million deaths. This number is expected to rise to 1 billion in the 21st century if smoking patterns remain unchanged. Moreover, exposure to secondhand smoke accounts for approximately 600,000 deaths each year. Additionally, smokeless tobacco use is a growing global problem.

Tobacco use is a major global public health threat for all countries, and no form of tobacco use is safe; yet tobacco is grown in more than 120 countries. In 2013, more than 6 trillion cigarettes were consumed by almost 1 billion smokers. More than 300 million people use smokeless tobacco in over 75 countries. Smokeless tobacco is particularly dangerous for oral health, since it comes in direct contact with the tissues of the oral cavity.

There are a number of effective approaches to reduce tobacco use. The WHO's Framework Convention on Tobacco Control provides a legal binding outline of effective policies to curb global tobacco use. Policies that create smoke-free areas, increase tobacco taxes and increase the retail price of tobacco are the most effective in reducing tobacco use.

Strict and coherent regulation at all levels of tobacco production and use, from growing the plant to disposal of waste, has the potential to decrease consumption rates and promote cessation. Comprehensive tobacco control programmes that promote cessation through population-based interventions give governments the opportunity to decrease tobacco-related morbidity and mortality.

Dentists and the dental team can be effective in helping patients to reduce or quit tobacco consumption, and should be a role model and refrain from using tobacco themselves.



TOBACCO SMOKING  
Age-standardized prevalence of adult tobacco smoking 2011

40% or more  
30% – 39%  
20% – 29%  
less than 20%  
no data

MARSHALL ISLANDS  
NAURU  
KIRIBATI  
VANUATU  
COOK ISLANDS  
TONGA

RECOMMENDATIONS

POLICIES FOR TOBACCO CONTROL

WHO MPOWER recommendations for effective tobacco control:

- 1 Monitor tobacco use and prevention policies.
- 2 Protect people from tobacco smoke.
- 3 Offer help to quit tobacco use.
- 4 Warn about the dangers of tobacco.
- 5 Enforce bans on tobacco advertising, promotion and sponsorship.
- 6 Raise taxes on tobacco.

*“Raising taxes on tobacco is the most effective way to reduce use and save lives. Determined action on tobacco tax policy hits the industry where it hurts.”*

Margaret Chan,  
WHO Director-General, 2014

TOBACCO FACTS

Tobacco use	Types of tobacco use	Effects of tobacco on oral health
<p><b>800</b> million men smoke. <b>200</b> million women smoke.</p> <p><b>600,000</b> individuals die each year from secondhand smoke: <b>156,000 men</b>, <b>281,000 women</b> and <b>166,000 children</b>.</p> <p>At least <b>300 million</b> people use smokeless tobacco and <b>90%</b> of these are in Southeast Asia.</p> <p>In 2011, manufacturers spent about <b>US\$9.5 billion</b> on advertising cigarettes and smokeless tobacco.</p> <p>Governments spend less than <b>US\$1 billion</b> on tobacco control each year.</p>	<p><b>Smoking</b></p> <p>cigarettes</p> <p>bidis</p> <p>kreteks</p> <p>pipes</p> <p>cigars</p> <p>waterpipes</p> <p><b>Smokeless</b></p> <p>snuff, dry and moist</p> <p>chewing tobacco</p> <p>snus</p> <p>dissolvables</p>	<p><b>Increases risk of:</b></p> <ul style="list-style-type: none"> <li>oral cancer</li> <li>smoker's palate</li> <li>periodontal disease</li> <li>premature tooth loss</li> <li>gingivitis</li> <li>staining</li> <li>halitosis (bad breath)</li> <li>loss of taste and smell</li> </ul>



# Alcohol

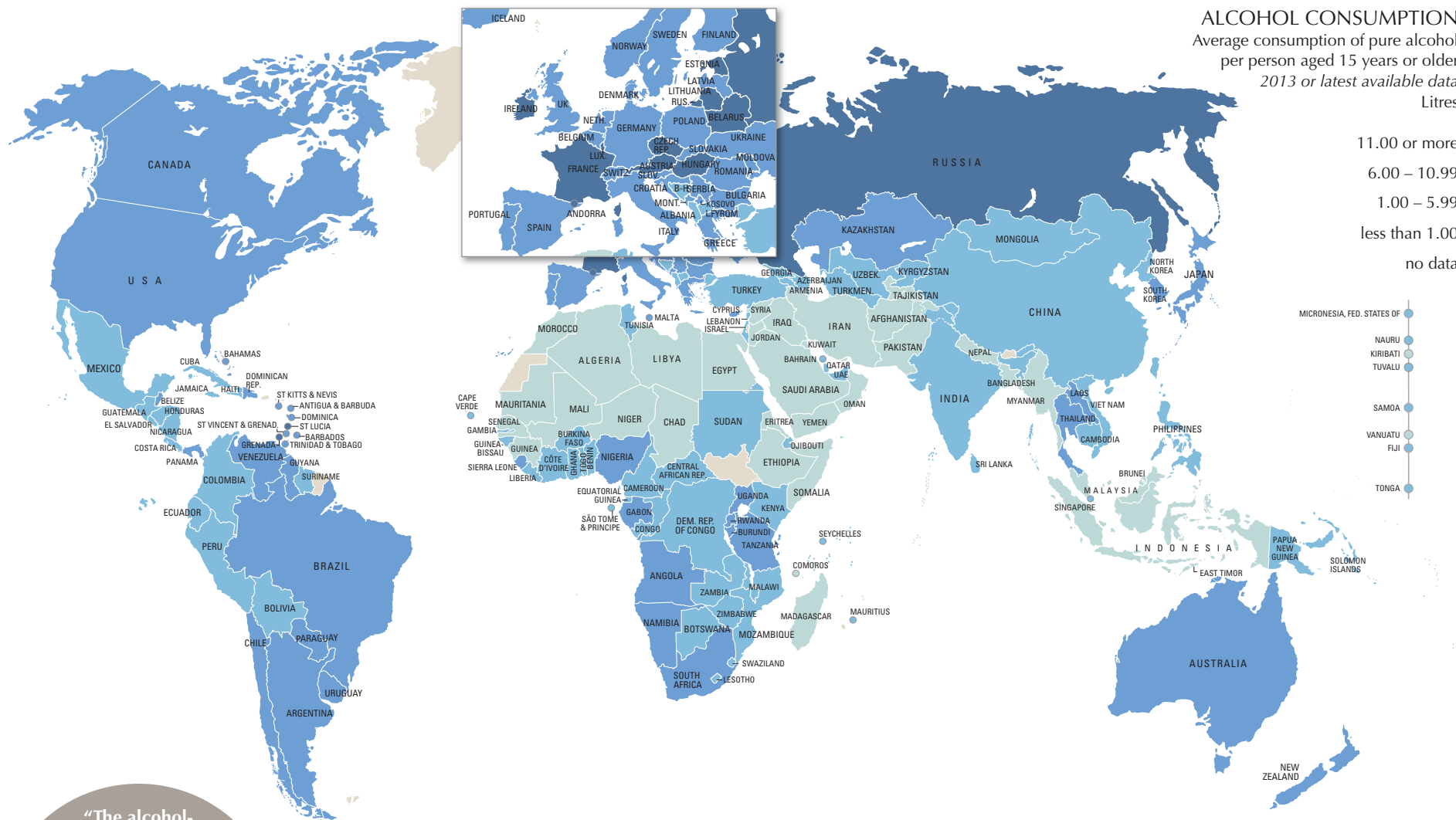
**Harmful use of alcohol is a major risk factor for more than 200 diseases, including oral cancer and periodontal disease, and must be addressed as part of a comprehensive approach to all NCDs.**

The consumption of alcohol has been an integral part of many cultures for millennia. Today, the harmful use of alcohol is at high levels and it results in a significant health, social and economic burden on societies.

Alcohol is the third leading risk factor for disability in the developed world, after tobacco use and hypertension. Its use is associated with more than 200 diseases, including oral diseases. Alone or in combination with tobacco, it is a major risk factor for cancers of the mouth, larynx, pharynx and oesophagus, and it is associated with other oral diseases such as periodontal disease. Its use increases the risk of facial and dental injuries through falls, road traffic accidents or interpersonal violence. Furthermore, alcoholic drinks can be acidic and high in sugar, resulting in damage to teeth in the form of tooth erosion and tooth decay.

The abuse of alcohol during the early stages of pregnancy increases the risk of damage to the developing foetus. It has a direct effect on the cells that give rise to the structures of the mouth and teeth, resulting in abnormal facial growth that is one of the symptoms of foetal alcohol syndrome.

Strategies to curb alcohol use are ideally integrated with other common risk factors for NCDs. Approaches focus on availability and pricing of alcohol, and on prevention interventions and treatment in healthcare systems. Oral health professionals need to be aware of the harms that alcohol causes and to provide adequate advice and care to patients.



RECOMMENDATIONS

**POLICIES TO REDUCE HARMFUL USE OF ALCOHOL**

- 1 Implement effective measures that regulate alcohol availability, such as limiting hours and days of sale.
- 2 Enforce zero tolerance for drunk driving to reduce alcohol consumption and related traffic accidents.
- 3 Raise taxes on alcoholic beverages to effectively reduce consumption.
- 4 Enforce laws restricting sale to and purchase of alcohol by minors to tackle underage drinking.
- 5 Reduce exposure and incentives for alcohol consumption by regulating or banning alcohol advertising and promotion.

*“The alcohol-attributable disease burden as well as the social and economic burden may increase further unless effective prevention policies and measures based on the best available evidence are implemented world-wide.”*

*Oleg Chestnov, WHO Assistant Director-General for Noncommunicable Diseases and Mental Health, 2014*

**ALCOHOL FACTS**

Alcohol consumption	Impact of alcohol on general health	Impact of alcohol on oral health
Globally, harmful use of alcohol causes approximately <b>3.3 million</b> deaths every year.	Alcohol is the <b>third leading risk factor for disability</b> in developed countries.	Alcohol and tobacco are major risk factors for <b>cancers</b> of the mouth, larynx, pharynx and oesophagus, and for <b>periodontal disease</b> .
<b>Global average</b> adult annual consumption in 2010: <b>6.2 litres</b> of pure alcohol.	<b>Alcohol abuse</b> in the early stage of pregnancy can cause <b>abnormal facial growth</b> in the foetus.	<b>Excessive consumption</b> of alcohol can lead to <b>injury</b> , often to the <b>mouth</b> and <b>teeth</b> .
<b>5.1%</b> of the global burden of disease is attributed to alcohol consumption.		The acidity and high sugar content of alcoholic drinks can cause <b>tooth erosion</b> and <b>decay</b> .

# Diet

**A healthy diet, low in sugar, salt and fat, and high in fruit and vegetables contributes to reducing the risk of oral diseases, obesity and other NCDs.**

Socioeconomic development, urbanization and rapid globalization have led to major changes in the way we produce, store, prepare and consume food. Despite achievements in reducing global hunger, many countries still face high rates of undernutrition and malnutrition, which especially affect the development of children and their chances in life. 100 million under-fives worldwide are underweight. At the same time, rates of overweight and obesity are increasing steadily, challenging societies and health systems with a growing burden of lifelong diseases, including diabetes, cardiovascular diseases and cancer. Worldwide, 52 percent of adults over 18 are either overweight or obese, a figure that has doubled since 1980. Moreover, malnutrition – deficiencies of essential micronutrients and vitamins, such as vitamin A, iron or iodine – causes serious diseases that can coexist with overnutrition or undernutrition.

Nutrition and oral health are closely linked. High sugar intake is directly related to tooth decay, and untreated tooth decay has strong associations with low BMI in children. Extended periods of micronutrient deficiencies can lead to serious oral symptoms. Under- and malnutrition are co-factors for noma.

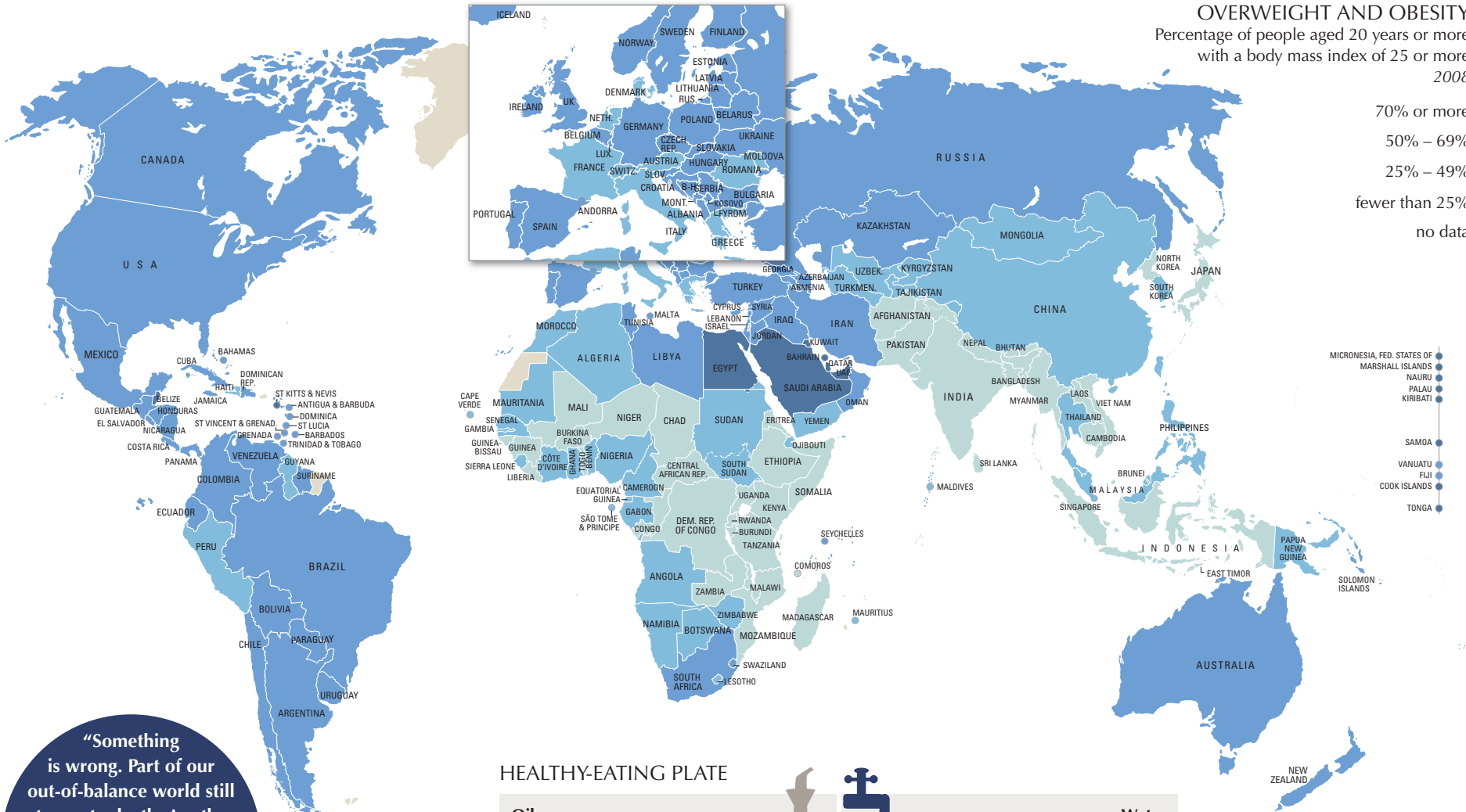
A healthy and balanced diet is thus essential for growth and healthy body functions. Many countries provide nutrition guidelines defining recommended daily intake for different food categories. The 'healthy-eating plate' concept takes into account variation in recommendations between countries and cultures, and focuses on the basic principles of variety, proportions and frequency of consumption of respective food categories.

Oral health professionals have an important role in addressing NCDs and oral diseases, particularly obesity and tooth decay, by promoting healthy eating. Transparency in food labelling

and encouraging healthy consumer choices are among key policy strategies, as well as regulating the advertising of energy-rich foods to children, and restricting their availability in school settings.

**"Something is wrong. Part of our out-of-balance world still starves to death. Another part stuffs itself into a level of obesity so widespread that it is pushing life-expectancy figures backwards."**

*Margaret Chan, WHO Director-General, 2014*



**RECOMMENDATIONS**

**POLICIES TO PROMOTE A HEALTHY DIET**

- 1 Restrict sales of unhealthy foods and drink; increase taxation on both, and limit their serving sizes and availability.
- 2 Enforce systematic consumer-friendly food-labelling regulations to facilitate informed food choices.
- 3 Implement integrated approaches to nutrition counselling by addressing general health aspects and those linked with oral health.
- 4 Ban sugar-sweetened beverages and unhealthy snacks in schools and make healthy meal options available.
- 5 Promote the use of natural and indigenous products with good nutritional values over the use of processed food.

**HEALTHY-EATING PLATE**

**Oil**  
Healthy oils such as olive oil are recommended. Trans fats should be avoided.

**Water**  
Water, tea or coffee (with little or no sugar) are the recommended main sources of liquid. Sugar-sweetened beverages should be avoided.

**Vegetables/Fruits**  
WHO recommends a minimum of five servings of fruits and vegetables every day.

**Whole Grains**  
Staple starchy foods, preferably whole grain, should be the main source of daily energy intake.

**Healthy Protein**  
Fish, poultry, beans and nuts are preferable to red meat and processed meat.



Poor oral health impacts individuals in various ways: many conditions cause pain, affect quality of life, reduce school and work productivity; and the required care results in a significant financial burden to healthcare systems and those concerned.

Oral health is affected by a wide range of social determinants, which WHO defines as ‘the circumstances in which people are born, grow up, live, work and age’. In turn, these are influenced by wider socioeconomic and political circumstances. Oral health, like general health, is also characterized by a social gradient, with better health status at the top and a higher disease burden at the bottom of the gradient. This is a general phenomenon observed in all countries and across all populations within countries. This social gradient in health means that inequalities in general health and oral health affect everyone.

Striking examples of inequalities include the prevalence of tooth decay, which affects only 16 percent of Japanese aged 6 to 19 years, but 97 percent of 12-year-old Filipinos; edentulousness affects the poor much more than the rich; and the number of missed school days due to poor oral health is significantly higher for children from lower-income families, ethnic minorities and immigrants. Access to oral healthcare shows particularly strong

inequalities because of poor coverage in primary healthcare. For example, more than 40 percent of US residents must pay for their dental costs themselves, compared to 10 percent for physician consultations. Only about two-thirds of the world’s populations have access to adequate oral healthcare, with big differences between countries. This chapter illustrates the many dimensions of inequalities, describes their causes and their impacts.

**“The improvement in dental health, as with the improvement in general health, must be enjoyed by all in society. This worthy goal is unlikely to be achieved unless we put social justice at the heart of all decision making.”**

Michael Marmot,  
Professor of Epidemiology and Public  
Health at University College  
London, 2010

An essential entry point to improving oral health globally is therefore to address the social determinants of oral health. In this respect the Ottawa Charter for Health Promotion, with its focus on empowerment, provides an appropriate framework to bring about tangible change. A ‘bottom-up’ perspective and acquiring a better understanding of why people with lower socioeconomic position have more difficulties in looking after their own health may help to develop more responsive policies.

Approaches that promote equity in access and benefit, such as water fluoridation and school health programmes, are ways of providing environments conducive to better oral health. Other strategies include the enforcement of food policies, comprising transparent labelling of foods and restricting the availability of sugar-sweetened beverages in schools.

# Inequalities in oral health

**Socioeconomic status is a fundamental determinant of both oral and general health. Action to reduce oral health inequalities needs to address the underlying causes of disease.**

## Oral health status

Health inequalities refer to differences in health status, both within and between countries, that are deemed avoidable, unfair and unjust. Reducing health inequalities is now a global public health priority. Health inequality is not simply about differences between the rich and poor in society. As is the case in general health, a consistent stepwise social gradient exists for oral diseases – oral health steadily worsens in line with socioeconomic status.

This social gradient is a universal phenomenon across the life course, from early childhood to older age, affecting almost all oral diseases to a varying degree, such as tooth decay, periodontal disease and oral cancers. Social gradients can be observed in all countries and populations around the world. What causes this universal social patterning of oral disease? In

2008, WHO highlighted the underlying causes of inequalities as ‘social determinants – the conditions in which people are born, grow, live, work and age’.

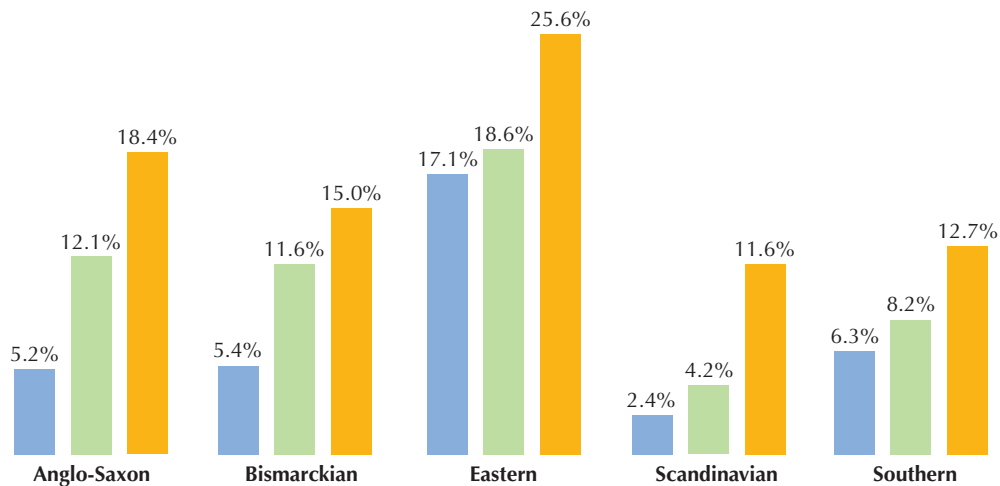
The social gradient in oral diseases has profound implications for policy. The traditional clinical ‘high risk’ approach to prevention fails to address the importance and impact of the broader determinants of health. Instead, action is needed to address the scope of underlying causes of poor oral health. Working in partnership across relevant sectors, agencies and professions using upstream, midstream and downstream strategies is essential. Dental teams and their national professional bodies have an important advocacy role in promoting policies to reduce health inequalities in the populations they serve.

## SOCIAL GRADIENTS OF EDENTULOUSNESS

Age-standardized prevalence among those aged 45 or older by occupation and welfare state regime 2013

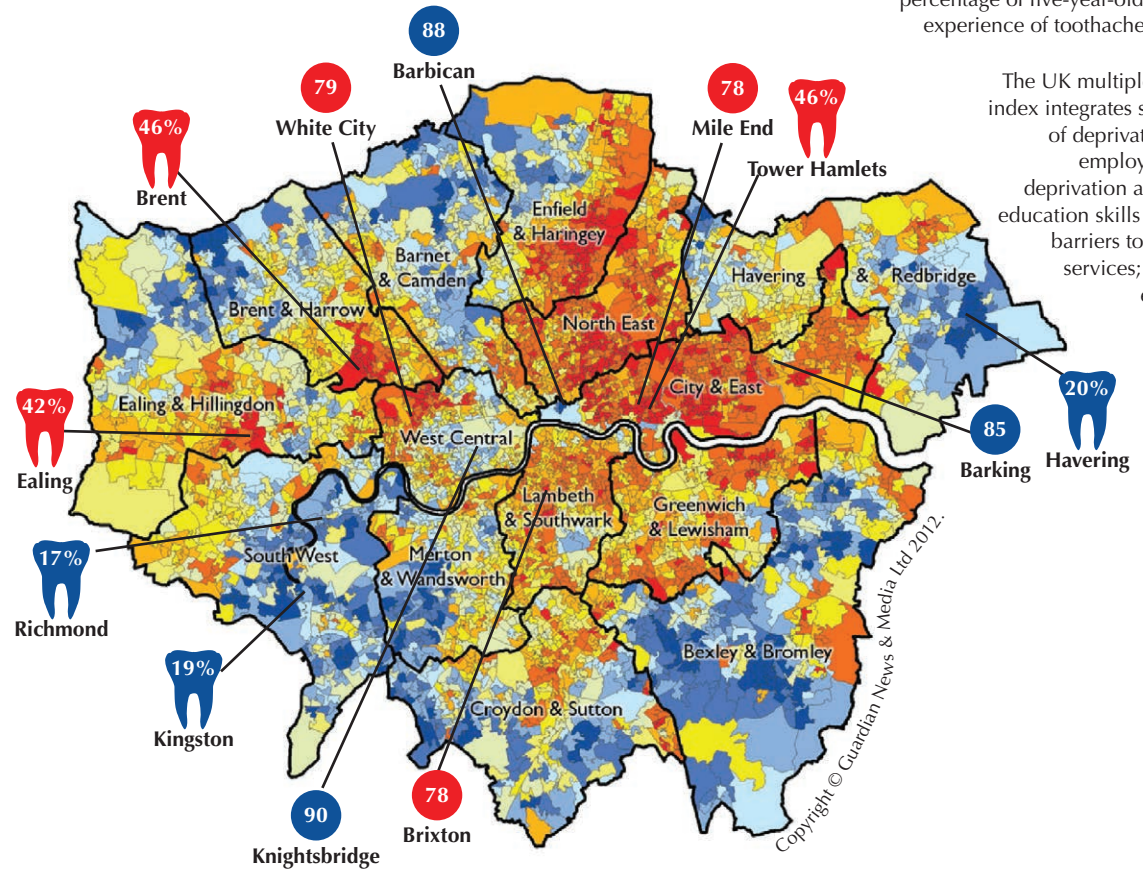
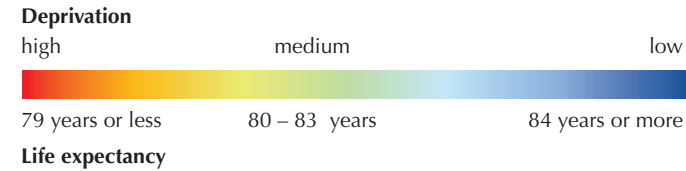
- manager and professionals
- intermediate
- manual workers

Levels of edentulousness show similar patterns in people with similar professional and education background, irrespective of the type of healthcare system in the country they live in. In surveys, edentulousness is always highest for manual workers and lowest for managers and professionals.



## INEQUALITIES WITHIN A RICH MEGA-CITY

Level of deprivation in London 2012

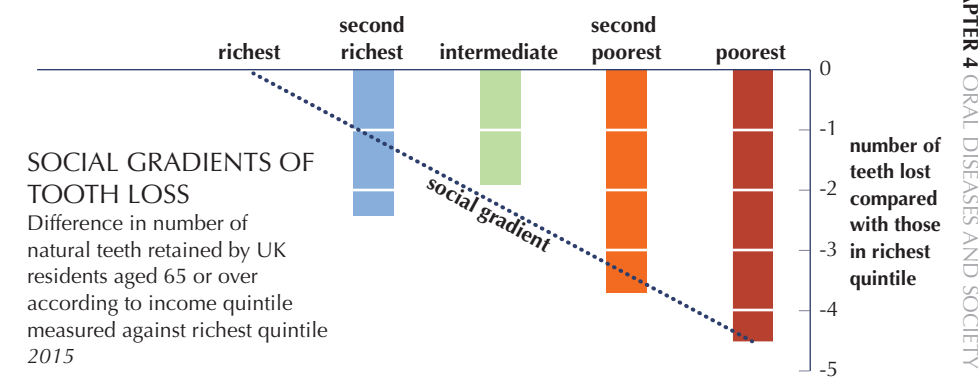


Compared with:

life expectancy at birth 2005–09 **00**

percentage of five-year-olds with experience of toothache 2012 **%**

The UK multiple deprivation index integrates seven aspects of deprivation: income; employment; health deprivation and disability; education skills and training; barriers to housing and services; crime; living environment.



# Inequalities in oral health

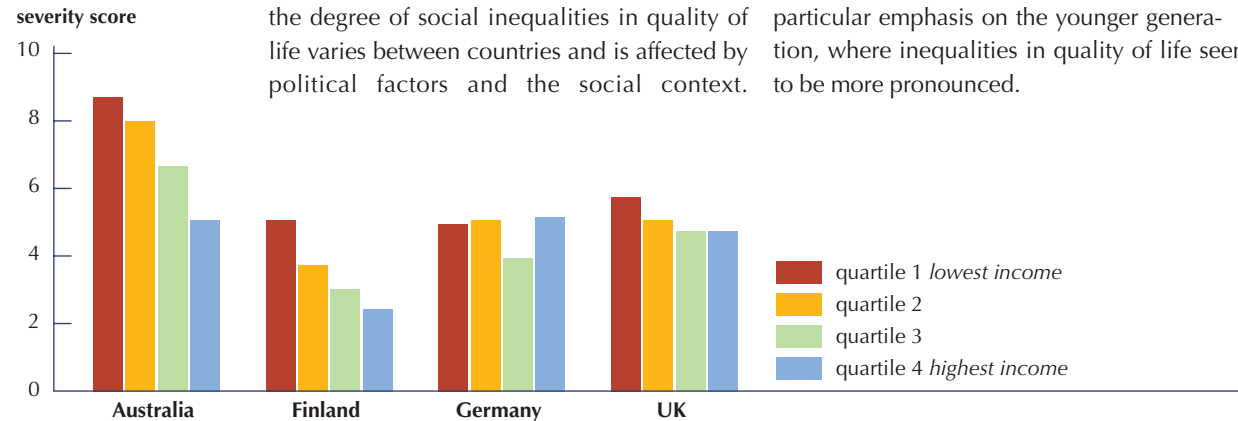
Oral conditions have considerable impact on the quality of life of individuals and populations, particularly among younger population groups and those with lower socioeconomic position.

## Impact of oral diseases

Oral conditions affected 3.9 billion people worldwide in 2010, with untreated tooth decay being the most prevalent, and severe periodontitis the sixth most prevalent of all 291 conditions studied. Their impact on the wellbeing of people and societies is evident at different stages across the life course. Evidence from different countries demonstrates the considerable school and work absenteeism related to oral conditions. Furthermore, dental status affects diet and nutrition, particularly in children and older people, while oral conditions and tooth loss have a significant negative impact on people's quality of life, not only affecting them functionally, but psychologically and socially. Globally, oral conditions accounted for 15 million Disability Adjusted Life Years in 2010; this is an average health loss of 224 years per 100,000 people.

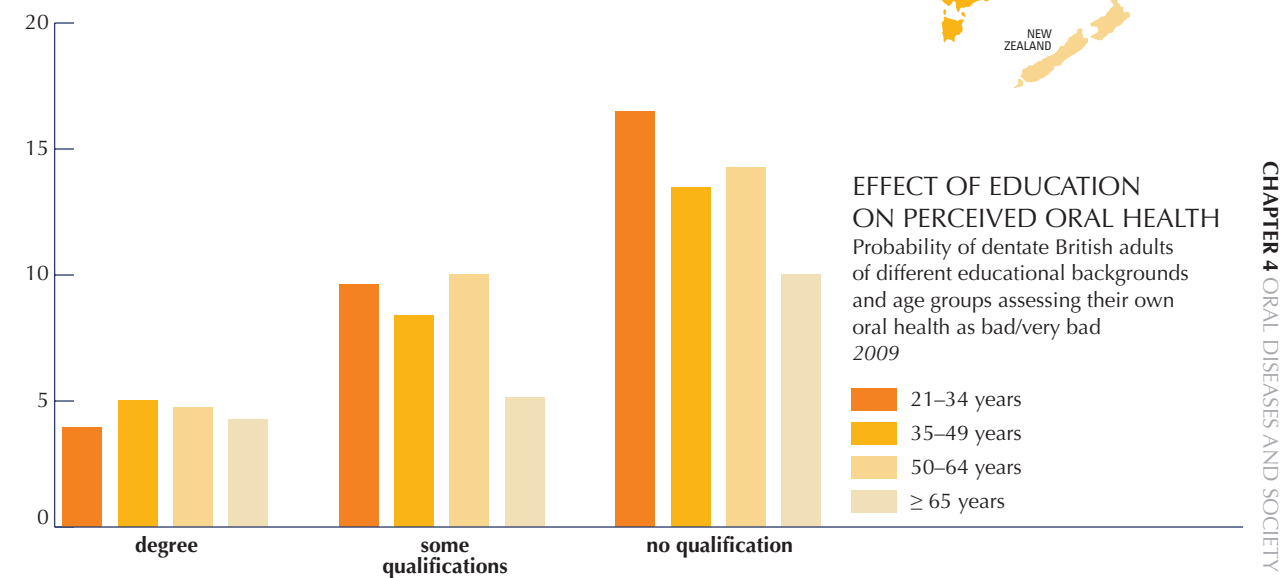
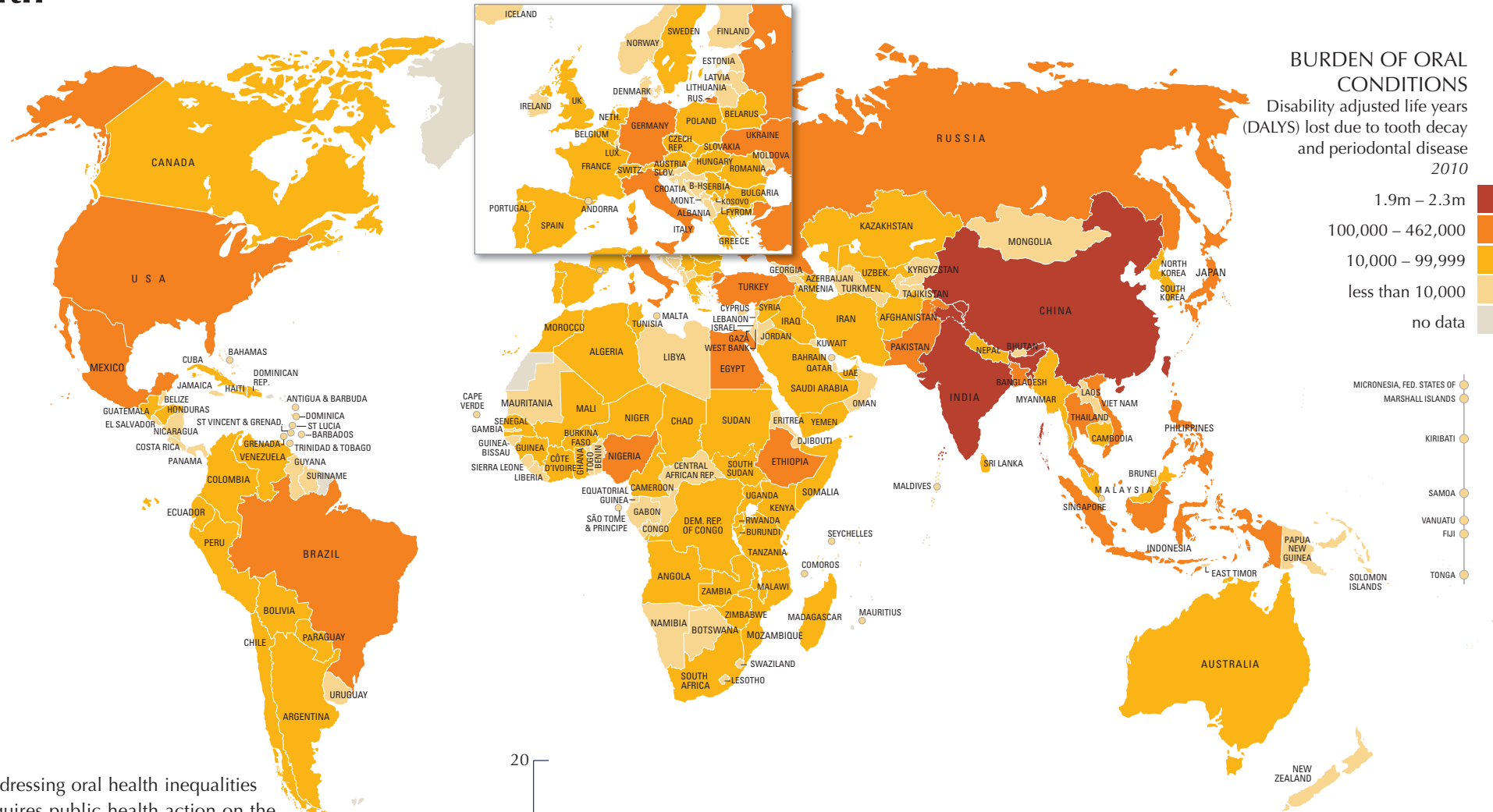
## THE IMPACT OF HOUSEHOLD INCOME ON ORAL-HEALTH RELATED QUALITY OF LIFE

Perception of oral function among adults with their own teeth in different income quartiles 1998–2002



As with general health, the impact of oral conditions on quality of life is unequally distributed between different socioeconomic groups. Subjective measures of oral health and quality of life among dentate adults show considerable inequalities, with worse perceptions the lower the socioeconomic position. These social gradients are stronger at younger ages, but no such inequalities in quality of life exist among edentulous older adults. However, the degree of social inequalities in quality of life varies between countries and is affected by political factors and the social context.

Addressing oral health inequalities requires public health action on the broader determinants of health, and particular emphasis on the younger generation, where inequalities in quality of life seem to be more pronounced.



# Inequalities in oral health

Oral diseases have considerable impact in terms of treatment costs and productivity losses. Providing equitable access to oral healthcare is a major public health challenge and substantial inequalities persist between population groups and countries.

## Access to oral healthcare

Oral diseases impact on individuals, communities, society, health systems and the economy. Yet, the full significance of this impact is unclear due to the lack of comprehensive and comparable international statistics on oral diseases, particularly for low- and middle-income countries.

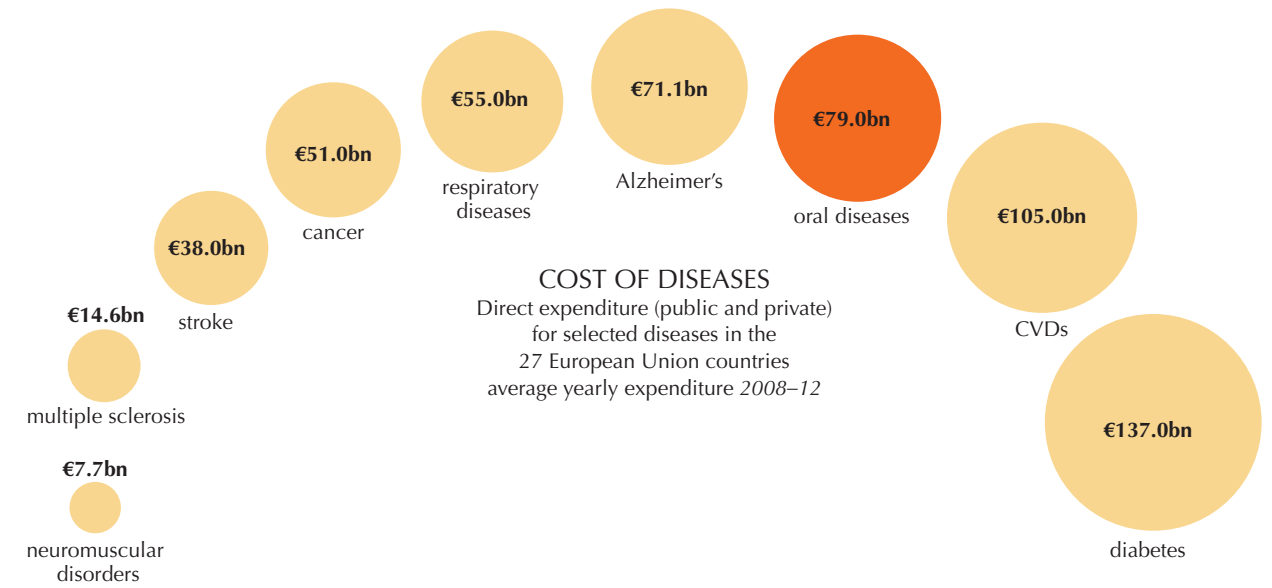
WHO estimates that oral diseases are the fourth most expensive diseases to treat. Annual spending on oral healthcare in the 27 European Union member states was estimated at €79 billion (annual average 2008–12), while the USA alone spent more than US\$110 billion. Dental expenditure also plays a significant part in household medical spending. Across OECD countries, average out-of-pocket payment for dental care represents about 55 percent of total dental care expenditure, compared to an average of 20 percent out-of-pocket spending for general healthcare.

In addition to treatment costs, the indirect costs of oral conditions are significant. A Canadian study found that 3.5 working hours/year/person were lost due to oral diseases, translating to productivity losses of over CND\$1 billion/year

for Canada alone. Earlier findings from the USA indicate that 2.4 million days of work and 1.6 million days of school were lost due to oral disease in 1996. Absenteeism from school and work can limit academic achievement and reduce employment opportunities.

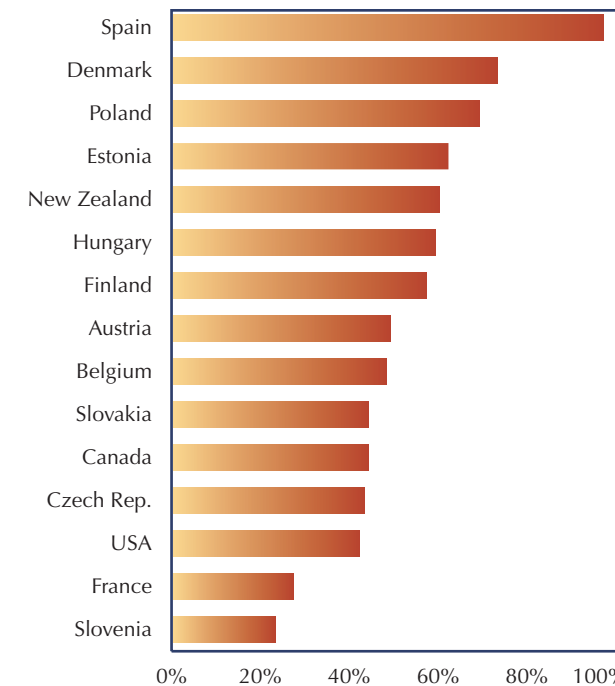
People from the upper end of the socioeconomic scale are more likely to seek regular dental care than those from the lower end. The USA and other countries see increasing emergency hospital admissions for dental problems, simply because such emergency care is free of charge. Admissions in the USA have doubled in the last 10 years and related costs amount to US\$2.7 billion.

Affordability of oral care is a clear barrier since most of the treatment costs are borne by the patient. However, amplified public subsidies for dental care, extending coverage of health insurance, and improved availability of oral healthcare services will not by themselves reduce inequalities unless those worse off are aware of the benefits of good oral health, and policy programmes address the broader determinants of health.



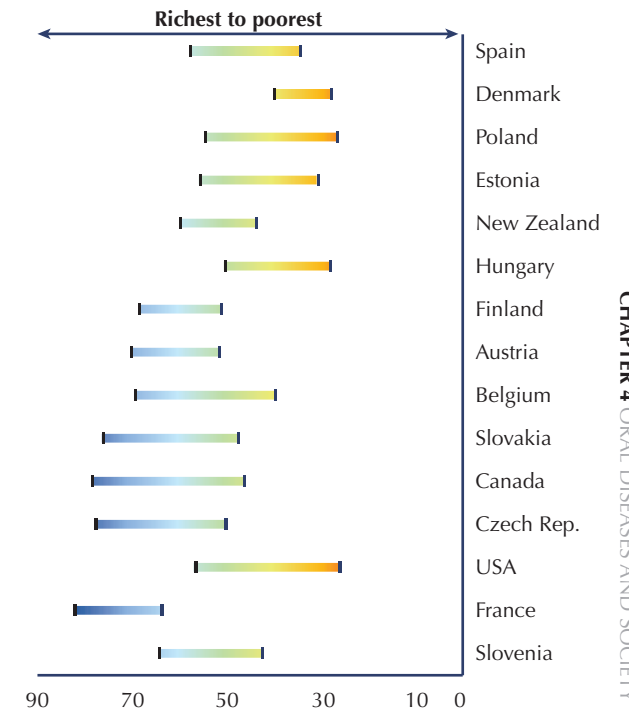
## OUT-OF-POCKET EXPENDITURE

As a percentage of total dental expenditure in OECD26 2011 or latest available data selected OECD countries



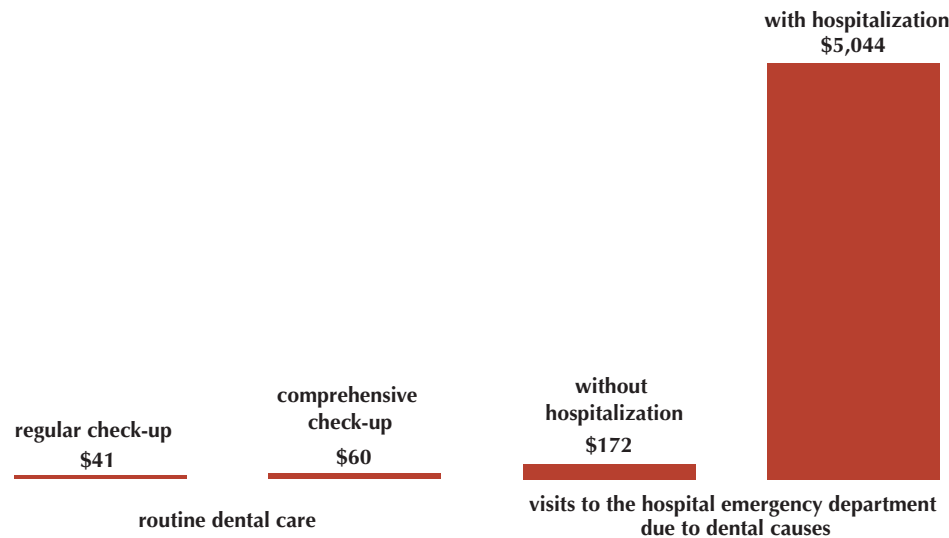
## TAKE-UP OF DENTAL CARE

Probability of visit to dentist in past 12 months by income group 2009 or latest available data selected OECD countries



## THE PRICE OF NEGLECT

The average cost of dental care per person in California in US\$ 2009





## Oral Diseases: Prevention and Management Chapter 5

At the UN High-Level Meeting on the Prevention and Control of Non-communicable Diseases in 2011, Helen Clark, Administrator of the United Nations Development Programme (UNDP) and former New Zealand Prime Minister, recognized that oral diseases are an obstacle to human development.

Historically, approaches to oral care have focused on individual curative care rather than on population-based preventive interventions. However, the financial and human resource costs of this approach are unaffordable for many countries, and unsustainable on a global scale. Most oral diseases can largely be prevented through simple, cost-effective measures that involve reducing exposure to recognized risks and strengthening healthy behaviours. Prevention, and oral health promotion are highly cost-effective strategies to address the global burden of oral diseases. For instance, estimates from the USA show that every dollar spent on preventive dental care could save between US\$8 and US\$50 in restorative and emergency treatment, emphasizing the importance of increasing the focus on the prevention of oral disease.

Prevention of oral disease and promotion of oral health can be directed towards individuals, communities or entire populations. Adequate access to fluoride is one of the most successful population-based preventive interventions. Fluoridation programmes have demonstrated their efficiency, cost-effectiveness and safety over the past 60 years in targeting tooth decay, the most prevalent health condition worldwide.

Other preventive measures address risk factors for oral disease that include unhealthy diet – in particular high sugar intake – tobacco use, alcohol consumption, and a set of broader health determinants. Many of these risk factors are shared between oral disease and other major NCDs. The Common Risk Factor Approach can thus contribute not only to improved oral health, but also to alleviating the global burden of NCDs.

The integration of oral and general health should be the cornerstone of policy approaches to improve prevention and control of oral diseases. This is acknowledged in the Oral Health Action Plan adopted by the 60th World Health Assembly in 2007. This emphasizes 'the intrinsic link between oral health, general health and quality of life' and identifies 'the need to incorporate programmes for promotion of oral health and prevention of oral diseases into programmes for the integrated prevention and treatment of chronic diseases'. In the same document, the ministers of health call for the creation of innovative workforce models to integrate essential oral healthcare into primary healthcare. This is also one of the key strategies set out in FDI's Vision 2020.

The challenge in addressing oral diseases and promoting oral health will require the right balance between a greater emphasis on population-wide prevention, strengthening the oral health workforce that still suffers from low numbers, and also changing and adapting the capacities and skills of oral healthcare providers; all of this in the context of increased integration across disciplines and sectors.

# Provision of oral healthcare

Dentists are the principal providers of oral disease treatment and prevention. Their role is changing in response to emerging risk factors, evolving disease burdens, demographic changes, and broader health system and socioeconomic pressures.

## Dentists

Differences in disease burden, inequalities in access to care, and the unequal distribution of dentists between and within nations present major challenges to global healthcare systems. These challenges require cost-effective management of the existing disease burden, and effective prevention to achieve sustainable improvements in oral health. Changing global trends, exposures to risk factors and demographic developments have resulted in new disease patterns that demand innovative multi-sectoral and inter-professional collaboration.

The majority of dentists worldwide work in private-practice settings, with a smaller proportion working in public clinics, academia, research, administration and industry. They are key providers of oral healthcare, education, prevention, supervision and management within the dental team. A growing number of women are practising as dentists, and many nations have, or soon will have, a majority of female dentists.

Affordability and availability are major barriers to accessing care. Dentists tend to concentrate in more affluent urban areas, leaving rural or disadvantaged populations relatively underserved. The services of private dentists are unaffordable for many, and oral healthcare is often not integrated into the primary healthcare system.

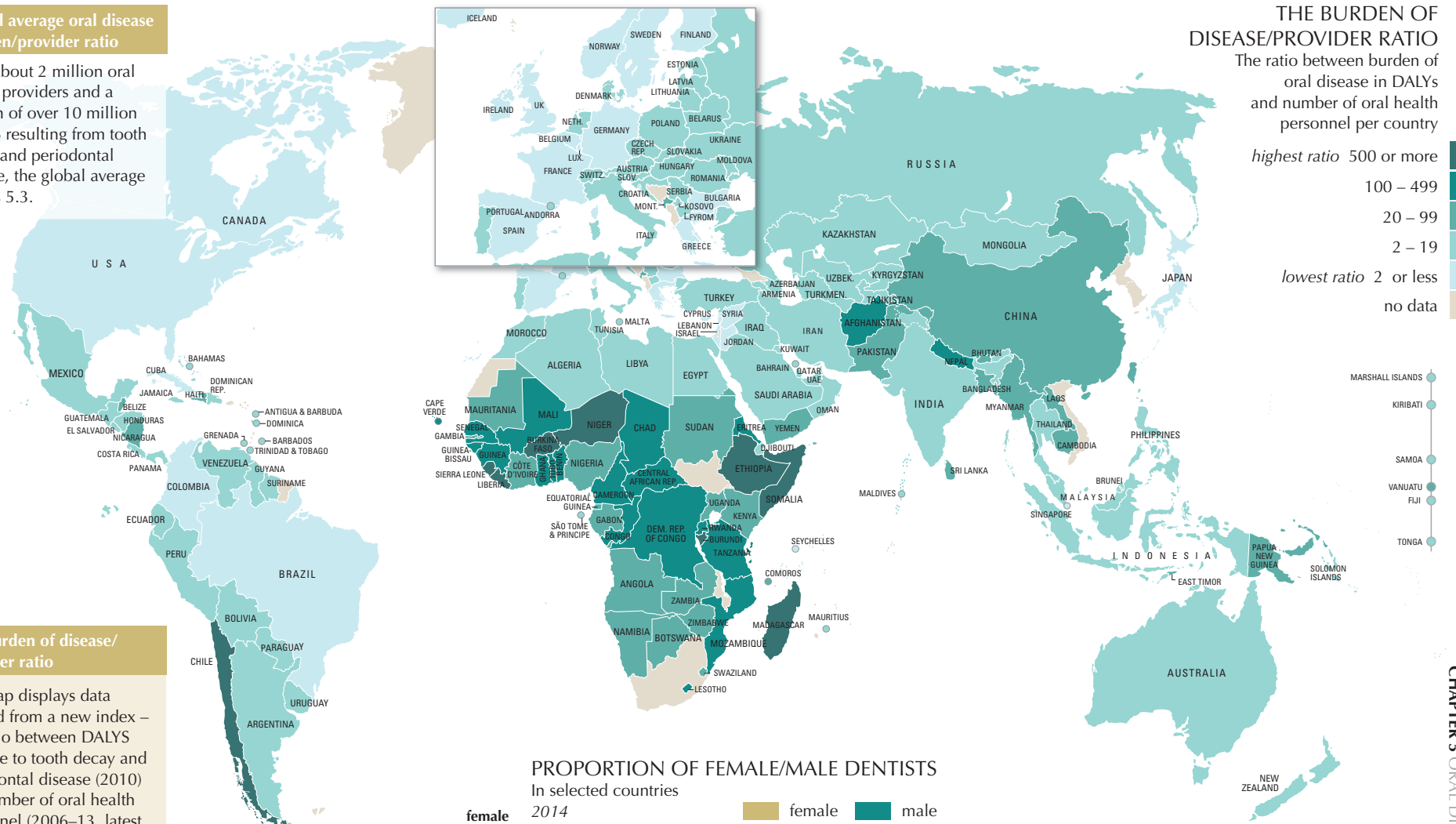
Strategic dental workforce planning should thus be embedded in overall planning for human resources in health, so that pressing social determinants of oral and general health can be addressed effectively, and crucial service and access gaps be reduced. The gap between the burden of disease and the availability of care can be addressed by creating dentist-led oral healthcare teams, that include a flexible mix of complementary mid-level providers and others, as required by local needs.

### Global average oral disease burden/provider ratio

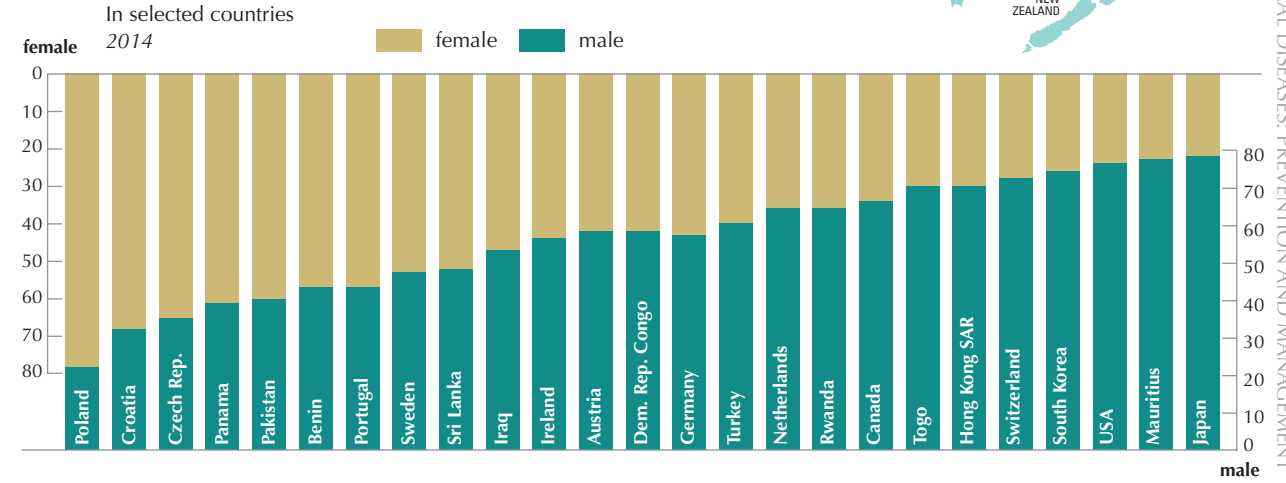
With about 2 million oral health providers and a burden of over 10 million DALYS resulting from tooth decay and periodontal disease, the global average ratio is 5.3.

### The burden of disease/provider ratio

The map displays data derived from a new index – the ratio between DALYS lost due to tooth decay and periodontal disease (2010) per number of oral health personnel (2006–13, latest available). It therefore relates disease burden to available dentistry personnel, thus showing the potential for providing oral care. A country with a high disease burden and low provider numbers will score high, while a country with a similar disease burden but higher provider numbers will score lower (more detail provided in the annex).



### PROPORTION OF FEMALE/MALE DENTISTS





# Provision of oral healthcare

Oral healthcare is best delivered by a team led and supervised by dentists, and composed of oral health professionals with different skills and training, thus ensuring quality care for all.

## Dental team

The dental profession leads the development and implementation of oral healthcare services, providing equitable and appropriate oral healthcare for all. Dental teams are led and supervised by a dentist, and may include various oral health professionals with different training, competencies, practice limits, registration, recognition and supervision requirements, depending on community needs, available resources and national legislation.

Dentists lead the team, are responsible for diagnosis, providing oral healthcare and prescriptions as well as supervision and management. They also ensure quality and safety of care in accordance with national regulations. Other oral healthcare professionals, including dental surgery assistants, dental nurses and chairside assistants, may assist dentists with a range of clinical duties. Dental hygienists work

in the field of prevention, oral hygiene and promoting healthy behaviours.

Dental technicians provide technical laboratory services in close collaboration with the dentist.

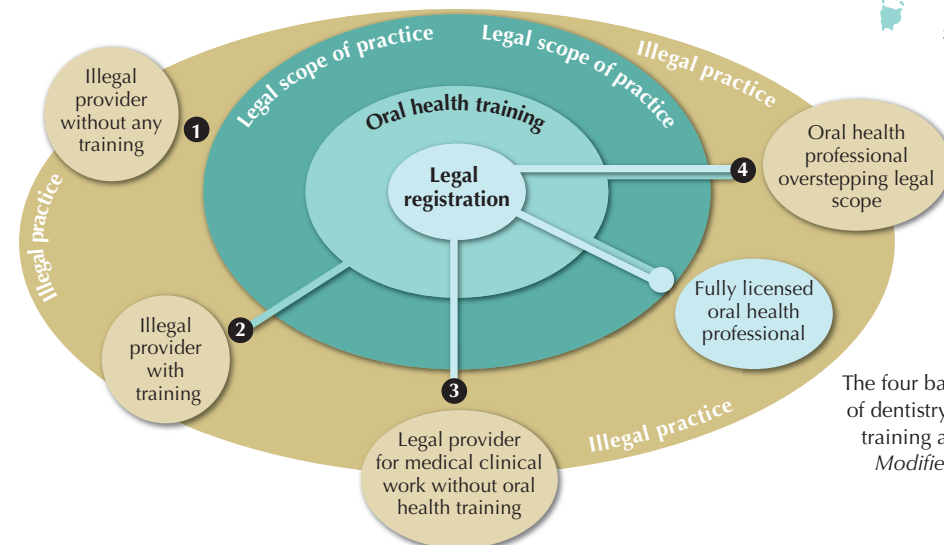
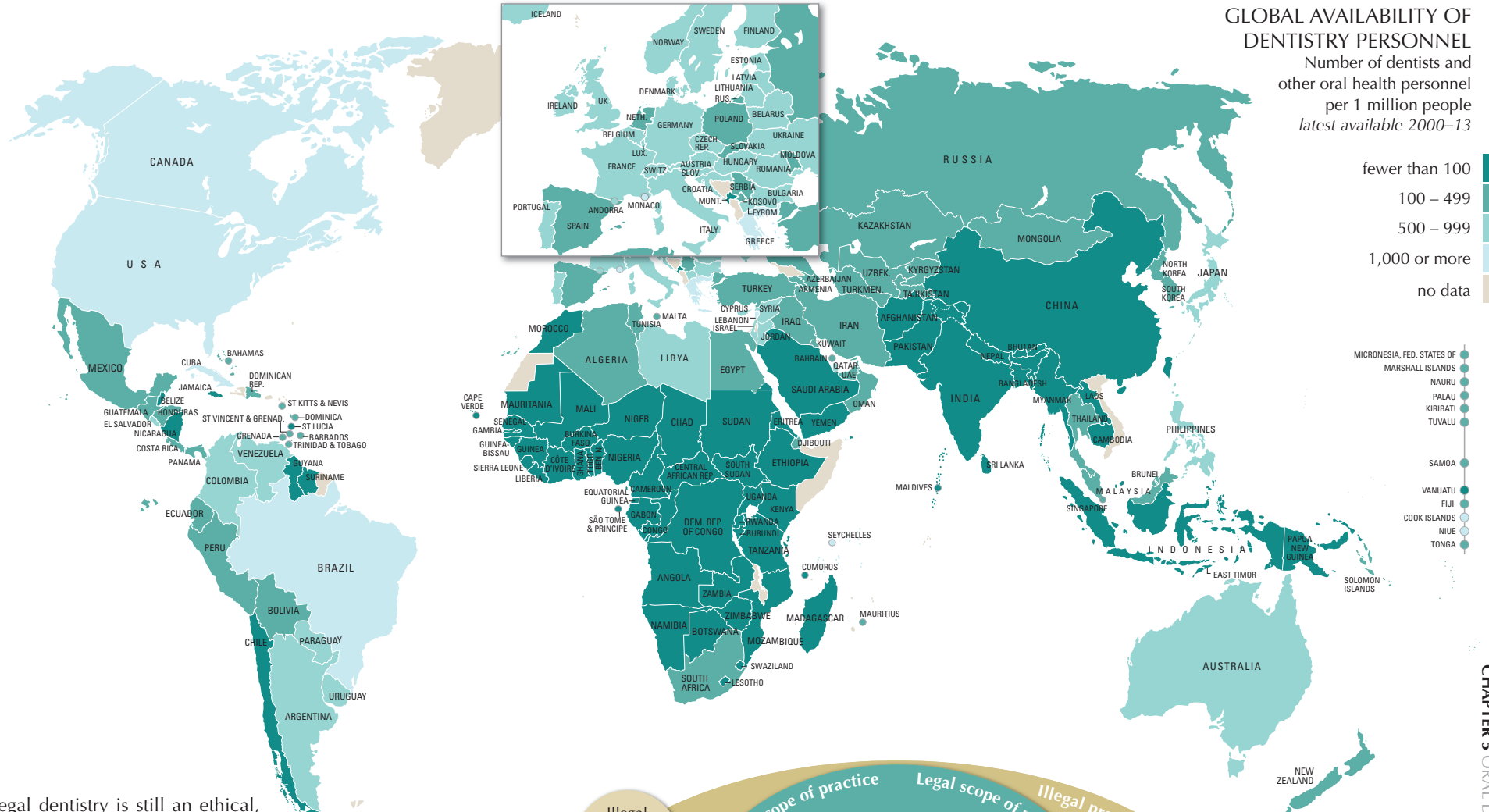
Mid-level providers may include dental therapists, who provide limited restorative and surgical services, sometimes for specific population groups such as children. Clinical dental technicians, or denturists, may

fabricate removable prosthetic appliances either with or without prescription from a dentist, and work directly with patients. The role of community oral health workers may include provision of simple emergency care in primary healthcare settings, oral health promotion, screening, and referral when needed. The names and scope of practice of all these professions are defined nationally.

Illegal dentistry is still an ethical, public health and legal problem in many countries. Illegal practitioners are unregulated and lack proper education and licensing, necessary instruments, cross-infection control and patient safety standards for state-of-the-art oral care. Their practice may incur serious health dangers for patients, yet they may be the only available or affordable provider in certain settings. Innovative and flexible workforce models, integrated within a primary healthcare system, may address the needs of deprived or remote communities in a better and safer way.

**“We can shape a new model of oral healthcare delivery which relies on a team-based collaborative approach where fully trained dentists take responsibility for supervising a team, provide sufficient training to the healthcare workforce and delegate specific tasks ... while retaining full responsibility for diagnosis, treatment planning and treatment.”**

*FDI Vision 2020 – Shaping the future of oral health, 2012*



**TYPOLGY OF ILLEGAL DENTISTRY**  
The four basic types of illegal practice of dentistry, depending on oral health training and legal scope of practice.  
*Modified from Benzian et al, 2010*

# Provision of oral healthcare

Access to basic oral care is mandatory for all countries. It is possible even for resource-poor health systems, through the use of cost-effective, evidence-based interventions that emphasize prevention and self-care.

## Oral healthcare continuum

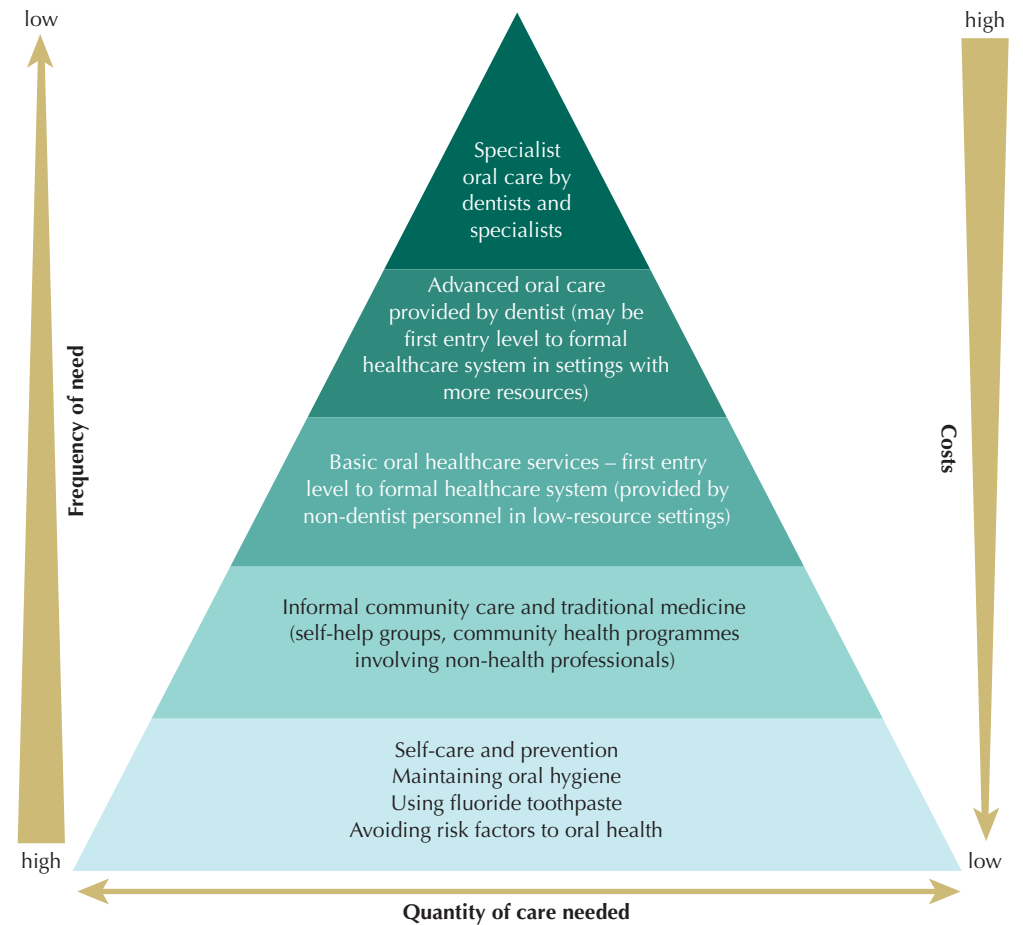
Systems that provide general healthcare and oral healthcare have generally evolved separately around the world over the last 150 years. Oral healthcare is often only partially integrated into public healthcare systems, or it is entirely absent. As a result, access to appropriate and affordable oral healthcare services is a distant aspiration for the majority of the world's populations. Untreated tooth decay in permanent and primary teeth ranks first and tenth respectively among the 291 commonest diseases. These are damning statistics and provide stark evidence of the neglect of oral health.

An ideal primary (oral) healthcare system should provide universal coverage; be people-centred; have demand-led policies and programmes; and be integrated with general health in all policies, including labour, environment and education. It is more likely to benefit a greater proportion of the population than

traditional approaches focused on curative care. Clinical oral healthcare is generally costly and thus unaffordable for the weaker health systems characteristic of resource-poor economies.

The Basic Package of Oral Care is a model for integrating basic oral healthcare and prevention into the entry levels of healthcare systems. It is currently the only WHO-approved oral health system model for the management of the commonest oral diseases. It comprises modular components that can be adapted and scaled to match available resources and community needs. It has an initial focus on self-care and prevention, with other priorities set according to disease burden and available resource. The minimum requirement is to cover basic emergency care and pain relief. Curative and specialist care can be added, resulting in the full range of services in a universal coverage context.

THE ORAL HEALTHCARE CONTINUUM



## BASIC PACKAGE OF ORAL CARE

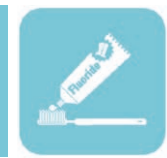


### Oral Urgent Treatment

Oral Urgent Treatment (OUT) is an on-demand service providing basic emergency oral care. The three fundamental elements of OUT are:

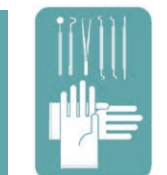
- relief of oral pain
- first aid for oral infections and dento-alveolar trauma
- referral of complicated cases.

OUT can be provided by trained non-dentist personnel.



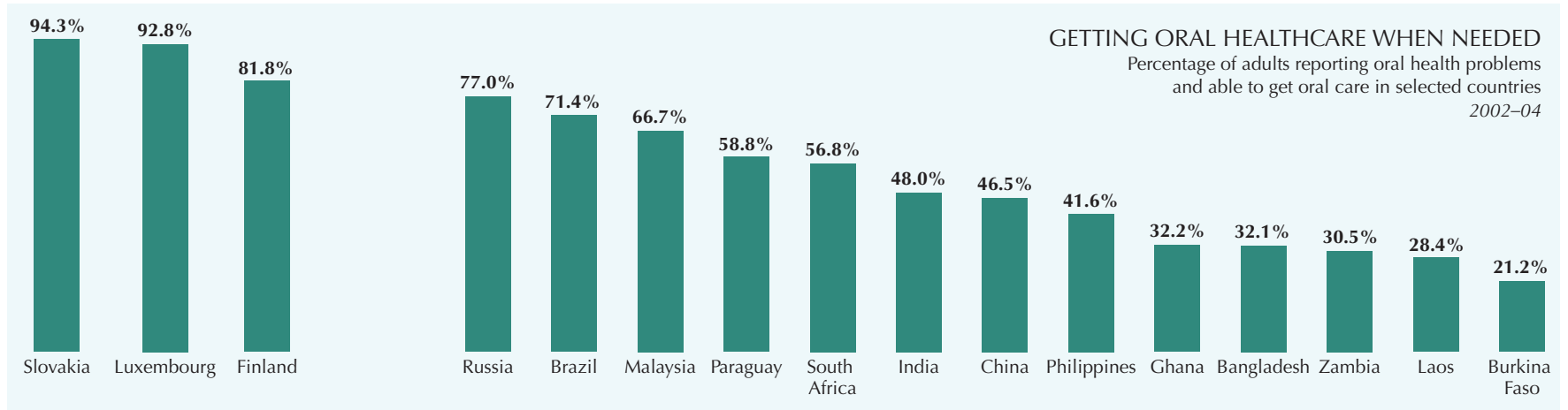
### Affordable Fluoride Toothpaste

Use of Affordable Fluoride Toothpaste (AFT) is one of the most important preventive measures in managing tooth decay. However, fluoridated toothpaste is often too expensive for disadvantaged groups in low- and middle-income countries to purchase. Approaches to AFT aim at enabling everyone to clean teeth twice daily with quality fluoride toothpaste.



### Atraumatic Restorative Treatment

Atraumatic Restorative Treatment (ART) is a caries management approach, consisting of a preventive (fissure sealant) and a restorative component (restoration). ART can be performed inside and outside a dental clinic, as it uses only hand instruments and a powder-liquid high-viscosity glass-ionomer, and requires neither electricity nor running water. It is relatively painless, minimizing the need for local anaesthesia and making cross-infection control easier.



# Prevention of tooth decay

The use of fluorides for the prevention of tooth decay is safe, efficient and highly cost-effective. Increased efforts are required to promote access and use of appropriate fluorides in order to achieve universal access.

## Fluorides

Good oral hygiene, a reduction in consumption of dietary sugars, and the regular, appropriate use of fluoride are key elements of effective tooth-decay prevention strategies.

Fluoride has been used for over 70 years in the prevention of tooth decay. A large body of scientific evidence demonstrating its effectiveness in population-wide studies supports its use. However, the evidence is still evolving and varies for different modes of delivery. The effect of fluoride is local (topical) on the tooth surface: inhibiting bacterial acid production, stopping enamel demineralization, enhancing remineralization (repair) and improving enamel resistance to future acid attacks.

Fluoride can reach the tooth surface in many ways: it can be added to water, salt or milk as part of community interventions; be professionally applied or prescribed as gel, varnish or tablets; or comprise part of self-care in toothpaste and mouthrinses. The evidence for these fluoridation methods varies from very strong to weak, so that

the choice of the most suitable fluoridation strategy depends on many factors, including the evidence of effectiveness, the setting and the resources available.

Fluorides are safe and effective if applied at recommended levels. However, exposure to higher-than-recommended levels of fluoride during tooth development (between birth and four years of age) may cause dental fluorosis. The majority of cases are mild and unnoticeable, only the severe forms appear as brown spots or discolouration of the teeth.

Sodium-fluoride is part of WHO's model list of essential medicines, and access to fluorides has been recognized as a part of the basic human right to health. The potential for reducing inequalities in the tooth-decay burden through universal access to fluorides for dental health is largely missed through absence of preventive national fluoride policies promoting availability, affordability or use of fluoride products, and mandating water, salt or milk fluoridation.

*"The experts reaffirmed the efficiency, cost-effectiveness, and safety of the daily use of optimal fluoride. They confirmed that universal access to fluoride for dental health is a part of the basic human right to health."*

*Call to Action to Promote Dental Health by Using Fluoride, WHO, FDI and IADR, 2006*

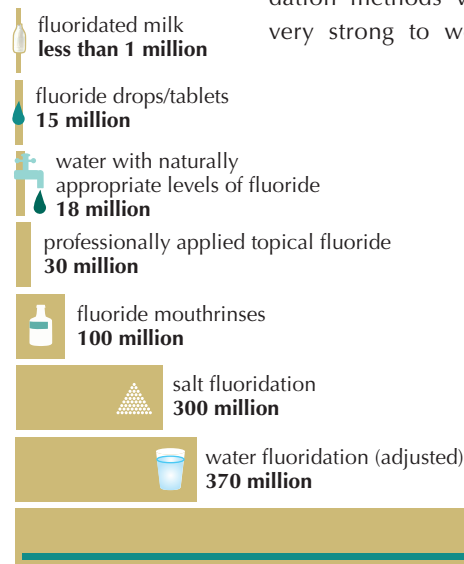
### FLUORIDE FACTS

Use of fluorides is among the **top 10** greatest public health achievements ever (according to US Centers for Disease Control)

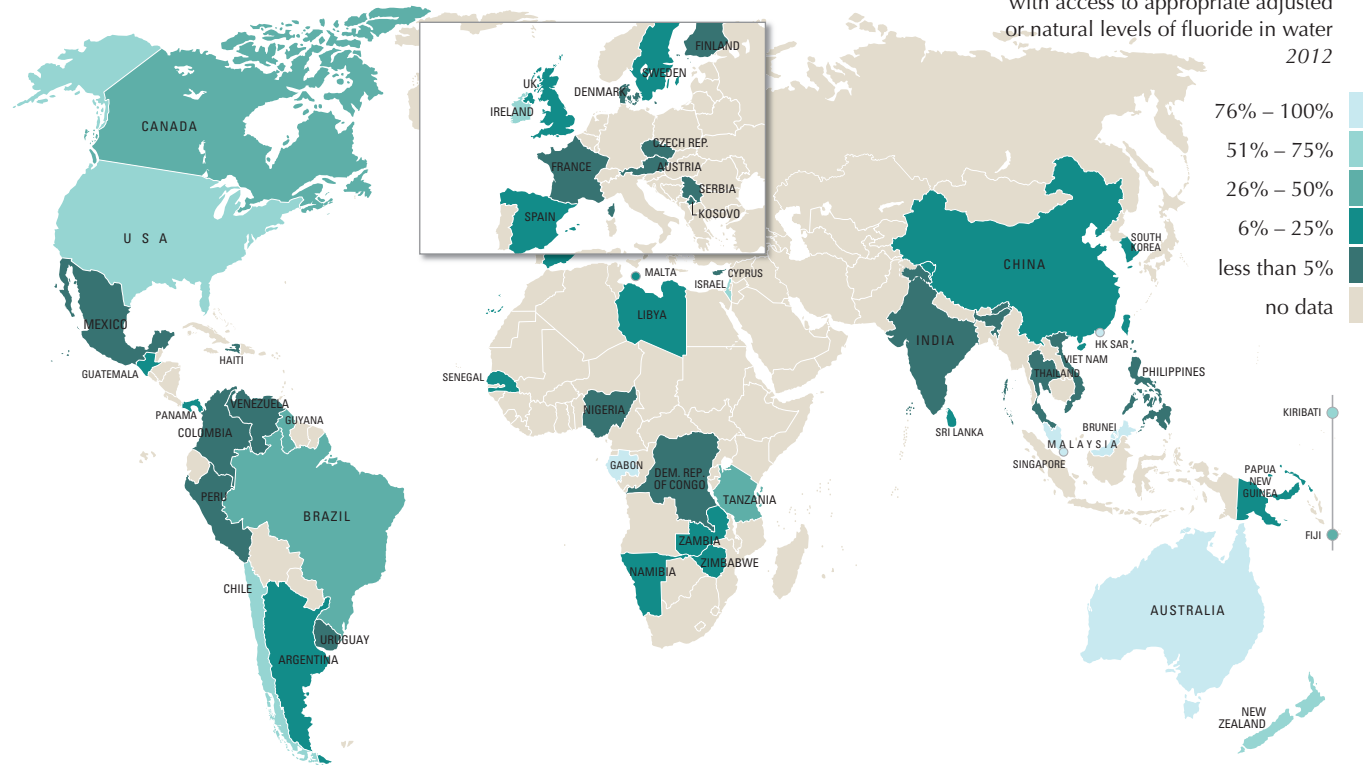
Fluoride can lead to a **20% – 60%** reduction in tooth decay, depending on delivery method.

**US\$1** spent on salt fluoridation = **US\$250** savings in future dental treatment costs.

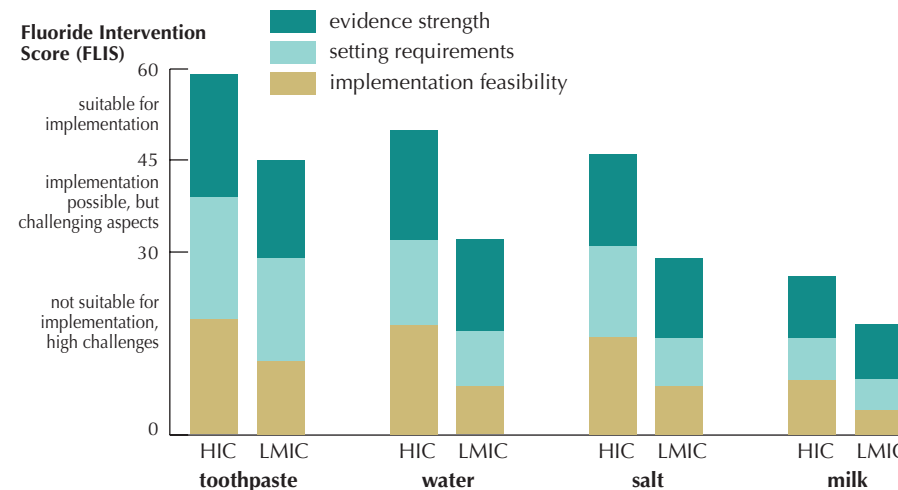
**GLOBAL FLUORIDE USE**  
Estimated number of people worldwide using different sources of fluoride 2001 salt 2013 water 2012



**FLUORIDE IN WATER**  
Percentage of population with access to appropriate adjusted or natural levels of fluoride in water 2012



**CHOOSING THE RIGHT FLUORIDE INTERVENTION**  
Estimated suitability of fluoride interventions in high-income (HIC) and low-/middle-income (LMIC) country settings using the Fluoride Intervention Score (FLIS)



- Criteria for selecting a fluoride intervention:**
- 1** Strength of scientific evidence:
    - Effectiveness
    - Efficiency
    - Safety
    - Compliance
  - 2** Setting requirements:
    - Feasibility
    - Equity
    - Legislation
    - Fluoride mapping
  - 3** Implementation feasibility:
    - Quality assurance
    - Sustainability
    - Surveillance
    - Communication

# Prevention of tooth decay

**Fluoride toothpaste is highly effective in preventing tooth decay. It is safe and readily available, but greater effort is required to improve its affordability and quality to ensure universal access.**

## Fluoride toothpaste

Fluoride toothpaste is the most widespread and most rigorously evaluated means of fluoride use for preventing tooth decay. The evidence for its decay-preventing effect in both primary and permanent dentitions is strong. Its use in combination with water or salt fluoridation is safe. Furthermore, the protective effect is increased. Toothbrushing without fluoride toothpaste helps improve oral hygiene, but has no decay-preventing effect.

Fluoride was first added to toothpaste in 1914, but it was only in 1955 that the first commercial fluoride toothpaste (Crest®) became available. Most toothpaste sold in high-income countries now contains fluoride, and its widespread use is seen as the main reason for the significant decline of tooth decay in these countries in recent decades.

Typical formulations of effective fluoride toothpaste contain 1,000 to 1,500ppm (parts-per-million) fluoride; low-fluoride child toothpastes exist, but evidence for their effectiveness is

weak. The international standard ISO 11609 defines minimum quality, labelling and testing requirements, but national compliance and enforcement varies greatly.

There are huge differences in affordability and quality of fluoride toothpaste. Even though widely available for purchase, the cost of toothpaste, particularly for poor populations, is a major barrier to regular use. The low quality of certain toothpastes in low- and middle-income countries may also reduce their decay-preventing effect. Labelling requirements are not always met, so that transparency for the consumer is compromised, and counterfeit toothpaste may not even contain fluoride.

Since water and salt fluoridation are not available to the majority of the world's population, fluoride toothpaste remains the most significant decay-preventing intervention globally, yet more efforts are required to improve affordability and quality.

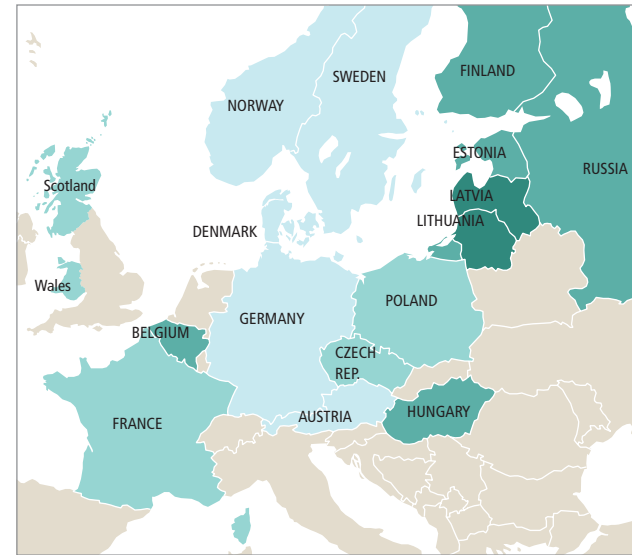
*"The issue of toothpaste cost deserves additional attention because price will determine access to tooth pastes, especially in the emerging market economies (EME) of the world. The need for fluoridated toothpaste is particularly critical in many EME countries, where water fluoridation may be impractical, where salt fluoridation has not yet gained traction, and where the infrastructure for dental public health services may be underdeveloped."*

*John Stamm, University of North Carolina, 2007*

### RECOMMENDATIONS

#### POLICIES TO IMPROVE QUALITY AND REDUCE COST OF FLUORIDE TOOTHPASTE

- 1 Remove taxation and tariffs, which constitute a significant cost factor, and pass on savings to the consumer.
- 2 Increase taxation of toothpastes without fluoride to discourage their use.
- 3 Enforce equity pricing – differential prices for different populations, depending on purchasing power.
- 4 Promote generic competition and local production, while ensuring quality standards.
- 5 Improve capacities of national food and drug administrations for better monitoring of toothpaste quality.
- 6 Strengthen and enforce the regulations of ISO 11609.



## TOOTHBRUSHING HABITS IN EUROPE

Proportion of 11- to 15-year-olds who report brushing their teeth more than once every day 2010

- 75% or more
- 65% – 74%
- 55% – 64%
- less than 55%
- no data

## TOOTHPASTE FACTS

### Main functions of toothpaste:

**Tooth decay prevention:** standard (1,000 – 1,500ppm) or high fluoride content (2,500 – 5,000ppm).

**Plaque control:** addition of antibacterial substances.

**Reduction of tooth sensitivity. Whitening or bleaching effect.**

**Freshening breath.**

### Best toothbrushing practice:

- Brush twice a day.
- Do not rinse after brushing.
- Use a pea-sized amount of toothpaste.
- For children up to the age of six, supervise their brushing.

US\$1 spent on promoting the use of fluoride toothpaste in Nepal = savings of

**US\$87–US\$356**

Size of the global toothpaste market in 2016:

**US\$14bn**



## AFFORDABILITY OF FLUORIDE TOOTHPASTE

Days of household expenditure by the poorest 10% of the population needed to buy a year's supply of the cheapest fluoride toothpaste per person 2006



In 2012, FDI's Vision 2020 document *Shaping the Future of Oral Health* identified a wide range of challenges and opportunities for oral health. 'Persisting oral health inequalities; lack of access to oral healthcare; unaffordability of dental treatment in many places; a growing and ageing population; workforce migration; dental tourism; the emergence of new educational models; the evolving distribution of tasks between members of the oral healthcare workforce; ongoing legislative actions targeting hazardous materials; and the increasing use of information and communication technologies in all segments of our lives and professions' were listed among those opportunities and challenges that require appropriate and timely action.

This chapter focuses on some of these challenges and details important aspects where oral health professionals and policy makers need to collaborate closely in order to identify and implement adequate solutions.

Dental education is an area where new solutions are needed so that the educational model responds to new needs, effectively bridges the gap between medical and dental education, promotes and strengthens collaborative practice, and includes public health, disease prevention and health promotion as core activities of every oral health professional. Unless such changes are brought about, the long-term goal of having sufficient numbers of appropriately skilled and motivated oral health professionals in every healthcare system will remain an unfulfilled wish.

In the context of the global health workforce crisis, the migration of health professionals has received increasing attention. People have always moved to another country for work, but the accelerated migration from poorer to

wealthier countries carries the risk of increasing pressures on already strained health systems in the former. On the other hand, migration may have many positive effects, such as boosting local economies through remittances. Although the human right to free movement should not be restricted, strategies to enhance effective retention of dentists in their countries of origin, combined with ethical codes to mitigate the negative effects of active recruitment by high-income countries, should be in place to ensure that oral health professionals are available where they are needed.

At the same time as the mobility of oral health professionals has increased, the mobility of patients is also on the rise and the number of individuals travelling abroad to seek oral healthcare has increased sharply in the past decade. This represents a new challenge for oral healthcare, as it raises questions about access and quality of care, legal aspects and ethical responsibilities.

The challenges for research in oral health are diverse and fundamental. In the future the focus of research will not only be on basic discovery science and the clinical and technical aspects of providing oral care. In addition, there will need to be a greater emphasis on implementation and translational research, taking into account the global health implications of oral diseases and the different needs of low- and middle-income countries.

As set out in FDI's Vision 2020, all of these challenges highlight the need to shape an inclusive and effective new model of oral healthcare, for the ultimate benefit of all patients worldwide. The measure of our success in achieving this will be the increase in people who retain a full set of healthy teeth throughout life.

# Challenges in education

**Contemporary dental education equips oral health professionals with the required mix of skills and competencies to meet the needs of their patients and populations.**

Dental education has developed over the last 150 years generally separate from medical education, and often focuses on restorative and clinical dentistry. The recognition of the links between oral and general health and of the shared wider determinants of oral health have led to new models of dental education that foster active collaboration among healthcare professions and disciplines. Emphasis on public health, evidence-based health promotion and disease prevention, along with critical-thinking skills to evaluate new research information are among the new core competencies that lead the profession towards addressing population needs that go beyond the dental chair.

Dental degree programmes generally comprise essential health sciences and clinical skills in oral diagnosis and care, requiring four to six years of study, depending on national legislation. A range of postgraduate specializations exists, as well as formal education pathways for other professionals of the dental team.

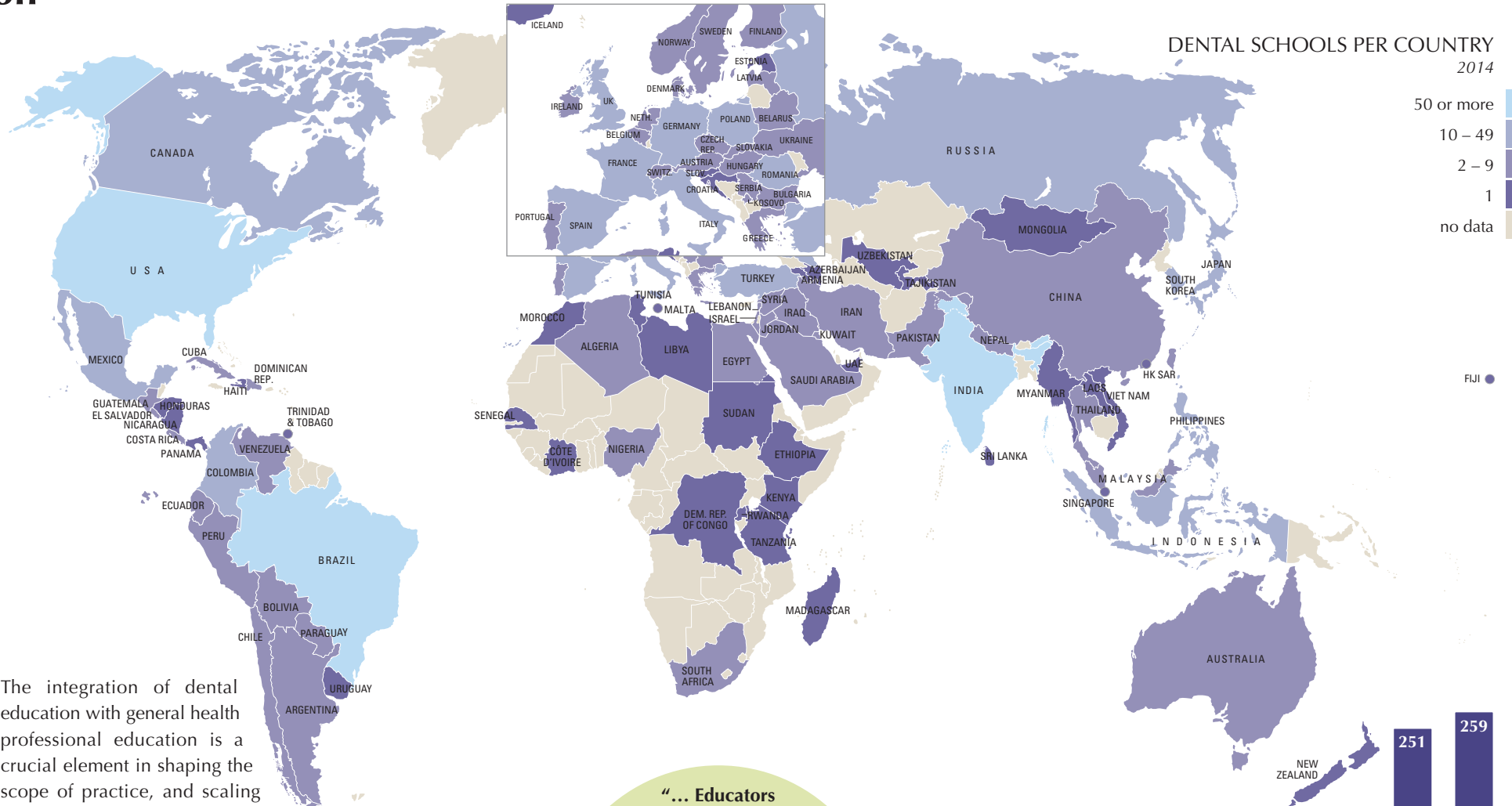
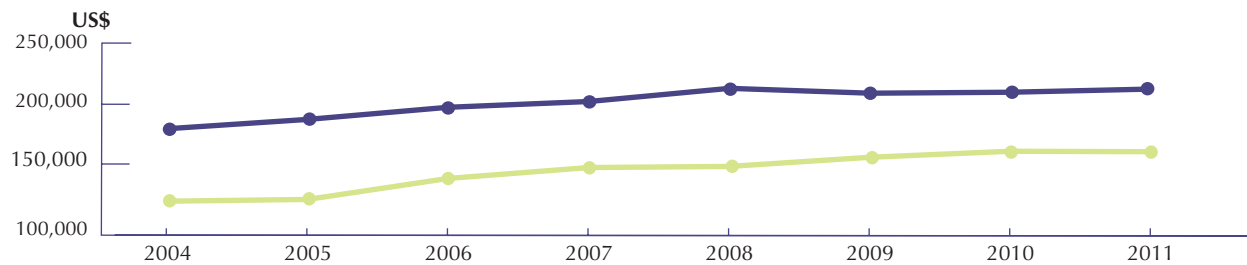
There are large regional disparities in the provision of dental education, with Africa having the lowest number of dental schools out of all the world regions. In contrast, dental education has become a lucrative business in some countries, with a rapidly increasing number of predominantly private dental training institutions. This poses increasing challenges for ensuring educational quality, governance and licensing. Accreditation of dental education programmes and licensure requirements vary regionally, and there are no globally recognized competency standards.

The integration of dental education with general health professional education is a crucial element in shaping the scope of practice, and scaling up the number and impact of oral health professionals worldwide. Adequate public investments in oral and health professional education are required, together with curricular and institutional reforms, in order to create an effective global oral health workforce.

## COST OF DENTAL EDUCATION

Average educational debt incurred by dental graduate in private and public dental schools in the USA, adjusted for inflation 2004–11

— private school  
— public school



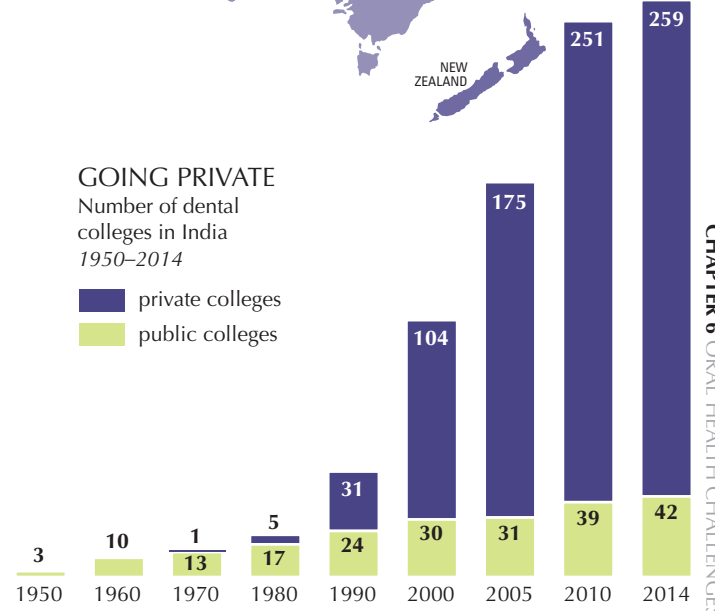
**“... Educators in dental schools are ... facing demands to introduce a curriculum to develop awareness of public health service and policy, inter-professional cooperation, critical thinking and decision making, self-management and organization culture, and reflection and interpersonal feedback.”**

*Young Guk Park, Dean of Kyung Hee University School of Dentistry, 2015*

## GOING PRIVATE

Number of dental colleges in India 1950–2014

■ private colleges  
■ public colleges



# Challenges of global migration

Migration and mobility of oral health professionals and of patients result from complex push and pull factors. The positive and negative impacts on sending and receiving countries need to be balanced through appropriate policies and regulations.

## Migration of oral health professionals

International mobility and migration are part of our increasingly globalized, interlinked economies. The cross-border movement of oral health professionals is a recognized phenomenon with both positive and negative effects. Yet very little is known about the extent of the migration of oral health professionals, because no recent international statistics are available.

Migration of health workers is a complex issue both for source and receiving countries, with many drivers for workforce migration, both professional and personal. These include lack of career opportunities or specialization; personal and family reasons, such as education for children; or economic reasons, including a better and more stable income. These factors coexist with broader health-system, social and political issues.

There is a recognized global shortage of skilled human resources for health, but international recruitment is only a partial and temporary solution to national shortages. Active recruit-

ment by receiving countries may be detrimental for health systems in source countries, which lose the educational investment made in those health professionals who migrate. On the other hand, the economy of some net exporting countries may depend on remittances from those migrating abroad.

Receiving countries, in turn, are required to ensure the competence and quality of care provided by foreign-trained professionals, as well as their rights to equal pay and opportunities. Such efforts must be mindful of the human right to free movement, as well as the rights and opportunities for locally trained professionals.

WHO and other organizations have developed codes of practice for international recruitment alongside policy options for countries to facilitate effective national workforce planning, mitigate possible negative effects of international migration, and monitor workforce flows more effectively.

## Dental tourism

Medical and dental tourism are increasing trends facilitated by the ease of travel, information and trade in the wake of globalization. The international mobility of patients who seek care outside their home country involves complex issues related to ethics, quality of care and the provider-patient relationship, but also related to costs, commercialization and consumerism.

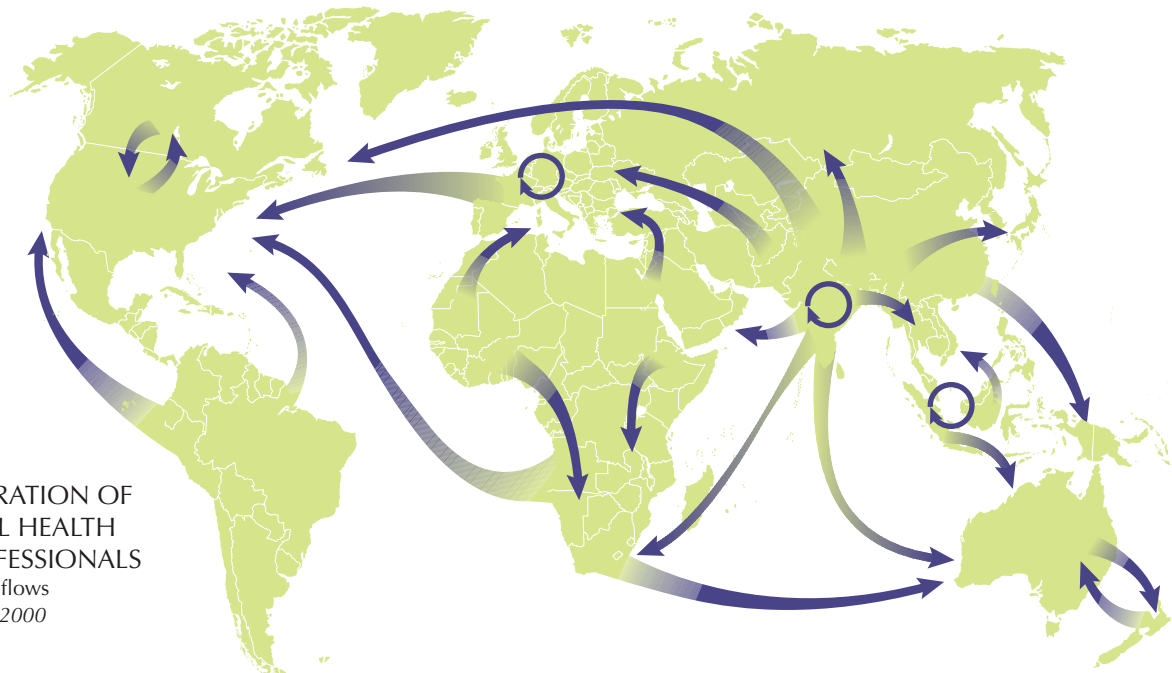
Problems may arise from cross-border insurance coverage, warranty aspects and treatment complications. On the other hand, medical tourism has developed into a major

revenue stream for certain destinations and may contribute to strengthening local health-care systems.

Main reasons for dental tourism include lower costs of care in the destination country, no waiting times and short time-span of treatment, combining treatment with travel to exciting and exotic holiday destinations, and the availability of procedures that are not legally available in the home country.

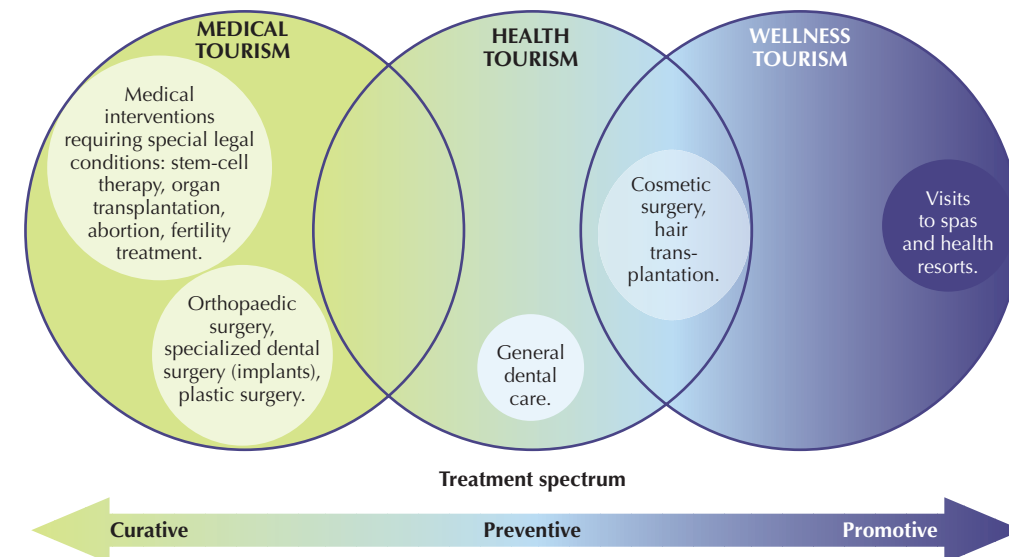
“FDI acknowledges that access to oral healthcare as well as migration for professional, economic or personal reasons are human rights and all countries need to plan accordingly ... Planned international recruitment of oral health professionals can only be a partial solution to domestic shortages. It is essential that international recruitment be done without detriment to health services of countries.”

*FDI Policy Statement on Ethical International Recruitment of Oral Health Professionals, 2006*



MIGRATION OF ORAL HEALTH PROFESSIONALS  
Major flows  
1999–2000

MEDICAL TOURISM DOMAINS AND TREATMENT APPROACHES  
Modified from Hall, 2011



# Challenges in research

**Oral health research, encompassing the full range of basic, clinical, translational and applied health-system research is essential to address the unacceptably high health and economic burden of oral diseases, and to improve oral health worldwide.**

Science and research provide the foundation for evidence-based health programmes, policies and clinical practice. More than 4 billion people worldwide suffer from oral diseases, generating an enormous health and economic burden. It is thus imperative to promote, coordinate and support the full range of basic, clinical and translational research, together with research training and capacity building, to reduce this disease burden.

Oral health research faces the same challenges of dissemination and implementation of research findings as the rest of the health sector. The continuum from discovery to global application recognizes the different levels and types of research, as well as their interplay, in order to make best use of research in improving global oral health. The first step in this continuum is the translation from basic science to clinical practice. The subsequent, equally important steps are related to translation and facilitation of broad health-system adoption and population-level measures.

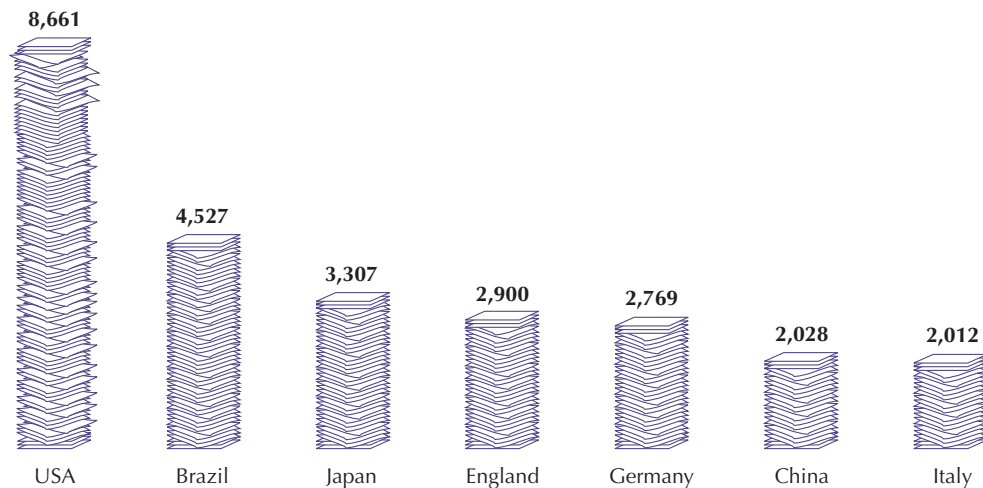
Oral health research has traditionally focused on basic, clinical and technical aspects of providing

oral care, mainly in high-income countries. It is only recently that more emphasis has been placed on implementation and translational research, taking into account the global health implications of oral diseases and the different needs of low- and middle-income countries.

The so called '90/10 Gap', whereby 90 percent of research and spending are directed towards the needs of only 10 percent of the world's population also applies to oral health research. The bias in the origin of research publications is an indicator of this. Furthermore, a paradigm shift is required, with greater emphasis on prevention and the integration of oral health research into the mainstream of clinical science.

Developing and coordinating international collaborative research priorities is a crucial element in a concerted effort to fill essential knowledge gaps in oral health. A particular focus on evaluating social and behavioural interventions, implementation and delivery will be required if the major global oral health inequalities are to be reduced.

**PUBLICATIONS**  
Papers published on dental research per country of origin 2007–11

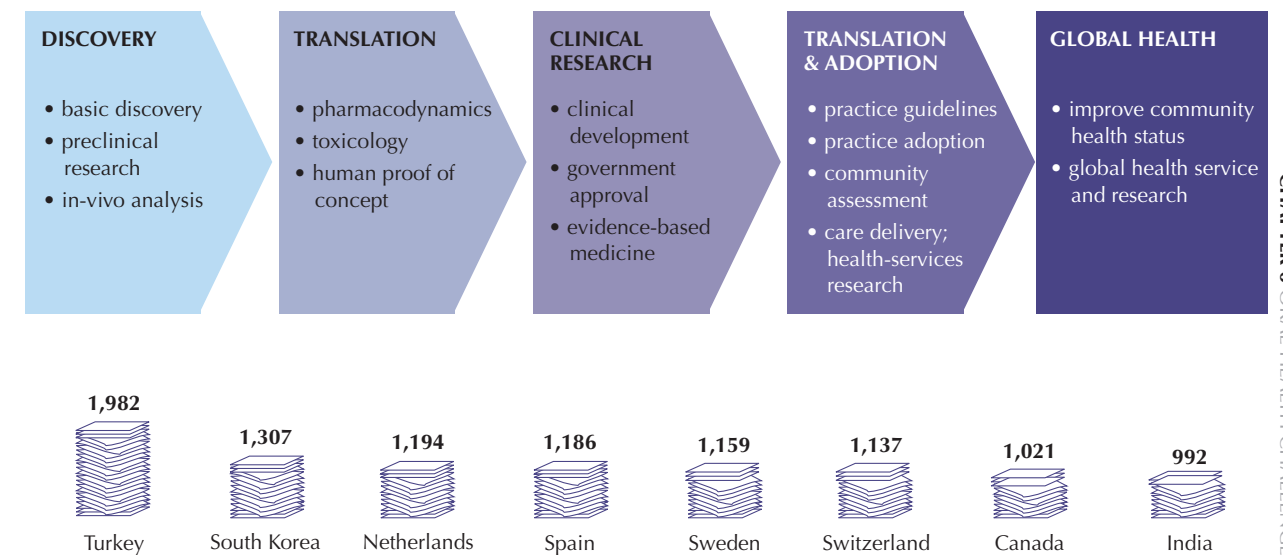


**THE IADR-GOHIRA RESEARCH PRIORITIES**  
The International Association for Dental Research (IADR) Global Oral Health Inequalities Research Agenda (GOHIRA) initiative has identified priorities for research required to implement strategies that could reduce oral health inequalities worldwide.

1	Identify critical gaps in knowledge.
2	Develop and implement, in partnership with cognate evidence-based medical and dental organizations, a knowledge base that uses a standard set of reporting criteria and includes a registry of implementation trials.
3	Emphasize the significance of psychosocial determinants of oral health, oral health-related behaviour, and oral healthcare-seeking behaviour, on whole populations and underprivileged communities.
4	Emphasize the importance of integrating research on oral health inequalities, with wider approaches to reducing health inequality as a whole.
5	Emphasize the importance of multi-disciplinary and translational research, seeking input from a range of social scientists and health professionals.
6	Develop disease-prevention strategies based on broad social and environmental determinants of health, adopting upstream rather than downstream strategies.
7	Develop strategies that are capable of local interpretation in a way that respects cultural sensitivities and socioeconomic constraints for improving oral health literacy.
8	Develop community-based regional- and country-level systems for oral health promotion and healthcare, recognizing previous experience and resource implications, and, where appropriate, emphasizing whole and at-risk populations.
9	Raise the issue of oral health inequalities, with the need to promote proportionate universalism and specific emphasis on underprivileged communities, in wider public debates.
10	Advocate for the inclusion of oral health with other sectors in all policies, in line with the Adelaide Statement of Health in All Policies.

## APPLYING RESEARCH FROM DISCOVERY TO HEALTH

Modified from Dzau et al, 2010







Historically, oral health and dentistry have struggled for recognition as a speciality separate from health and medicine. This long-held and deliberate focus on a separate ‘identity’ has now become recognized as one of the reasons for the low priority and neglect of oral health on international health agendas. The resulting disconnect between oral health, dentistry and the mainstream of global health policy and practice fails to recognize that oral health and oral healthcare are intrinsically linked with many other sectors, within and outside the field of health. As a consequence, there has been a failure to integrate oral health into overall health strategies and messages.

One of the main challenges faced by oral health professionals and dental public health advocates today is thus to ensure adequate recognition and consideration of oral health matters on the global health agenda. At the same time, policies need to be translated into tangible actions giving everyone equitable access to effective prevention and appropriate care.

The global fight against NCDs, which is now guided by the WHO’s global action plan, is a good example for the benefits of integrating oral and general health. Oral diseases are recognized as an area of major public health concern and a deeper integration of oral health into NCD policies could lead to general health benefits.

Oral health can benefit from strategies addressing NCDs, and in particular common risk factors; and vice versa, strategies aimed at

improving oral health can also yield important contributions towards achieving the voluntary global NCD targets set for 2025.

Similarly, oral diseases were directly or indirectly linked to all of the MDGs (2000–15). However, this entry point has not been used systematically to improve the prioritization and integration of oral health in international public health agendas. With the replacement of MDGs by a range of SDGs (2015–30), health will play a central role as a prerequisite and an outcome of sustainable development. Again, ensuring that oral health is related to SDG targets and indicators from the beginning will strengthen the case of cross-sectoral integration of oral health in the context of sustainable human development.

In particular, this strong connection can serve to promote oral healthcare in the context of Universal Health Coverage, which, as discussed in this chapter, constitutes an essential element to foster progress on oral health outcomes, inequalities and socioeconomic impact.

This chapter closes on an environmental note and, more specifically, on the Minamata Convention on Mercury. Oral health professionals and their representative organizations participated actively in the drafting process of the convention and the agreement to phase-down amalgam use. This involvement is another demonstration that the dental profession takes international responsibilities and commitments seriously; and that oral healthcare can be part and parcel of other important issues that top the global health and development agendas.

# Oral health and NCDs

NCDs are a growing global threat. Oral diseases are integral to prevention and control of NCDs.

## Political Declaration of the High-Level Meeting of the General Assembly on the Prevention and Control of Noncommunicable Diseases

We, Heads of State and Government and representatives of States and Governments...

1 Acknowledge that the global burden and threat of noncommunicable diseases constitutes one of the major challenges for development in the 21st century, which undermines social and economic development throughout the world and threatens the achievement of internationally agreed development goals;

19 Recognize that renal, oral and eye diseases pose a major health burden for many countries and that these diseases share common risk factors and can benefit from common responses to NCDs.

## A common action plan

Noncommunicable diseases (NCDs) are the leading cause of death and disability, responsible for over two-thirds of all deaths, 80 percent of which occur in low- and middle-income countries. The four main NCDs are cancer, diabetes and cardiovascular and chronic respiratory diseases. Oral diseases are important NCDs: untreated tooth decay is the single most prevalent and preventable disease, and oral cancer among the 10 most common cancers.

The underlying causes of NCDs are social, economic and environmental determinants, including poverty, unemployment, discrimination, and lack of education and inequitable trade policies; and common risk factors such as tobacco and alcohol use, lack of physical activity and unhealthy diets high in salt, saturated fat and free sugars. Oral diseases share all of these underlying determinants and risk factors with the other major NCDs. The Common Risk Factor Approach provides the basis for the inclusion of oral diseases in NCD prevention and control programmes.

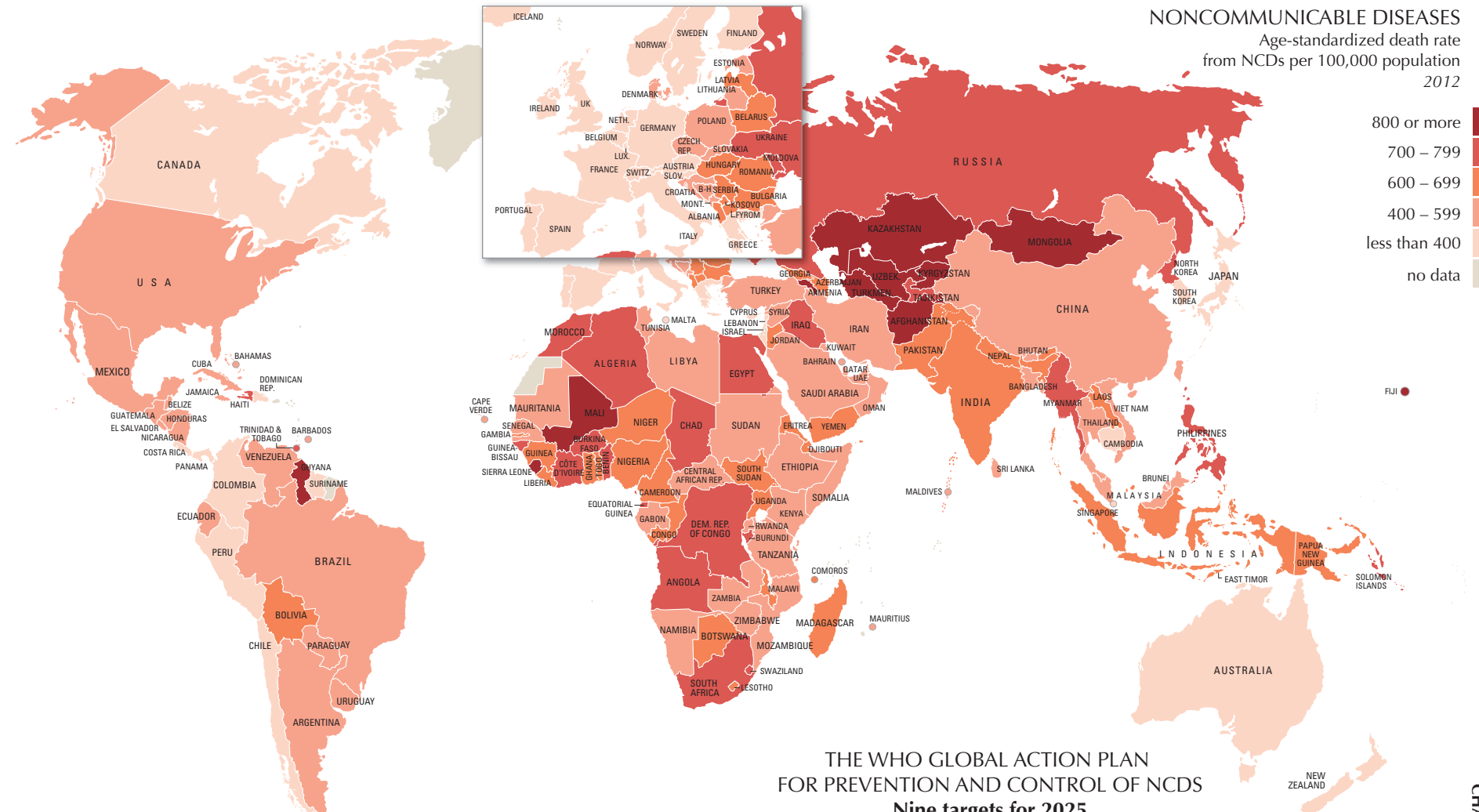
The growing burden of NCDs worldwide was recognized by the UN High-Level Meeting on the Prevention and Control of NCDs in 2011 which committed member states to a comprehensive range of actions to address NCDs. Paragraph 19 of the resulting political declaration explicitly mentions oral diseases as sharing the same determinants as the other NCDs.

WHO's World Health Assembly adopted a global action plan in 2013 to bring about a reduction in the global NCD burden. Although many countries have subsequently developed specific policies, the 2014 UN progress review revealed that more must be done. Continued advocacy for the integration of oral diseases into these national action plans is essential if reductions in oral health inequalities and the burden of oral disease are to be achieved.

## COST OF ACTION V INACTION ON NCDs

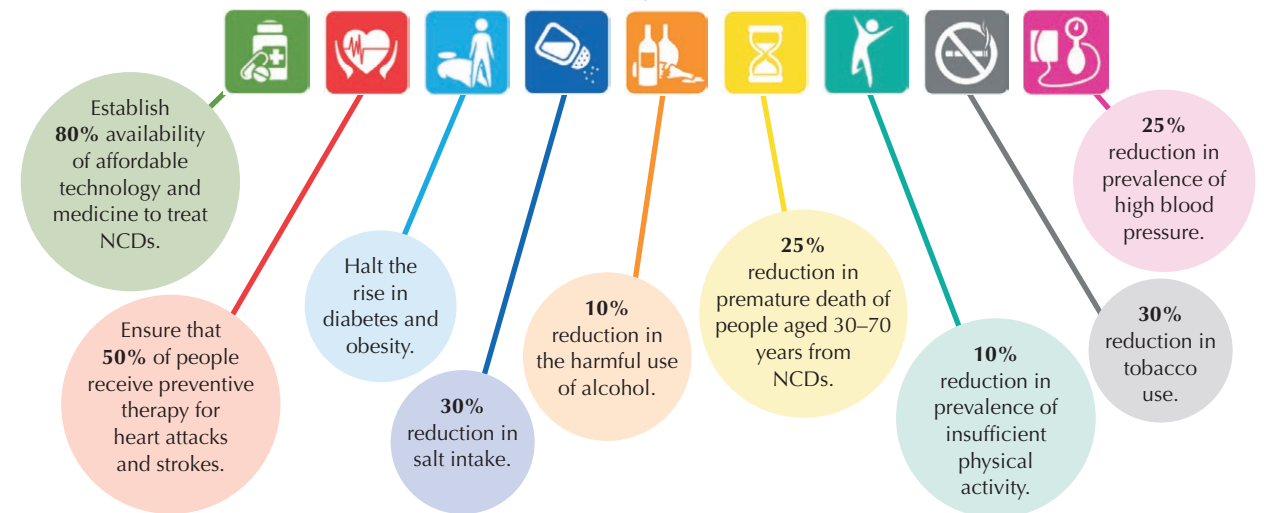
In low- and middle-income countries

<b>Action</b>	<b>US\$11 billion</b> a year estimated cost of implementing <b>Global Action Plan</b>
<b>Inaction</b>	<b>US\$7 trillion</b> over 15 years estimated loss of productivity and price of healthcare if no action is taken



## THE WHO GLOBAL ACTION PLAN FOR PREVENTION AND CONTROL OF NCDs

### Nine targets for 2025



# Oral health and NCDs

The global momentum for NCDs is a window of opportunity to improve oral health on a global scale.

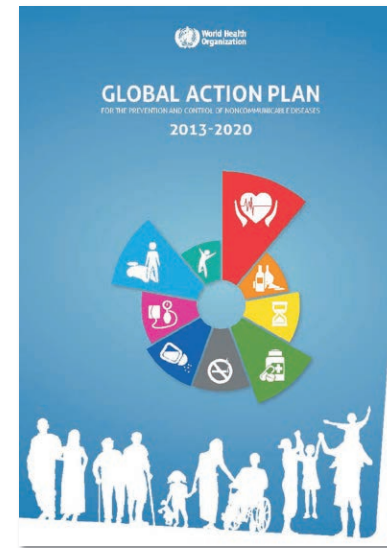
## A developing movement

The meeting of the UN General Assembly in 2011 and the adoption of the High-Level Political Declaration on Prevention and Control of Non-communicable Diseases marked a major turning point in global health. The declaration and the subsequent planning and target-setting process have recognized the shift from communicable towards noncommunicable diseases that will transform the global health landscape in the next decade. The increasing health, social, and financial burden they cause is the key factor for the prioritization of NCDs.

The prevention and control of NCDs is based on the integration of the Common Risk Factor Approach and interventions addressing the shared wider social determinants of health. Because oral diseases share the same risk factors and determinants, there is a compelling case for integrating oral health goals into approaches directed at all NCDs. Furthermore, evidence for the enormous economic and social impact of poor oral health continues to accumulate.

While oral health may benefit from strategies addressing NCDs, particularly from reducing consumption of sugar, tobacco and alcohol, strategies aimed at improving oral health can also make important contributions towards achieving the voluntary global NCD targets set for 2025. The WHO Sugars Guideline published in 2015 is an important example of this. The strong recommendation that sugars should not exceed 10 percent of energy intake was based on evidence for their effect on tooth decay. However, it is anticipated that adherence to the guidelines will also reduce other NCDs, especially obesity.

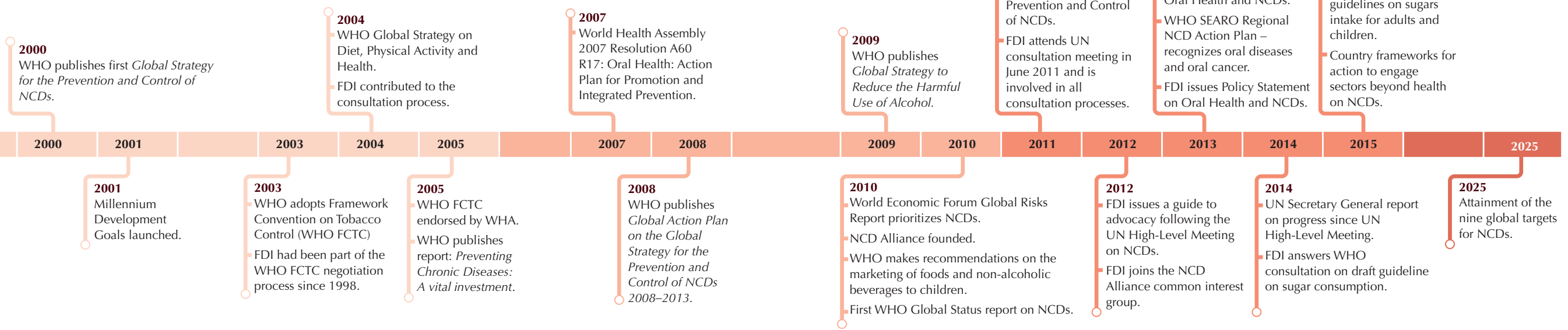
Because so many of the determinants of both oral and general health lie outside the direct influence of healthcare systems, comprehensive intersectoral action is required to achieve improvements in health. It is imperative that oral health is included in all such strategies directed against the NCD epidemic. Every opportunity should be taken to advocate for the inclusion of 'Oral Health in all Policies'.



**“Oral diseases are often overlooked among NCDs by the international community, and it is a health area that we cannot afford to ignore and that is largely preventable. I implore my fellow heads of state and governments to include oral health among the NCDs, and for health ministries to become more engaged. We must have a shared sense of moral duty to make proper oral health a priority.”**

Jakaya Mrisho Kikwete, President of Tanzania, 2011

## A GLOBAL MOVEMENT AND ITS MILESTONES



# Oral health and global development

**Linking and integrating oral health with the SDGs is crucial for better prioritization of oral diseases in the context of global public health and development.**

The Millennium Development Goals (MDGs) from 2000 to 2015 were a concerted international effort to eradicate extreme poverty, to promote education, health and environmental protection, as well as to accelerate development and cooperation worldwide through a set of eight agreed goals. These were supported by a comprehensive monitoring mechanism that obliged UN member states to track progress and report regularly. Health was directly addressed by three of the eight goals.

Oral diseases are linked, directly and indirectly, to all eight MDGs; however, this advocacy opportunity was not systematically used to improve prioritization and integration of oral health on international public health agendas.

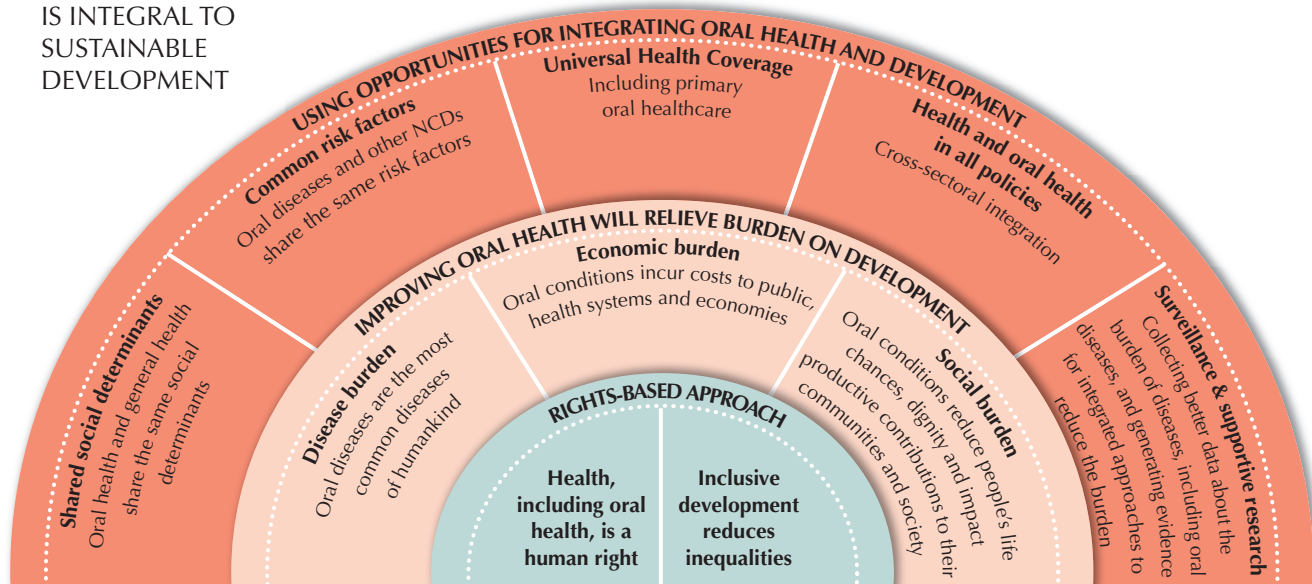
With the MDGs expiring by the end of 2015, the UN has put a global consultative process in place to take stock of the MDG achievements and to develop a set of Sustainable Development Goals (SDGs) for the period 2015 to 2030. The SDGs set new global priorities to promote sustainable and equitable development across the world. They carry forward some of the unfinished MDG commitments,

reinforce those where progress was made, but also put new emphasis on a framework for integrating action across multiple sectors to facilitate human development in a manner that optimizes the use of planetary resources without endangering sustainability.

Health, as a precondition and an outcome of sustainable development, has a central role in the SDG context, in particular through Goal 3, to 'Ensure healthy lives and promote well-being for all at all ages', which includes 13 health targets. Of these 13 targets, at least seven are of direct concern to the oral health community.

It will therefore be important to relate oral health systematically to the goals of the SDGs, their indicators and targets from the outset. This will provide a framework for the systematic inclusion of oral healthcare in strengthening health systems, to promote oral healthcare and prevention in the context of NCDs and universal health coverage; and to make strong advocacy arguments for cross-cutting and multi-sectoral integration of oral health in sustainable human development.

ORAL HEALTH IS INTEGRAL TO SUSTAINABLE DEVELOPMENT



## STRENGTHS AND WEAKNESSES OF THE MILLENNIUM DEVELOPMENT GOALS (2000–15)



**“Oral diseases are an obstacle to development. Something as preventable as tooth decay can impair people’s ability to eat, to interact with others, attend school, or work. These consequences all detract from human wellbeing, economic potential, and development progress.”**

*Helen Clark, Administrator of the UNDP, 2011*



# Universal Health Coverage

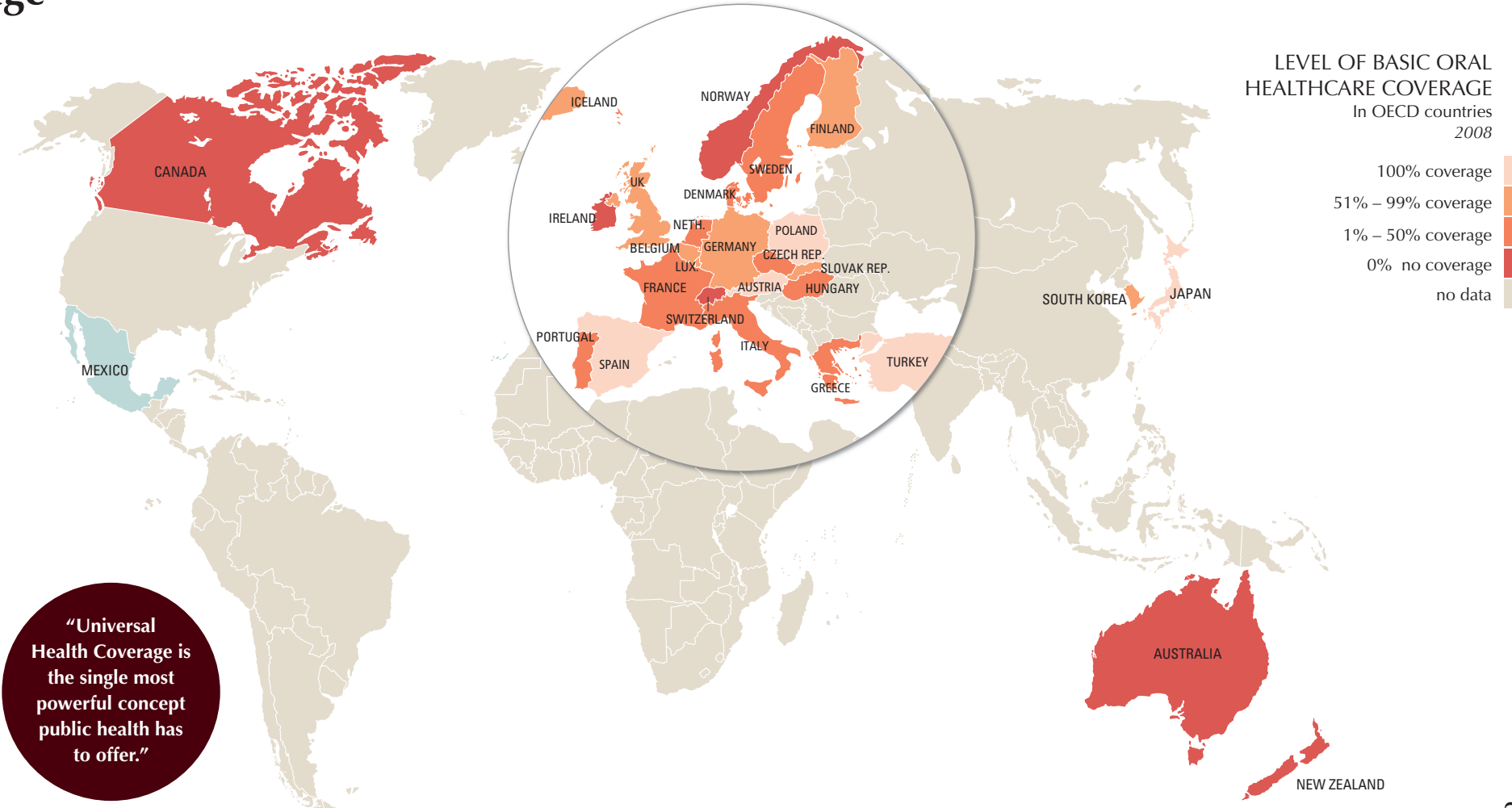
**Basic oral healthcare should be an integral part of Universal Health Coverage, an increasingly recognized concept aiming to ensure access to basic primary health services for all.**

The concept of Universal Health Coverage (UHC) has gained increasing attention since the first related WHO resolution in 2005. WHO defines UHC as a system in which ‘all people have access to services and do not suffer financial hardship paying for them’. The goal of UHC is thus to guarantee access to healthcare for all and to provide financial protection.

UHC alone does not eliminate inequalities, but it is a major step towards that goal, especially when combined with other measures addressing determinants of health. Truly ‘universal’ health coverage will only be achieved when promotive, preventive, curative and rehabilitative oral healthcare are fully integrated in the wider health system context. Moreover, appropriate financing mechanisms must cover all population groups, including the most disadvantaged such as the poor, disabled, immigrants and others.

To date, there is no generally agreed concept or solution for the variety of national contexts, needs and resources. Countries across the world include dental services with varying levels of coverage, depending on their economic resources and political priorities. Most high-income countries are implementing reforms to contain costs, particularly by increasing co-payment for services deemed non-essential, such as eye and dental care.

On the other hand, many low- and middle-income countries are trying to address health needs by providing minimum primary care services to the majority of people covered by health insurance systems and other financing mechanisms. At present a global picture of the extent of inclusion of oral healthcare services is not available. Increased focus on implementation and health-service research is required to evaluate existing Universal Oral Health Care models and to guide evidence-based policy decisions for new ones.



**LEVEL OF BASIC ORAL HEALTHCARE COVERAGE**  
In OECD countries  
2008

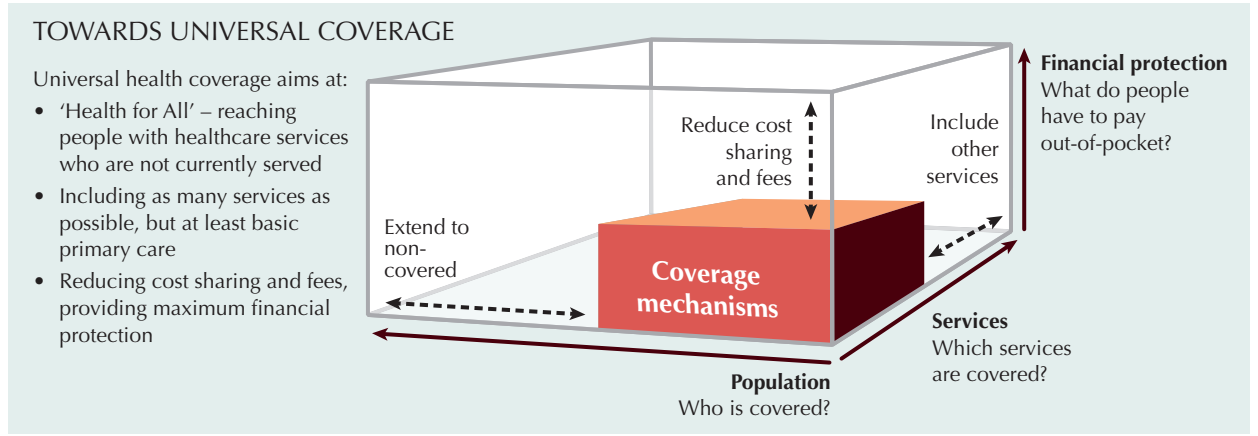
- 100% coverage
- 51% – 99% coverage
- 1% – 50% coverage
- 0% no coverage
- no data

**“Universal Health Coverage is the single most powerful concept public health has to offer.”**

*Margaret Chan, WHO Director-General, 2015*

**“Every member of a society should have healthcare coverage. Because oral health is integral to overall health and oral healthcare is an essential type of primary healthcare, access to oral healthcare coverage should be universal.”**

*Scott Tomar, Professor at the University of Florida, College of Dentistry, and Lois Cohen, Ambassador for Global Health Research, 2010*



# Amalgam and the Minamata Convention

**The Minamata Convention on Mercury provides challenges to current dental practice, but it is also an opportunity for innovation and better prioritization of oral disease prevention.**

Minamata disease, named after the Japanese city where the neurological condition bearing its name was discovered in 1956, is caused by severe mercury poisoning. Extreme symptoms include mental retardation, paralysis, coma, and even death. A congenital form of the disease can also affect the unborn foetus.

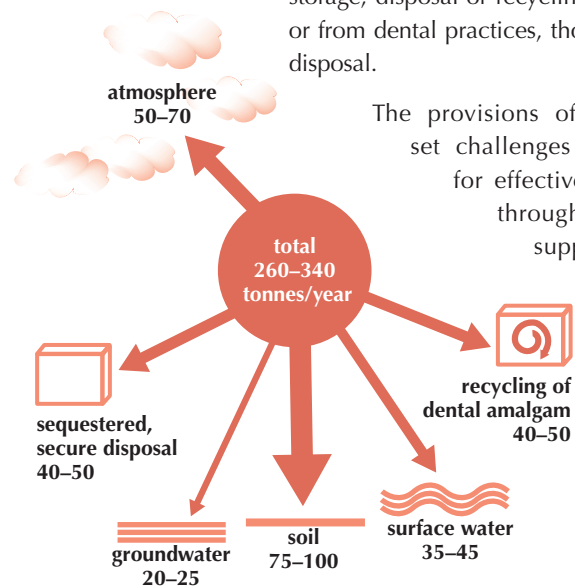
To address the health and environmental threats of mercury use, the United Nations Environment Programme (UNEP) initiated the process in 2009 to develop the Minamata Convention on Mercury. This global, legally binding convention was adopted in 2013 and opened for signature.

The Convention's impact on dentistry is considerable because it requires the gradual phase-down of dental amalgam, a mercury-containing, cost-effective metal-alloy filling material used in restorative dentistry for well over 150 years. Global consumption of mercury for dental use reached about 8 percent of overall mercury consumption in 2000. While amalgam use accounts for less than 1 percent of global mercury emissions, there are concerns that mercury can escape during manufacture, storage, disposal or recycling, from crematoria or from dental practices, though inappropriate disposal.

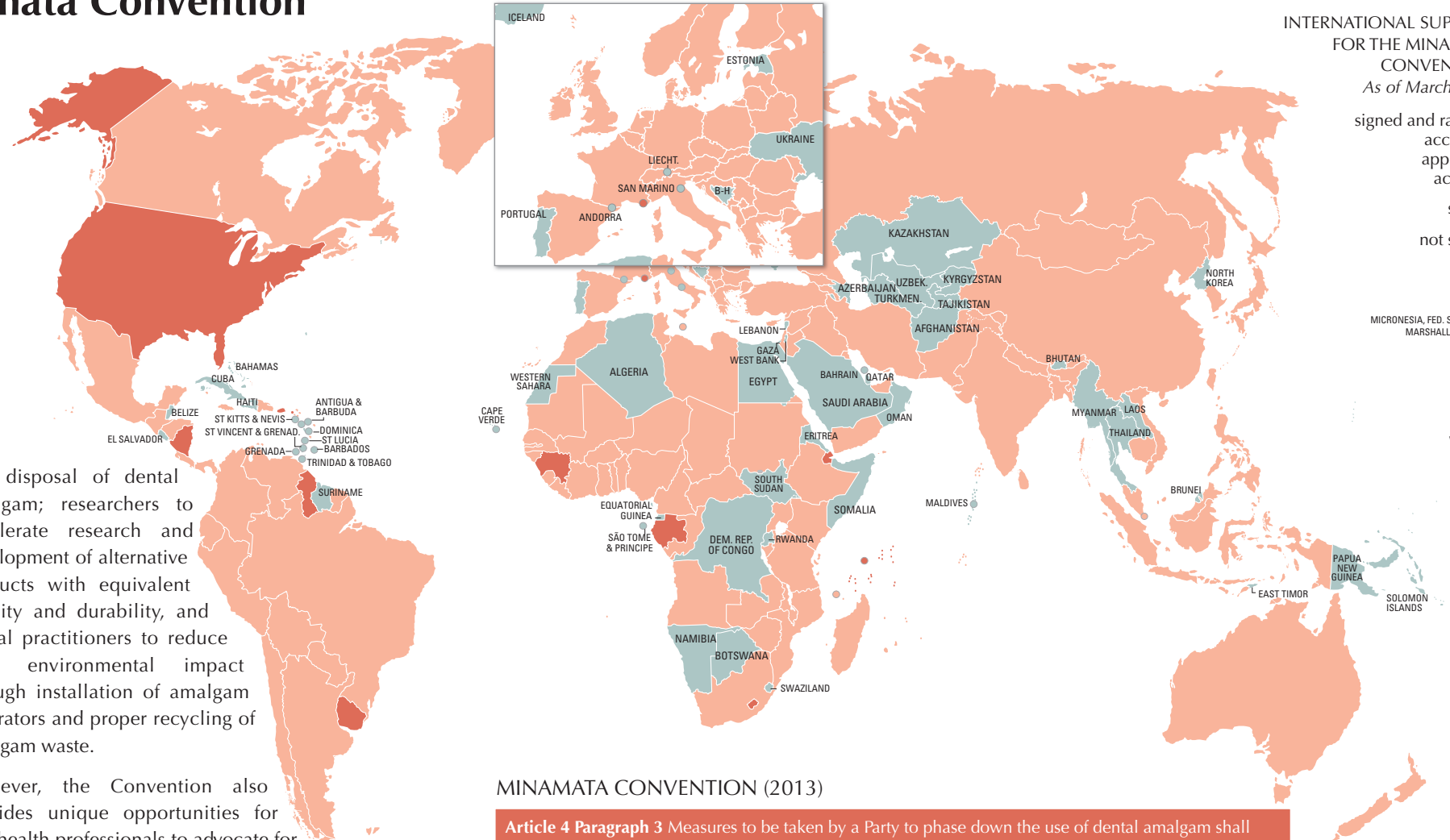
and disposal of dental amalgam; researchers to accelerate research and development of alternative products with equivalent solidity and durability, and dental practitioners to reduce their environmental impact through installation of amalgam separators and proper recycling of amalgam waste.

However, the Convention also provides unique opportunities for oral health professionals to advocate for effective prevention strategies against tooth decay; and for policy makers to prioritize prevention and control of oral diseases as part of primary healthcare, so that the long-term need for dental fillings is reduced.

The provisions of the Convention set challenges to: governments for effective implementation through regulation of supply, import, use



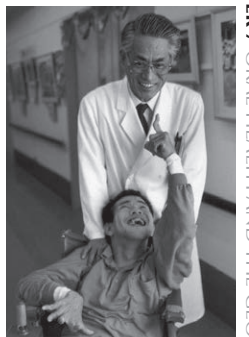
**MAJOR PATHWAYS OF MERCURY RELEASE INTO THE ENVIRONMENT DUE TO DENTAL AMALGAM USE**  
Metric tonnes per year



## MINAMATA CONVENTION (2013)

**Article 4 Paragraph 3** Measures to be taken by a Party to phase down the use of dental amalgam shall take into account the Party's domestic circumstances and relevant international guidance and shall include two or more of the measures from the following list:

- 1 Setting national objectives aiming at dental caries prevention and health promotion, thereby minimizing the need for dental restoration;
- 2 Setting national objectives aiming at minimizing its use;
- 3 Promoting the use of cost-effective and clinically effective mercury-free alternatives for dental restoration;
- 4 Promoting research and development of quality mercury-free materials for dental restoration;
- 5 Encouraging representative professional organizations and dental schools to educate and train dental professionals and students on the use of mercury-free dental restoration alternatives and on promoting best management practices;
- 6 Discouraging insurance policies and programmes that favour dental amalgam use over mercury-free dental restoration;
- 7 Encouraging insurance policies and programmes that favour the use of quality alternatives to dental amalgam for dental restoration;
- 8 Restricting the use of dental amalgam to its encapsulated form;
- 9 Promoting the use of best environmental practices in dental facilities to reduce releases of mercury and mercury compounds to water and land.



Dr Moryama with Mr Hannaga – a congenital Minamata disease patient at Meisui-en Hospital, 1991.



*The Challenge of Oral Disease – A call for global action* provides a brief account of the global challenge that the burden of oral disease presents to all countries. It also makes recommendations for action to address this unacceptable burden and reduce the impact of these largely preventable diseases.

The challenges associated with a rapidly growing global population, particularly in middle-income countries, exacerbated by rising exposure to common NCD risk factors, lead to increasing pressures on already strained health systems. Despite progress and advances in some areas, the state of the world's oral health is still characterized by neglect, low prioritization and inadequate responses of governments and national health systems.

Even in high-income countries, large segments of the population have limited access to oral healthcare, so that much of the oral disease burden remains untreated. Moreover, there is a paucity of good country-level data on the prevalence of oral disease, especially in low- and middle-income countries, which handicaps the ability of governments to

implement public health planning and the development of appropriate preventive and curative programmes.

It is now time for governments and policy makers to respond to the global oral health crisis and act to reduce the burden of oral disease, through the implementation of evidence-based policies and strategies. The current momentum in the prevention and control of NCDs provides a unique opportunity for the integration of measures to improve oral health and general health. This book outlines some of the possible approaches to achieve better recognition, integration and prioritization of oral diseases at the community, national, regional and international level.

All chapters of *The Challenge of Oral Disease – A call for global action* provide practical recommendations and guidance for action. The following presents the key points in a summarized style, in order to facilitate advocacy and ready access to the most important aspects. This section may thus be used as a blueprint for addressing challenges related to oral diseases.

## Oral and general health – the life-course approach

### Healthy primary and permanent teeth – important for health and wellbeing throughout life

Oral diseases have a major adverse impact on general health and on quality of life. A healthy and well-functioning dentition is important during all stages of life to support essential human functions, such as speaking, smiling, socializing and eating.

- Good oral hygiene practices and professional oral care, combined with a healthy lifestyle and avoiding risks such as high sugar consumption and smoking make it possible to retain a functioning dentition through life.

### Oral health and general health – closely related and to be considered holistically

The global improvement in life expectancy, and the resulting increase in the population of older people, makes a life-course approach to oral health very important.

- The close bi-directional relationship between oral and general health provides a strong conceptual basis for the integration of oral healthcare into general healthcare.
- Knowledge and awareness of the close associations between oral and general health, and the collaboration between oral and general health professionals is important for holistic care.

## The burden of oral diseases – a largely neglected reality

### Tooth decay – addressing the most common chronic disease worldwide

Untreated tooth decay is the most common chronic disease and a major global public health problem, with significant impacts on individuals, health systems and economies. Tooth decay is a complex multifactorial disease, but the main reason for its high prevalence is high sugar consumption, coupled with the lack of effective preventive strategies and limited access to appropriate oral healthcare.

- Tooth decay can largely be prevented by reducing sugar consumption, increasing appropriate fluoride use and by maintaining good oral hygiene.
- Early detection and care may reduce the progression of the disease to more severe forms.
- In order to reduce the disease burden, full integration of oral health into population-wide prevention and health-promotion strategies for NCD reduction is necessary, along with universal access to affordable fluoride and inclusion of primary oral healthcare in universal health coverage.

### Periodontal disease – a common but preventable oral condition

Periodontal disease is among the most common diseases of humankind, with close associations to general health. It is largely preventable through good oral hygiene and preventive policies addressing common determinants.

- Implementing population-wide strategies to maintain a healthy lifestyle, with low exposure to risk factors such as tobacco or alcohol use, along with good oral hygiene and regular check-ups, are important approaches in the prevention of periodontal disease.
- Early detection through regular visits to the dentist can help to address the progression from mild to severe forms of periodontitis.
- Management and prevention of periodontal disease should be integrated into strategies for addressing other oral diseases and NCDs. This will also require increased inter-professional collaboration between oral and general health professionals.

### Oral cancer – a challenge to public health in many countries

Oral cancer is among the 10 most common cancers worldwide and shows considerable regional variation. Survival rates are low compared to other cancers due to late detection and the complexities of appropriate care. The impacts on quality of life for those who survive the disease can be high.

- Reducing the main risk factors (tobacco use and excessive alcohol consumption) is effective in addressing the high incidence of oral cancer.
- Early detection can improve treatment outcomes through timely referral for specialist care. General population-wide

screening is not recommended, but there is good evidence for the screening of patients with risk factors.

- Appropriate specialist care should be part of universal health coverage, particularly in countries with high prevalence, in order to improve patient survival rates and quality of life, as well as to avoid catastrophic health expenditures for patients and families affected.
- Integrating oral cancer prevention and control into prevention and control of cancer in the context of NCDs is required to reduce incidence and improve treatment outcomes.

### Other oral conditions – high combined burden and impacts

HIV infection may be associated with important symptoms in the mouth, which impact the quality of life and nutrition of those affected. The involvement of oral health professionals in effective multi-disciplinary care is essential.

- Dentists and oral healthcare professionals have an obligation to provide ethical, equitable care to all patients, irrespective of their HIV status.
- Patients with oral manifestations should be referred for testing for HIV/AIDS, have appropriate medical follow-up, and be monitored for compliance with Highly Active Anti-Retroviral Treatment.

Noma is a disease of poverty and neglect, disfiguring and killing mainly children in Sub-Saharan Africa.

- Early detection, simple emergency primary healthcare and referral to specialist care are essential to prevent rapid disease progression. Measures addressing poverty and nutrition, basic healthcare and immunization of children, together with better awareness of this condition, may reduce the number of cases.

Cleft lip and/or palate are the most common congenital defects of the face and mouth, creating a heavy burden in terms of mortality, disability, quality of life and financial cost.

- Primary prevention and essential surgery services for birth defects such as cleft lip and/or palate must be part of integrated health-system strengthening in low- and middle-income countries.

Trauma to orofacial structures and teeth is common and can be prevented by improving public health policies and raising awareness of risks related to violence, sports and road safety.

- Policies and approaches to increase road-traffic safety, reduce violence and bullying at school, increase safety for contact sports, as well as improve post-trauma response through appropriate emergency care are important.

### Improving oral disease surveillance and data collection

The persisting gaps in data on the prevalence of oral diseases, and their burden and severity in different populations, means that awareness of the significance of these diseases is poor. Lack of good information creates a barrier to prioritizing their prevention and treatment, and limits the development of effective public health responses. There is thus a need for:

- Oral health and disease indicators to be included systematically in regular disease surveillance and epidemiological monitoring, including data on the related risk factors.
- Cancer registries to be strengthened to cover oral cancer effectively.
- Monitoring of noma, orofacial trauma and congenital malformations to be improved.
- Collected data to be made universally accessible and compiled in repositories, so that they are available for research and informed policy decision making.



## Social determinants and common risk factors – the main drivers of oral diseases

Both the general and oral health of whole populations are largely determined by social factors and their interaction with a set of common risk factors, namely sugar, tobacco, alcohol and poor diet.

- Policies and approaches aimed at reducing poverty, increasing social inclusion and improving the general levels of education and employment, combined with reducing barriers to healthcare, promoting affordable housing, safe water and sanitation, and protecting minority and vulnerable groups have the greatest potential to deliver sustainable improved health and oral health status.
- Systematically including health and oral health in all policies can help to reduce negative effects on health equity of policy decisions in other sectors and can contribute to increasing synergies for better health status of populations.
- Working effectively across disciplines and sectors has significant potential to reduce inequalities.
- Tackling inequalities requires action across the whole social gradient to deliver the greatest population-wide benefit.
- Effective measures to reduce exposure to risk factors to health and oral health are a key responsibility of governments in the context of protecting populations and improving their quality of life.

### Sugar consumption

Sugar is a leading risk factor for tooth decay. Population-wide strategies and policies to reduce sugar consumption as part of a healthy diet have the highest potential to promote better oral health. At the same time they also address diabetes, obesity and other NCDs. Such policies include, but are not limited to:

- Higher taxation on sugar-rich food and sugar-sweetened beverages.
- Transparent food labelling for informed consumer choices.
- Limiting the marketing and availability of sugar-rich foods and sugar-sweetened beverages to children and adolescents.
- Simplified nutrition guidelines, including sugar intake, to promote healthy eating and drinking.
- Strong regulation of sugar in baby foods and sugar-sweetened beverages.

### Tobacco use

Tobacco use in all forms is harmful to health, including oral health. Dentists and their teams can effectively help patients to quit and address tobacco-related oral diseases; policies to strengthen tobacco control include, but are not limited to:

- Protecting people from tobacco smoke, offering help to quit tobacco use and warning about the dangers of tobacco.
- Raising taxes on tobacco products to reduce consumption.
- Enforcing bans on tobacco advertising, promotion and sponsorship.

### Harmful use of alcohol

Harmful use of alcohol is a major risk factor for more than 200 diseases, including oral cancer and periodontal disease, and must be addressed as part of a comprehensive approach to NCDs; measures include but are not limited to:

- Raising taxes on alcoholic beverages to reduce consumption.
- Implementing and enforcing effective measures that regulate alcohol availability as well as strict zero-tolerance policies for drink driving.
- Regulating, reducing or banning alcohol advertising and promotion.

### Unhealthy diet

A healthy diet, low in sugar, salt and fat, contributes to reducing the risk of oral diseases, obesity, diabetes and other NCDs. Measures include, but are not limited to:

- Restricting sales, limiting serving sizes and availability, and increasing taxation on unhealthy food products; and banning unhealthy food from the school environment.
- Regulation of advertising and sponsorship of food manufacturers and implementing systematic consumer-friendly food-labelling regulations to facilitate informed food choices in every country.
- Promoting breastfeeding following WHO recommendations to improve nutrition and growth.
- Promoting natural and indigenous products with good nutritional values over the use of processed food through integrated nutrition counselling.

## Inequalities in oral health – disease burden, impact and access to care

Socioeconomic status is a fundamental determinant of both oral and general health. Action to reduce oral health inequalities needs to address the underlying causes of disease. Oral conditions have considerable impact on the quality of life of individuals and societies, particularly among younger population groups and those with lower socioeconomic position. Oral diseases have considerable impact in terms of treatment costs and productivity losses; equitable access to oral healthcare is a major public health challenge, and substantial inequalities persist between population groups and countries. Dental teams and their national professional bodies have an important advocacy role in promoting policies to reduce health inequalities in the populations they serve. Policy measures include, but are not limited to:

### Providing oral health care and prevention

#### Dentists and the dental team – key providers of oral care in the wider healthcare system

Oral healthcare is best delivered by a team led and supervised by dentists, and composed of oral health professionals with different skills and training, thus ensuring quality care for all. Dentists are the principal providers of oral disease treatment and prevention. Their role is changing in response to changing risk factors, evolving disease burdens, demographic changes, and broader health system and socioeconomic pressures.

Access to basic oral care is mandatory for everyone in all countries. It is possible even for resource-poor health systems, through the use of cost-effective, evidence-based interventions that emphasize prevention and self-care. An ideal primary (oral) healthcare system should provide universal coverage, be people-centred, have demand-led policies and programmes, and be integrated with general health in all policies, including labour, environment and education. Among other measures, this calls for:

- Embedding strategic oral health workforce planning in overall planning for human resources in health in order to reduce crucial service and access gaps.
- Addressing the gap between the burden of disease and the availability of care by creating dentist-led oral healthcare teams that include a flexible mix of complementary mid-level providers and others in the context of primary health care, as required by local needs and determined by local legislation.

- Public health action on the broader determinants of health, with particular emphasis on the younger generation, where inequalities in quality of life seem to be more pronounced.
- Extending coverage of health insurance, and improving the availability of oral healthcare services targeting disadvantaged population groups.
- Working in partnership across relevant sectors, agencies and professions, using upstream, midstream and downstream strategies.

- Including the dental profession in the planning, development and implementation of oral healthcare services, thus ensuring the provision of equitable and appropriate oral healthcare for all.

#### Self-care and prevention through fluorides and fluoride toothpaste

The use of fluorides for the prevention of tooth decay is safe, efficient and highly cost-effective. Consequently, increased efforts are required to promote access and use of appropriate fluorides, particularly of fluoride toothpaste, in order to achieve universal access. Among other measures, this calls for:

- Evidence-based selection of the most appropriate delivery method of fluorides for dental health, depending on local contexts and resources.
- Improving the monitoring and evaluation of population-wide fluoridation interventions to strengthen the evidence-base for effective programme planning.
- Removal of taxation and tariffs on fluoride products, mainly fluoride toothpaste in order to increase affordability; taxation of oral health products without fluoride should be increased to discourage the use of such products.
- Improvement of capacities of national food and drug administrations for better monitoring of toothpaste quality, as well as strengthening and enforcing the regulations of ISO 11609, which defines the minimum standards for toothpaste quality and labelling.

## Challenges in dental education, care and research

Contemporary dental education aims at producing oral health professionals equipped with the required mix of skills and competencies to meet the needs of their patients and populations; yet commercialism and the rapidly changing context for education is challenging. Moreover, migration and mobility of oral health professionals and of patients pose challenges and result from complex push and pull factors. The positive and negative impacts on sending and receiving countries need to be balanced through appropriate policies and regulations. Therefore, oral health research, encompassing the full range of basic, clinical, translational and applied health-system research is essential to understand, address and evaluate the multitude of approaches needed to improve oral health worldwide.

- The integration of dental education with general health professional education is a crucial element in shaping the scope of practice, and scaling up the number and impact of oral health professionals worldwide.

- Adequate public investments in oral and health professional education are required, together with curricular and institutional reforms, in order to create an effective global oral health workforce.
- Implementation of existing codes of practice for international recruitment alongside policy options for countries to facilitate effective national workforce planning, mitigate possible negative effects of international migration, and monitor workforce flows more effectively.
- Developing and coordinating international collaborative research priorities in order to fill essential knowledge gaps in oral health.
- A particular focus on evaluating social and behavioural interventions, implementation and delivery will be required if the major global oral health inequalities are to be reduced.

## Oral health and the global agenda

The context of the international policy environment provides challenges and opportunities for better recognition, prioritization and integration of oral health. Linking to and using these opportunities may accelerate the process of stepping-up responses on all levels to the growing global burden of oral diseases. Relevant international developments include, but are not limited to:

### Prevention and control of NCDs

NCDs are a growing global threat. Oral diseases are integral to prevention and control of NCDs. The global momentum for NCDs is a window of opportunity to improve oral health on a global scale. This requires, among others:

- Continued advocacy for the integration of oral diseases into action plans for prevention and control of NCDs.
- Comprehensive inter-sectoral action and inter-professional collaboration to achieve improvements in health and oral health.

### Oral health and global development

Linking and integrating oral health with the Sustainable Development Goals is crucial for better prioritization of oral diseases in the context of global public health and development.

- It will be important to relate oral health systematically to the objectives of the SDGs, their indicators and targets from the outset.

- This will provide a framework for the systematic inclusion of oral healthcare in strengthening health systems, to promote oral healthcare and prevention in the context of universal health coverage; and to make strong advocacy arguments for cross-sectoral integration of oral health in sustainable human development.

### Universal Health Coverage

Basic oral healthcare should be an integral part of Universal Health Coverage, an increasingly recognized concept aiming to ensure access to basic primary health services for all.

- Increased focus on implementation and health-service research is required to evaluate existing Universal Oral Health Care models and to guide evidence-based policy decisions for new ones.

### The Minamata Convention on Mercury

The Minamata Convention on Mercury aims at a complete elimination of mercury from the environment, including the use in dentistry through dental amalgam fillings. The convention includes provisions for increased investments in oral health promotion and prevention to reduce the need for restorative care. Depending on circumstances this may provide for major opportunities to prioritize prevention and control of oral disease.

# Milestones in Dentistry 7000 BCE – AD 1699

**7000 BCE Pakistan** Stone-age cultures in Baluchistan ('Indus Culture') use bow drills with flint burs to remove decayed tooth substance.

**5000 BCE Iraq** A Sumerian text describes 'tooth worms' as the cause of dental decay. This may be the earliest observation of the dental pulp.

**2700 BCE China** Acupuncture is used to treat toothache.



**2660 BCE Egypt** The Third Dynasty tomb of Hesy-Ra, describing him as 'the greatest of those who deal with teeth, and of physicians', and the tombs of three other named Fifth Dynasty dental specialists, all at Saqqara, reveal early specialization.

**1750 BCE Mesopotamia** Law 200 of the famous code of Hammurabi states that 'if someone knocks out the tooth of an equal, his own tooth is knocked out'.

**1700–1550 BCE Egypt** The Ebers Papyrus, a 21-metre-long text, describes extensively the knowledge and treatment of dental diseases of the time.



**900–300 BCE Americas** The Mayans implant semi-precious stones such as jade in teeth for cosmetic and cultural reasons. Front teeth are filed into different shapes to resemble sharp animal teeth.



**700 BCE Myanmar** Teeth found in the Halin area show gold-foil fillings probably made for cultural or ceremonial reasons.

**659 BCE China** Su Kung mentions amalgam for filling a decayed tooth in his *Materia Medica*.



**600 BCE – AD 400 Italy/Europe** The Etruscans and Romans become experts in restorative dentistry and make gold crowns and fixed bridgework. Full and partial dentures are not uncommon.

**500 BCE China/India** Recipes are described for a paste to clean teeth.

**450 BCE India** The process of crystallizing sugar-cane juice is invented.

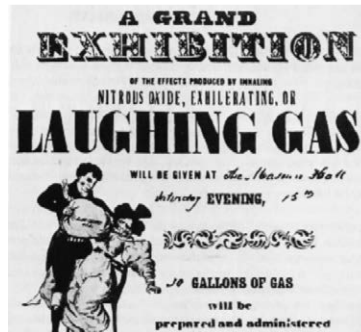
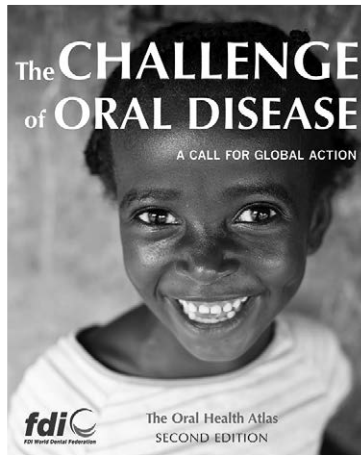
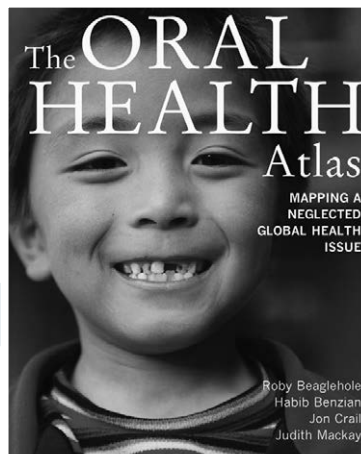
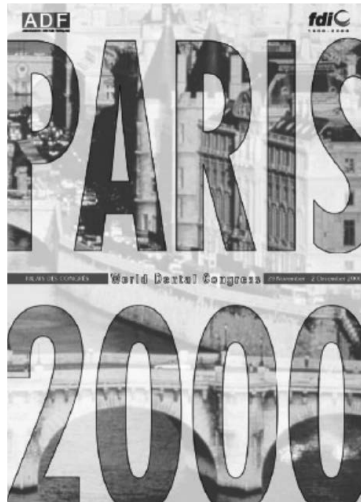
**450 BCE Italy** The Roman laws of the 12 tables bans placing gold in tombs except for gold in teeth. Bones, eggshells and oyster shells mixed with honey are used to cleanse the teeth. Aristocrats employ special slaves to clean their teeth.

**460–322 BCE Greece** Scientist and philosopher Hippocrates describes disposition, saliva and nutrition as the causing factors for caries, contradicting the prevailing belief that tooth worms are causing disease. Aristotle writes about dentistry, including the eruption pattern of teeth, treating decayed teeth and periodontal disease, extracting teeth with forceps, and using wires to stabilize loose teeth and fractured jaws. However, he wrongly believes that male humans, sheep, goats and pigs have more teeth than females.

**50–25 BCE Italy** Roman medical writer Aulus Cornelius Celsus summarizes contemporary knowledge of medicine and writes about oral hygiene, stabilization of loose teeth, treatment for toothache and tooth replacement. He stresses the great care needed when extracting teeth, and describes the method to reset a dislocated mandible still used today.

**174 AD Italy** Galen, the personal physician to Emperor Marcus Aurelius, collects all knowledge and his own research about medicine, including oral diseases. He states that 'Soon there will be more doctors than parts of the body and each disease will have its own doctor.'

## Annex



## Milestones in Dentistry 1700–1899

**650 India** Indian author Vagbhata describes 75 oral diseases.

**500–1000 Europe** During the Middle Ages, medicine, surgery, and dentistry are generally practised by monks, the most educated people of the period. While knowledge from Roman and Greek times has been lost, new folk medicine emerges with many doubtful practices, such as blood-letting.

**963–1013 Spain** Abù I-Qàsım (Abulcasis), an Arab surgeon from Spain, recovers the dental knowledge of the Greco-Roman world, and editions of his work circulate widely in Europe, some carrying fine illustrations of dental instruments for scaling, cautery of the pulp, and extraction.



**980–1037 Iran/Uzbekistan** Physician and philosopher Ibn Sinà, also known as Avicenna, describes medical knowledge of the time and covers dental diseases and treatment as well. His writings influence European medical thinking throughout the Middle Ages.

**1258 France** A Guild of Barbers is established. Barbers eventually evolve into two groups: surgeons, who are educated and trained to perform complex surgical operations, and lay barbers, or barber-surgeons, who perform more routine hygiene services, including shaving, bleeding and tooth extraction.

**1280 China** Medicine is divided into 13 specialisms, among them dentistry.

**1400s France** A series of royal decrees prohibits lay barbers from practising all surgical procedures except bleeding, cupping, leeching, and extracting teeth.

**1498 China** A toothbrush with bristles is first described.

**1500 The Caribbean** Sugar-cane plantations are established in the new colonies, particularly in the Canaries and the West Indies.

**1530 Germany** The first book devoted entirely to dentistry, *The Little Medicinal Book for All Kinds of Diseases and Infirmities of the Teeth*, is published. It covers practical topics such as oral hygiene, tooth extraction, drilling teeth, and placement of gold fillings. It is a standard textbook for more than 200 years. The last edition of the book is published in 1756.

**1533–1603 England** Queen Elizabeth I fills the gaps in her dentition with cloth to improve her appearance in public.

**1575 France** Ambrose Paré, known as the Father of Surgery, publishes his *Complete Works*, which includes practical information about surgery, such as tooth extraction, the treatment of tooth decay and jaw fractures. He also performs the first cleft-lip surgery.

**1664 onwards UK/Italy/Holland** At Oxford, and in London in the new Royal Society, the discoveries of the innervations of the teeth and jaws by Willis, of the microscopic appearance of the teeth and of the living and inanimate bodies to be observed in dental calculus by van Leeuwenhoek, and of the capillaries by Malpighi and more were published, as true science came to dentistry. Van Leeuwenhoek identifies some 'tooth worms' sent to him as cheese mites.

**1685 UK** Charles Allen publishes his book *The operator for the teeth* which goes into three editions and incorporates the recent discoveries, and some of his own, setting UK dentistry on a scientific theoretical base.

**1687 France** King Louis XIV undergoes an extraction of an upper molar that results in a jaw fracture and perforation of the maxillary sinus. The subsequent infection and further treatments leave the king without upper teeth for the rest of his life.

**1690 USA** Sugar-cane cultivation begins.



**1728 France** Dentist Pierre Fauchard, credited as the father of modern dentistry, describes in his book *Le Chirurgien Dentiste, ou Traité des Dents* a comprehensive system for the practice of dentistry, including basic oral anatomy and function, operative and restorative techniques, and denture construction. He also opposes the contemporary belief in tooth worms as the cause of

caries. His work is translated into English only in 1946.

**1746 France** Claude Mouton describes a gold crown and post to be retained in the root canal.

**1756 Germany** Philipp Pfaff, the dentist of the Prussian King Frederick II, introduces to Paris the use of wax and plaster to take an impression. This greatly improves the fitting of dentures. Like Pierre Fauchard, he establishes standards for dental care and pushes dental practice to new levels.

**1760 onwards France/UK/USA** Dentists commence school visits and are appointed to orphanages and public health institutions. They are listed under 'dentist' or 'dentiste' in public registers and directories.

**1768 UK** Thomas Berdmore noted the clear link between sugar, eating sweet things, and dental decay.

**1783 UK** Robert Woofendale links sugar consumption to decay in the second teeth of children

**1771 UK** John Hunter's *Natural History of the Human Teeth* is published, together with *A Practical Treatise on the Diseases of the Teeth*. One experiment appeared (incorrectly) to validate transplanting teeth. This practice, supported by Fauchard, had been condemned by Allen in 1685 as 'robbing Peter to pay Paul'; and by Pfaff in 1756 and Berdmore in 1768 for the transmission of disease, especially venereal.



**1776 UK** Joseph Priestley synthesises nitrous oxide, later known as laughing gas. By the 1840s its narcotic and pain-numbing properties are used by dentists and surgeons in particular.

**1776 USA** In one of the first known cases of post-mortem dental forensics, Paul Revere, a dentist and patriot of the independence wars, verifies the death of his friend by identifying the bridge he

constructed for him.

**1780 UK** William Addis starts semi-mass production of the modern toothbrush

**1790 USA** One of George Washington's dentists, John Greenwood, constructs the first known dental foot engine. He adapts his mother's foot treadle spinning wheel to rotate a drill.

**1790 USA** Josiah Flagg, a dentist, constructs the first chair made specifically for dental patients.

**1791 France** Nicolas Dubois de Chemant receives the first patent for porcelain teeth.

**1795 USA** Increased cancers of the lip are reported in pipe smokers by Samuel Thomas von Soemmering.

**1870 Japan** The practice of blackening the teeth of women of higher classes as a sign of marital fidelity, known since the 4th century AD, is banned. Some caries protection may have resulted from the painting of the teeth.

**1815 USA** Levi Spear Parmly, a New Orleans dentist, is credited as the inventor of modern dental floss (a piece of silk thread); although threads used as floss have subsequently been found in prehistoric sites.



**1815 UK** Teeth from the 50,000 soldiers killed in the battle of Waterloo are taken out and used to fabricate dentures, known as 'Waterloo teeth'. Even though the use of porcelain teeth and new materials become

## Milestones in Dentistry 1900–2004

more widespread, extracted human teeth are used until the 1860s to make dentures.

**1817–21** *UK/USA* Levi Spear Parmly, in a move away from traditional apprenticeship, advertises his *Dental Institution* in London to young men and women wishing to train as dentists.

**1832** *USA* James Snell invents the first reclining dental chair.

**1839** *USA* The *American Journal of Dental Science* is published as the world's first dental journal.



**1839** *USA* Based on an earlier German discovery, Charles Goodyear develops vulcanized rubber, a material that allows for cheap and well-fitting dentures. This material was replaced by acrylic resin in the 20th century.

**1839** *USA* The world's first dental school, the Baltimore College of Dental Surgery, opens. Dental schools are opened in Berlin in 1855, London in 1858, Paris in 1880, Geneva in 1881, Stockholm in 1888 and Vienna in 1890.

**1840** *USA* The American Society of Dental Surgeons, the world's first dental society, is founded.

**1841** *UK* John Tomes publishes the principles of anatomic forceps design for tooth extraction. Surgical instruments based on his concepts are still used today.

**1846** *France/USA* The collapsible tube, made out of lead or tin, is invented in both countries. It is only in 1896 that toothpaste starts to be sold in collapsible tubes in the USA and Germany.

**1847** *Hungary* Ignaz Semmelweiss identifies the risk of cross-infection between patients.



**1866** *USA* Lucy Beaman Hobbs graduates from the Ohio College of Dental Surgery, becoming the first woman in the world to earn a dental degree.

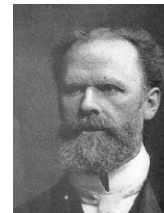
**1872** *USA* The first pedal-powered dental engine, manufactured by James B. Morrison, is sold at a dental meeting in Binghamton, New York. Morrison's inexpensive, mechanized tool supplies dental burs with enough speed to cut enamel and dentine smoothly and quickly, revolutionizing the practice of dentistry.

**1873** *USA* Colgate mass-produces toothpaste in jars.

**1874** *UK* The British government, under prime minister Gladstone, abolishes taxation on sugar, thus making it affordable by the general population.

**1875** *USA* The first electric dental drill is patented by George Green.

**1884** *Austria* The first local anaesthetic used in dentistry, cocaine, is introduced by the ophthalmologist Carl Koller.



**1890** *Germany* American scientist Willoughby Miller establishes the microbial basis of dental decay and initiates discussion of what was to become the 'focal infection' debate with his description of bacteria in the dental pulp. Belief in dental sources of infection being responsible

for diseases elsewhere in the body reached excessive levels in the 1920s, but is now the subject of rational investigation, particularly in association to periodontal disease.

**1895** *UK* Lilian Lindsay becomes the first British woman to gain a Licence in Dental Surgery (LDS).

**1896** *Germany/USA* Wilhelm Roentgen, a physicist, discovers the x-ray. The first x-ray images of teeth and jaws are taken in Germany only three months later. In the USA, C. Edmond Kells takes dental x-rays eight months later. He develops recurring cancer on his fingers and arm due to the constant exposure to radiation. After enduring 42 operations, resulting in arm and shoulder amputation, he commits suicide in 1928.

**1898** *USA* Johnson & Johnson is the first company to patent dental floss.

**1899** *USA* Edward Angle classifies the various forms of malocclusion. His classification system is still used to describe how crooked teeth are.

**1900** *France* The Fédération Dentaire Internationale (FDI) is formed in Paris by French dentist Charles Godon.

**1901** *France* The FDI Commission on Public Dental Hygiene is established.

**1903** *USA* Charles Land devises the porcelain jacket crown.

**1905** *Germany* Alfred Einhorn, a chemist, formulates the local anaesthetic procain, later marketed under the trade name Novocain and commonly used in dentistry.



**1905** *USA* Irene Newman becomes the first dental hygienist and engages in oral health promotion for children.

**1908** *USA* G.V. Black publishes his monumental two-volume treatise *Operative Dentistry*, which remains the essential clinical dental text for 50 years. Black later develops techniques for filling teeth, standardizes operative procedures and instruments, develops an improved amalgam, and pioneers the use of visual aids for teaching dentistry.

**1910** *USA* The first formal training programme for dental nurses is established. The programme is discontinued in 1914, mainly due to opposition by dentists.

**1914** *USA* Dental hygienists are introduced and named by Dr Fones. The first class graduates in Bridgeport Connecticut.



**1919** *USA/Germany* The company Ritter presents a dental unit, combining drill, pressurized water, air, cauterization and light. Other companies follow, and standards for dental surgery equipment are established.

**1920s** *France* The cord-driven Doriot arm, developed by the Parisian dentist Constant Doriot, becomes the standard to transfer the power of the electrical engine to the drill and bur. It is joined by the high-speed air-rotor drill of Walsh and Borden in 1957, and replaced by the Siemens micro-electric motor and air motors from 1965.

**1921** *New Zealand* Training for what became Dental Therapists started in New Zealand.

**1926** *USA* William J. Gies publishes a report on the state of dental education in the USA, criticizing poor standards and calling for an academic, university-affiliated dental education.

**1926** *USA* During the FDI Annual World Dental Congress in Philadelphia, a resolution is adopted recommending all governments to establish the position of a Chief Dental Officer.

**1937** *USA* Alvin Strock inserts the first Vitallium dental screw implant.

**1938** *USA* The nylon toothbrush, the first made with synthetic bristles, appears on the market, leading to the gradual replacement of animal hair in toothbrushes.

**1938** *USA* The DMFT index is first used for a large population study on caries in the USA by Klein, Palmer and Knutson.

**1940s** *USA* Trendley Dean determines the ideal level of fluoride in drinking water to substantially reduce decay without mottling.

**1945** *USA* The water fluoridation era begins when the cities of Newburgh, New York, and Grand Rapids, Michigan, add sodium fluoride to their public water systems.

**1949** *Switzerland* Oskar Hagger, a chemist, develops the first system of bonding acrylic resin to dentin.

**1949** *New Zealand* John Patrick Walsh patents a dental drill driven by compressed air, thereby reaching very high speed.

**1951** *France* FDI passes its first resolution supporting fluoride for caries control.

**1951** *Switzerland* The World Health Assembly of the World Health Organization (WHO) decides to incorporate a dental programme in WHO activities.

**1954** *Switzerland* The first electrical toothbrush is manufactured. In the early 1960s, cordless models are developed.

**1955** *USA* The first fluoride toothpaste is introduced.

## Milestones in Dentistry 2005–2015

**1957 USA** At the FDI's Annual World Dental Congress in Rome, the American John Borden introduces his high-speed air-driven handpiece.

**1957 USA** Dentsply introduce the ultrasonic scaler.

**1960s** Sit-down, four-handed dentistry (dentist and assistant), with the patient lying almost flat, becomes popular. This technique improves productivity and shortens treatment time.

**1960s Europe** Lasers are developed and approved for soft-tissue procedures.

**1961 USA/USSR** Space dentistry is established as a discipline. During extended stays in a zero-gravity environment, astronauts rapidly lose bone density, which can lead to tooth loss.

**1962 USA** Rafael Bowen develops a thermoset resin complex used in most modern composite resin restorative materials.

**1965 Germany** The first micromotor handpiece is presented by Siemens, finishing the era of the Doriot arm.

**1971 Germany** Based on an earlier suggestion of the German Professor Joachim Viohl, the FDI two-digit tooth notation is introduced as a worldwide standard.

**1975 Germany** Articain is introduced as a standard substance for local anaesthesia in dentistry.

**1980s Sweden** Per-Ingvar Brånemark describes techniques for the osseointegration of dental implants and lays the foundation for dental implantology.

**1980 Europe** The first European Union Dental Directive harmonizes training in European schools, enabling dental graduates to work anywhere in the EU.

**1981 Switzerland/UK** WHO and FDI jointly declare 'Global Goals for Oral Health by the Year 2000'.

**1980s World** Concern about the spread of new infections leads to an intensive review of dental procedures, equipment, disposables and sterilization protocols, all designed to eliminate the possibility of cross infection.

**1990s USA** New tooth-coloured restorative materials, plus increased usage of bleaching, veneers and implants inaugurate an era of aesthetic dentistry.

**1990 Canada** The phrase 'Evidence-Based Dentistry' (EBD), adopted from evidence-based medicine ('the integration of best research evidence with clinical expertise and patient values' is adopted as a synthesis of rational and scientific practice of dentistry.

**1994 Switzerland/UK** WHO and FDI declare the year 1994 the 'International Year of Oral Health', dedicating World Health Day on 7 April to oral health.

**1997 USA** FDA approves the Erbium-YAG laser, the first for use on dentin, to treat tooth decay.

**2000 France** During the FDI's Annual World Dental Congress in Paris the centennial of the organization is celebrated; France's President Jacques Chirac receives the FDI Council on this occasion at the Elysée Palace.

**2001 France** FDI establishes the World Dental Development & Health Promotion Committee in order to respond to the growing disparities in oral health worldwide.

**2002 USA** The landmark report *Oral Health in America: A report of the Surgeon General* is published.

**2003 Switzerland/France/USA** Global Goals for Oral Health by 2020 are established jointly by WHO, FDI and IADR.

**2004 Kenya** The first Conference for Oral Health in Africa is organized by FDI and WHO in Nairobi. The *Nairobi Declaration on Oral Health in Africa* recognizes oral health as a basic human right for the first time.



**2005 Switzerland** The WHO Framework Convention on Tobacco Control (FCTC) comes into force, using international law to improve public health by requiring governments to implement proven methods of reducing tobacco use.



**2005 France** The joint FDI/WHO publication *Tobacco or Oral Health* is published in six languages.

**2006 France/Switzerland** An expert consultation convened by WHO, FDI and IADR recognizes access to appropriate fluoride as a human right.

**2007 Switzerland** The Ministers of Health of 193 countries adopt the first resolution on oral health for 26 years during the 60th World Health Assembly in Geneva, calling for renewed attention to oral health worldwide.

**2008 Switzerland** The first World Noma Day is celebrated in Geneva on the occasion of the World Health Assembly. WHO, FDI and other organizations alert the world to this forgotten disease of poverty.

**2008 France** FDI declares *World Oral Health Day*, to be

celebrated every year on 12 September (birthday of FDI's founder Charles Godon and date of the historical Alma-Ata conference on Primary Health Care). In 2013 the commemorative day was moved to 20 March.

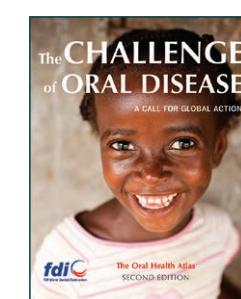
**2009 France** First edition of the *Oral Health Atlas* is published by FDI.

**2011 USA** The UN adopts the Political Declaration of the High-Level Meeting of the General Assembly on the Prevention and Control of Non-communicable Diseases, recognizing the major health burden oral disease poses for many countries.

**2012 Switzerland** FDI publishes its guidance document *Vision 2020: Shaping the future of oral health*.

**2013 Switzerland** The Minamata Convention on Mercury is adopted by UNEP to reduce mercury pollution.

**2015 Switzerland** WHO publishes the Guideline: Sugars intake for adults and children.



**2015 Switzerland** FDI publishes *The Challenge of Oral Disease: A call for global action*, the second edition of the *Oral Health Atlas*.

# Comments on data and sources

Collecting data on health is a complex undertaking that requires an appropriate and agreed indicator framework, as well as a health system that includes reliable surveillance systems and is able to report data regularly. Moreover, political support to allocate sufficient resources to statistical analysis and commitment to transparency for open access is required. Much progress has been made in collecting data on general health and health systems performance. Yet, all areas of data collection related to oral health, oral health systems and oral health programme performance are significantly lagging behind.

Initiatives from WHO, the European Union and others to integrate appropriate oral health indicators in routine health data surveys are welcome steps in the right direction that have yet to be implemented at a national level in many countries. Including key oral health data in international health statistics is a task still to be tackled on a broader scale.

Most maps and graphics in this atlas reflect averages from disparate datasets of varying coverage and quality. Averages, unfortunately, obscure significant differences from the mean and may paint a rosier picture for some countries than may exist for significant portions of their respective populations. Those averages may consequently also obscure existing inequalities, needs for future data collection, as well as associated recommendations for action.

Some of the data sources used throughout this atlas are outdated, unreliable or not comprehensive in coverage. Yet, they are still the best available. Is it better to have no data than information that is more than 10 years old? This question is difficult to answer. Researching the data revealed astonishing gaps in data availability and quality, ignorance of existing oral health indicators when developing national surveillance frameworks, or simply absence of any data at all. On the other hand, for many countries, generally high-income countries, data with acceptable quality exist. In order for this gap to be addressed, significant conceptual, political and financial efforts are required. However, despite the shortcomings of some underlying data, the sources used are generally the best available; and the maps highlight key issues in oral health that require international attention and action. After all, even the absence of data constitutes information and is a fact worth noting. Where no data was available, the country's name on maps is not displayed.

Although all possible efforts were made to present the most recent and reliable data, errors and omissions will occur. We welcome suggestions and comments on specific data aspects and accuracy, but encourage all to read the following remarks first, outlining the source and limitation of specific data. After all “No one loves the messenger who brings bad news”! (*Antigone*, Sophocles, Greek tragedian, 496–406 BCE).

## 2 Oral Diseases and Health

### 16–19 Tooth decay

Despite tooth decay being the most widespread chronic disease on the planet, the lack of reliable data is striking. Data used for the map is drawn from the *WHO Oral Health Country/Area Profile Programme*, which is, to date, the only available international repository of data for epidemiological data on oral health, especially tooth decay. However, the data available are often out of date: only 15% of countries around the world have published new data in the last 5 years; 20% in the past 5–10 years; 35% more than 10 years ago, and almost 1 in 3 countries worldwide has no reliable data available. More information on available oral health data, including maps and tables, can be found at the *FDI Data Hub for global oral health* ([www.fdiworldental.org/data-hub](http://www.fdiworldental.org/data-hub)) – FDI's online platform collating all available oral health data into a single resource.

Furthermore, many datasets do not rely on a national survey and are thus not representative for an entire country, but rather present data from only one region, city or village. Differences within countries, i.e. between rural and urban or different socioeconomic strata, are not reflected at all in this data. The focus of the data is on children aged 5–6 or 12–15 years; data for other age groups are not comprehensively gathered or reported. Despite WHO's definition of survey standards in its publication *Oral health surveys: Basic Methods*, its fifth edition published in 2013, researchers and governments are free to follow all or some of the guidance, or do things differently all together. This makes comparison between studies challenging.

The figure illustrating the number of people affected by common diseases used data from the *Global Burden Disease Study* (2010), as well as information obtained from the International Diabetes Federation. Untreated decay of primary and permanent teeth was calculated as follows: prevalence of untreated decay of primary teeth was obtained by dividing the estimated number of children affected, as per GBD study (dental caries of deciduous teeth), by the number of children aged 0–12 years according to 2010 world population statistics. Prevalence of untreated decay of permanent teeth was calculated by dividing the estimated number of adolescents and adults affected, as per GBD study (dental caries of permanent teeth), by the number of people aged +12 years according to 2010 world population statistics. World population statistics were obtained from the United States Census Bureau.

### 22–23 Periodontal disease

The map on severe chronic periodontitis is based on data from the *Global Burden of Disease Study* and shows estimates of prevalence for the year 2010 (Kassebaum et al, 2014). This study relies on an extensive systematic literature review which includes a total of 72 studies, covering 291,170 individuals aged 15 or more in 37 countries (from 16 of the 21 regions and all 7 super-regions). This recent and large-scale study was selected as source for the map,

since the information on periodontal disease in the *WHO Oral Health Country/Area Profile Programme* is even more limited and outdated than the data for tooth decay.

### 26–27 Oral cancer

Age-standardized incidence for oral cancer was sourced from the International Agency for Research on Cancer, which is a subsidiary agency of WHO. Their GLOBOCAN database developed the latest available estimate figures for the year 2012. Full details of GLOBOCAN data sources and methods are available at: [http://globocan.iarc.fr/Pages/DataSource\\_and\\_methods.aspx](http://globocan.iarc.fr/Pages/DataSource_and_methods.aspx)

The GLOBOCAN 2012 database uses the ICD10 code C00–C08 to define oral cancer. This definition includes the following cancer localizations: lips, tongue and floor of the mouth, gingiva, palate, salivary glands and other oral mucosa areas.

### 30–31 HIV/AIDS and oral health

The map is based on the latest available data from the WHO Global Health Observatory and shows the estimated percentage of the population aged 15–49 who were HIV-positive in 2011. However, the data from following the following countries did not come from WHO, but from the 2011 UNAIDS AIDSinfo database: Bangladesh, Czech Republic, Egypt, India, Maldives, Mongolia, Serbia, Sri Lanka, Tunisia and Uzbekistan. These countries were included to complete the latest available information for the world map.

### 32–33 Noma

Currently, there are no reliable global data on noma and therefore no map presenting prevalence or incidence could be developed. Available estimations are generally based on the number of noma cases referred for treatment, which are dependent on reliable systems of medical records and health facility reporting. It has previously been estimated that only 10%–15% of noma cases are referred for treatment and that the mortality rate was 80–90%. Based on these assumptions, WHO estimated the total number of cases worldwide per year to be at 140,000 in 1994 and about 42,000 in 2006. More recent figures are not available.

### 34–35 Congenital anomalies

The incidence rates of orofacial clefts per world regions were sourced from Mossey et al, 2012. Incidence rates for different ethnic groups were taken from Gundlach K et al, 2006. The incidence data are expressed as average number of birth defects per 100,000 live births. Some terminology relating to ethnic groups was modified. The ‘Asian’ group does not include data from Japan or Mongolia.

### 36–37 Oral trauma

Statistics for the main causes of oral trauma were sourced for Europe from: Boffano P et al, 2015; and for Rwanda from: Majambo M et al, 2013. Although both studies differ in methodology and scope, they provide a revealing comparison as to the proportion of different causes of oral trauma.

## 3. Oral Diseases and Risk Factors

### 42–43 Sugar

The map data are based on statistics published by FAO. These statistics show the availability for human consumption of each food item. The map data includes both, sugars and sweeteners, which, according to FAO's definition, comprise the following: fructose chemically pure, maltose chemically pure, maple sugar and syrups, sugar crops, other fructose and syrup, sugar, glucose and dextrose, lactose, isoglucose, beverage non-alcoholic; nutrient data only: molasses. These figures thus include both table sugar (added by the consumer on home-cooked products) and sugars used by the industry and added to processed foods.

The Sugar facts infographic has statistics on sugar consumption which are estimates based on the FAO statistics cited above. WHO-recommended daily sugar intake for children and adults is based on the WHO Guideline: Sugars intake for adults and children published in 2015. Sugar content per 100g of various foods is based on information available from the UK National Health Service. It is important to note that sugar content of different products can vary between countries, as well as between brands. Sugar amounts presented are thus only indicative.

### 44–45 Tobacco

Data on global cigarette consumption and facts of the infographic were used from *The Tobacco Atlas* (fourth edition) with permission of the American Cancer Society.

### 48–49 Diet

Data on Body Mass Index (BMI) were chosen to illustrate one of the main consequences of an inappropriate diet. The data are from the WHO Global Health Observatory and present the percentage of people aged 20 years or more with body mass index of 25 or more, including the categories of overweight and obesity.

## 4. Oral Diseases and Society

### 52–53 Inequalities in oral health – Oral health status

The London map is based on the UK's index of multiple deprivation, which integrates seven aspects of deprivation: income; employment; health deprivation and disability; education skills and training; barriers to housing and services; crime; living environment. It is used with permission of *The Guardian's* Data Blog. The map was merged with data called ‘Lives on the Line’, created by the University College London, displaying how life expectancy differs from tube station to tube station. The data showing the caries prevalence of 5-year-old children of selected London boroughs is based on NHS data from 2012 (Muirhead V et al, 2013).

Data on edentulousness is drawn from Guarnizo-Herreño et al, 2013. Countries were grouped according to Ferrera's welfare regime typology (Scandinavian, Anglo-Saxon, Bismarckian, and Southern) and the additional Eastern regime. The Scandinavian regime includes Sweden, Finland, and Denmark; the Anglo-Saxon includes the UK and Ireland; the Bismarckian regime includes

Austria, Belgium, France, Germany, Luxembourg, and the Netherlands; the Southern regime includes Greece, Italy, Portugal, and Spain; and the Eastern regime includes Czech Republic, Estonia, Hungary, Poland, Slovakia, and Slovenia. Social policy in each of these five social models has different characteristics in terms of expenses on social support, employment, principal source of financing, levels of poverty, re-distribution and private provision of social support (for more information see Popova & Kozhevniova, 2013). The graphic presented shows that levels of edentulousness have similar patterns in people with similar professional and education background, irrespective of the type of healthcare system in place in the country they live in.

#### 54–55 Inequalities in oral health – Impact of oral diseases

What is meant by ‘Disability Adjusted Life Years (DALYs)’? As per WHO definition, one DALY can be thought of as one lost year of ‘healthy’ life. The sum of these DALYs across the population, or the burden of disease, can be thought of as a measurement of the gap between current health status and an ideal health situation, where the entire population lives to an advanced age, free of disease and disability. DALYs for a disease or health condition are calculated as the sum of the Years of Life Lost (YLL) due to premature mortality in the population and the Years Lost due to Disability (YLD) for people living with the health condition or its consequences. Data used for the map illustrating the burden of oral conditions are taken from the *Global Burden of Disease Study* (Marcenes et al, 2013). Data for the figure illustrating the impact of household income on oral-health related quality of life is taken from Sanders et al, 2009. Finally, data for the figure illustrating the effect of education on perceived oral health is adapted from Guarnizo-Herreño et al. (2014)

#### 56–57 Inequalities in oral health – Access to oral healthcare

The figure ‘Price of neglect’ is based on data from Maiuro L, 2009.

Data illustrating the cost of a range of diseases in 27 European countries were obtained from various sources and studies, all listed in the reference section. Data were obtained for cardiovascular disease (Nichols M et al, 2012); cancer (Luengo-Fernandez R et al, 2013); Alzheimer’s disease (Wimo A et al, 2009); lung disease (European Respiratory Society, 2012); diabetes (IDF, 2013); brain disorders – including multiple sclerosis, neuromuscular disorders and stroke (Olesen J et al, 2012); and the cost of oral disease (Eaton K, 2012).

### 5. Oral Diseases: Prevention and Management

#### 60–61 Provision of healthcare – Dentists

The traditional way of assessing workforce levels in a country is to calculate the ratio of professionals per population. Such a map is presented in the next section Provision of Healthcare – Dental Team.

This section presents a new approach, whereby the metrics is a ratio between the number of oral health professionals in a given country and the burden of oral disease. This ratio uses data from

WHO about the density of oral health personnel (called dental personnel by WHO, and including dentists, auxiliaries and lab technicians for some countries). These are the professionals available to address the burden of oral disease. For simplicity the burden is expressed in DALYs and calculated using data for untreated decay of deciduous and permanent teeth, as well as severe periodontal disease, thus capturing the oral diseases with the highest burden (Kassebaum et al, 2014 & 2015).

This metric particularly highlights areas with high disease burden and low provider numbers. A given value should be seen in relation to other countries and to other indices. The ratio also shows the importance of curbing the disease burden, rather than increasing the provider levels, as the only realistic way of addressing oral disease. Full details of the new metric, including methodology, interpretation and application will be available in a forthcoming scientific paper.

The ratios of male/female dentists were provided by the respective national member associations of the FDI World Dental Federation.

#### 62–63 Provision of healthcare – Dental team

Statistics on dentistry personnel stem from the WHO World Health Statistics 2014, which covers the years 2006–2013. For countries for which no recent data is available, however, older data is provided as follows: Antigua and Barbuda 1997, Somalia 1997, Haiti 1998, United States of America 2000, Honduras 2000, Papua New Guinea 2000, Greece 2001, Venezuela (Bolivarian Republic of) 2001, Saint Kitts and Nevis 2001, Dominica 2001, Saint Vincent and the Grenadines 2001, Paraguay 2002, Saint Lucia 2002, Andorra 2003, Portugal 2003, Spain 2003, Netherlands 2003, Democratic People’s Republic of Korea 2003, Nicaragua 2003, Lesotho 2003, Ethiopia 2003, Seychelles 2004, Argentina 2004, Italy 2004, Philippines 2004, Ireland 2004, Mauritius 2004, Suriname 2004, Sao Tome and Principe 2004, Gabon 2004, Comoros 2004, Equatorial Guinea 2004, Botswana 2004, Angola 2004, Nepal 2004, Mozambique 2004, Eritrea 2004, Congo 2004, Democratic Republic of the Congo 2004, Burundi 2004, Chad 2004, Barbados 2005, Iran (Islamic Republic of) 2005, Solomon Islands 2005, China 2005, Uganda 2005, Guinea 2005.

Moreover, these WHO statistics include not only dentists, but also dental nurses, hygienists and dental laboratory technicians. Among all statistics for health professionals from the WHO World Health Statistics 2014, only the ‘dentist’ category uses such an undifferentiated approach, while figures for physicians, nurses and pharmacists are well separated. The reason for this difference in statistical recording is unclear. Due to variability of data sources, the professional-level and associate-level occupations may not be distinguishable for all countries since they were not reported separately. Figures presented may thus overestimate the available workforce figures and may not be comparable with data about dentists from other sources, particularly national statistics.

#### 64–65 Provision of healthcare – Oral healthcare continuum

Data on availability and use of dental care presented in the graphic comes from Hosseinpoor et al, 2012, who analysed data from 52

countries participating in the World Health Survey 2002–2004. The information is based on a questionnaire survey that was part of a bigger survey.

#### 66–67 Prevention of tooth decay – Fluorides

Information on global fluoride use was based on estimations made for the year 2000 by Rugg-Gunn, 2001, but was updated where more recent estimations had been made. Care should be taken in interpreting this data, since populations might be benefiting simultaneously from multiple sources of fluoride. Thus, for example, the majority of those who are exposed to fluoridated water are probably also benefiting from the use of fluoride toothpaste. A simple summation of the number of people using different modes of fluoride delivery therefore cannot provide a reliable estimate of the number of people globally benefiting from fluoride. The data for water fluoridation were used with permission of the British Fluoridation Society from their publication *One in a Million*, 2012.

Information on other methods of fluoridation are even scarcer and oftentimes rely on estimations (as indicated in the text – data on salt fluoridation from 2013, other fluoridation methods 2001). The lack of reliable usage information is in stark contrast to the importance of fluorides in the prevention of tooth decay.

#### 68–69 Prevention of tooth decay – Fluoride toothpaste

Data about the toothbrushing habits are coming from a study involving 20 countries (Honkala et al, 2015). Data on the annual cost of fluoride toothpaste in terms of the number of days of household expenditure were based on a study conducted by Goldman et al, 2009. Annual average consumption in their calculation was based on 182 g/person.

### 6. Oral Health Challenges

#### 72–73 Challenges in education

The statistics of dental schools worldwide are based on the International Federation of Dental Educators Association’s (IFDEA) datapool. In most countries, the number of dental schools has remained stable over the last 10 years, particularly in high-income countries; whereas on specific countries, such as Brazil, India, Pakistan and others, the number of dental education institutions has increased significantly, mainly due to a boom in private dental schools.

#### 74–45 Challenges of global migration

There is virtually no data on international migration of dentists, despite considerable international effort to collect data on migration of other health professionals. This may be due to the overall small volume of dentist migration, yet for smaller countries migration can be a significant problem. The available information on migration has been simplified and condensed; only the major migration streams, source countries and destination countries are represented on the map.

### 7. Oral health on the global agenda

#### 80–81 Oral health and NCDs

The data for the map showing deaths due to NCDs – age-standardized death rate (per 100 000 population), both sexes, 2012 – were taken from the WHO Global Health Observatory. Estimates of the cost of action versus inaction in low- and middle-income countries were retrieved from a report commissioned by WHO and issued by the World Economic Forum in 2011. An additional report published at the same time estimates that the global cost of NCDs, including mental illness, will amount to US\$ 47 trillion in the time-span 2010–2030 (Bloom et al, 2011).

The timeline synthesizes milestones and other NCD-related events from different sources and is not intended to be comprehensive.

#### 84–85 Oral health and global development

The editorial deadline of the *Oral Health Atlas* was April 2015. At this point, the Sustainable Development Goals were still under negotiation and not finally approved. The wording was chosen accordingly to cover for possible reviews and changes.

#### 88–89 Amalgam and the Minamata Convention

Data for the map illustrating the number of signatory parties to the Minamata Convention was sourced from UNEP and reflects the status as of April 2015.

### Abbreviations used in book

DALYs	Disability Adjusted Life Years
DMFT	Decayed, Missing, Filled Teeth
FDI	FDI World Dental Federation
MDGs	Millennium Development Goals
NCDs	Noncommunicable diseases
OECD	Organisation for Economic Cooperation and Development
SDGs	Sustainable Development Goals
UHC	Universal Health Coverage
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WHO	World Health Organization



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## About FDI

FDI World Dental Federation serves as the principal representative body for more than 1 million dentists worldwide, developing health policy and continuing education programmes, speaking as a unified voice for dentistry in international advocacy, and supporting member associations in global oral health promotion activities. Over the years, it has developed programmes, initiatives, campaigns, policies and congresses, always with a view to occupying a space that no other not-for-profit group can claim.

FDI works at national and international level through its own activities and those of its member dental associations. It is in official relations with the World Health Organization (WHO), and is a member of the World Health Professions Alliance (WHPA).

