

Manual of
**Clinical
Procedures
in Dentistry**

Edited by Nairn Wilson and Stephen Dunne



WILEY Blackwell

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Nairn Wilson and Stephen Dunne
King's College London Dental Institute (KCLDI)

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Preface

Dentistry is a complex healthcare science, oral health being of considerable importance to general health and wellbeing, let alone comfort and confidence in eating, tasting, swallowing, speaking, conveying a range of emotions through facial expressions, including smiling, and other forms of interpersonal interaction, notably kissing.

This manual provides guidance on procedures in primary dental care. In contrast to the countless, traditional books detailing the knowledge and science behind specific aspects of dentistry, this manual is a comprehensive, practical guide to the delivery of effective, state of the art oral healthcare – the ‘what, when and how’ of clinical practice.

It is acknowledged that desirable clinical outcomes in dentistry may typically be achieved in a number of different ways and, despite the efforts of generations of clinical academics and practitioners engaged in research, the evidence base to adopt one approach or technique over another remains limited in many situations. The approaches and techniques advocated in this manual reflect current thinking and teaching by the exceptionally large, highly qualified team of clinicians, past and present, who, by virtue of their expertise, are collectively responsible for King’s College London Dental Institute (KCLDI) – the largest dental clinical academic centre in Europe, enjoying substantial national and international standing as an outstanding centre of clinical excellence. Indeed, KCLDI is one of the top five dental clinical academic centres in the world, irrespective of whatever measures and criteria are employed for such ranking.

Given the above, this manual is considered to be unique and, as a consequence, an important, new addition to existing dental literature; its style, scope and purpose are unparalleled. Furthermore, as elements of primary dental care underpin advanced and specialist clinical practice, it is considered that this manual should find application in every sector of dentistry – a ubiquitous manual which is intended to have a place in all clinical environments.

All those who have contributed to the production of this manual are to be thanked and congratulated. It has been a huge KCLDI team effort, backed up by an equally huge effort by the team at Wiley. It is impossible to put a figure on the number of expert and specialist ‘man hours’ invested in the production of this publication, which from the outset put quality, immediate clinical relevance, ease of use and, above all else, excellence in clinical care first and foremost. Nothing would give the entire team behind this manual more pleasure and professional satisfaction than knowledge that their individual and collective effort helps enhance patient care and promote trans-national harmonisation of teaching and training in the art and science of the clinical practice of dentistry.

Is this manual intended to be read and studied cover to cover? No! It has been designed to enable members of the dental team at all levels to dip into the wealth of guidance brought together under one title, according to individual needs and interests. That said, much may be learnt from systematically working through the manual, and this has been catered for in the order of contents, starting with the changing nature of the practice of dentistry and an overview of patterns and trends in oral and dental diseases, and culminating with guidance on audit and procedures for the management of patient concerns and complaints in everyday practice. Apologies to anybody who feels that insufficient weight and density of detail has been assigned to their area of practice; every effort has been made to present equitable, balanced, conflict-free guidance across the ever-increasing spectrum of the clinical practice of dentistry.

More than enough from the Editors. Time for you to get into the meat of the manual. Hopefully, the more you read, the more you will value the manual, and share the view that every member of the dental team should have access to a copy.

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1

The Changing Nature of the Practice of Dentistry

Nairn Wilson

This introductory chapter gives an overview of the changing nature of the practice of dentistry, highlighting current and anticipated future issues and challenges.

Big Picture

Dentistry is a fast developing biomedical healthcare science which should be viewed as an integral element of mainstream healthcare – oral health having been recognised to be important to general health and wellbeing. Moving on from the long-established, experienced-based, mechanistic approach to treating different forms of oral and dental pain, discomfort and disease, dentistry is evolving into a patient-centred, evidence-based, preventatively orientated, minimum intervention system of care to establish and maintain oral health – a health-rather than a disease-management service. This, however, only holds true for dentistry in forward-looking, typically well-developed countries of the world. In other countries, where there are provisions for oral healthcare, dentistry may be found to be caught, to different degrees, in a twentieth century time warp, with treatment focusing on pain relief, often by means of traditional, interventive restorative procedures and the extraction of teeth, with or without prosthetic replacement. Elsewhere in our diverse, unequal world, billions of people have no, or at best very limited access to any form of dental care.

This chapter, in common with the rest of the manual, considers arrangements, procedures and techniques for patient-centred, evidence-based, preventatively orientated approaches to oral healthcare provision – best practice.

Oral and Dental Disease

The social determinants of oral and dental disease are largely universal: exposure to an unhealthy diet, tobacco use, excessive consumption of alcohol, and poor oral

hygiene all contribute to poor oral health. In addition, many adults do not help themselves limit their exposure to oral and dental disease, by, for example, indulging in the frequent consumption of sugar, forgetting to brush their teeth, not bothering with interdental cleaning, and only seeking dental care when in pain or experiencing a problem.

In most developed countries overall levels of dental disease, in particular amongst children, have shown improvements in recent years, but behind such encouraging statistics there tend to be widening health inequalities, with levels of oral and dental disease increasing amongst the children of the poorest members of society. At the other end of the age spectrum, there is increasing longevity, with many more teeth being retained into old age; however, oral health among older people is generally poor, with levels of xerostomia and advanced periodontal disease being a particular cause for concern. In adolescents and young adults pathological tooth wear is now relatively common, and oral mucosal disease, notably the incidence of oral cancer, is increasing. So, while much has been achieved through the application of advances in the prevention of oral and dental disease, much remains to be done, and new forms of disease such as peri-implantitis, albeit limited to those who have been fortunate enough to access implant dentistry, are generally considered to be a 'ticking time bomb'. Overall, it may be concluded that there continues to be widespread exposure to the determinants of oral and dental disease, the most prevalent forms of which – caries and periodontal disease – are opportunistic and given the chance will affect patients of all ages. Furthermore, as discussed in detail in Chapter 2, it may be concluded that oral and dental diseases continue to be a major public health problem, in large part because of the failure of individuals to practise the most basic of preventative measures.

In helping to address oral and dental disease issues, dental teams should seek to find ways, in the community in which they operate, to help reduce oral health

inequalities and increase public awareness of the importance of oral health and how it may be achieved and maintained. Such a service to society, if undertaken by all dental teams, would make an enormous difference to oral health in general.

The Dental Team

Modern oral healthcare is best provided by a dental team. The day of the single-handed general dental practitioner, attempting to meet most, if not all of the many different dental needs of a diverse population of patients of all ages, is widely considered to be a thing of the past. For maximum efficiency and effectiveness, the dental team, led by one or more dentists and supported by a network of specialists in different, distinct branches of dentistry, should comprise:

- Oral health therapists, which may comprise (dental) therapists with skills and expertise in oral hygiene, or therapists together with dental hygienists.
- Dental nurses, trained together with other members of the dental team, with roles and responsibilities, over and above chairside participation in the provision of treatment, ranging from the recording of simple intraoral radiographic images to the application of preventive measures (e.g. fluoride varnishes) and oral health education. Dental nurses in modern practice environments must have well-developed skills in running, or at least overseeing, state of the art decontamination and sterilisation procedures.
- Dental technologists, including clinical dental technologists, to work with the chairside team in the provision of indirect restorations, removable prostheses and other appliances. Increasingly, dental technologists are critical to developments in digital dentistry, including, for example, the production of restorations from digital images and CAD CAM (computer assisted design–computer assisted milling). It is anticipated that dental technologists of the future may have as many information technology (IT) skills as traditional manual skills.
- Practice managers with wide-ranging roles and responsibilities to ensure the safe, efficient running of the practice or dental health centre. Practice managers' skills and expertise may usefully include, by way of example, business development and marketing, practice accounting, consumables logistics and the management of human resources within the practice or centre.
- Dental receptionists as the patient's first and most common point of contact with the dental team. In this role, receptionists require excellent human relationship

and communication skills, together with skills in diary management, aimed at the best use of the time and skills of the various members of the dental team. Dental receptionists, in addition to requiring good telephone and face to face communication skills, are extending their roles to include multimedia communications with patients. Receptionists may also play crucial roles in patient satisfaction surveys and the initial response to concerns and complaints.

As leaders of dental teams, dentists, amongst the many other challenges they face, must develop the necessary leadership skills during their formative years in clinical practice. Leadership courses are anticipated to become an important element of postgraduate dental education.

The Practice Environment

With the further demise of 'old-style', single-handed dental practices, in favour of multisurgery practices, if not dental health centres, the practice environment will continue to change. General dental practitioners of the future, more often than not with advanced skills and knowledge in some aspect of dentistry, may increasingly find themselves working in the same environment as specialists, as part of a 'full service' dental team. The facilities to support dental teams of different sizes and composition will grow in sophistication to take advantage of anticipated advances in dental technologies, some of which may be transformational, and possible changes in the scope of dentistry to facilitate the shared care of patients with other healthcare professionals. Innovations in IT, ergonomically enhanced ways of working, new devices and different forms of instrumentation, novel presentations of materials and growing patient expectations are some of the many factors which will individually and collectively shape and fashion the practice environment of the future. Above all else, the practice environment, apart from being welcoming and comfortable for patients and a good work environment for the dental team, must become an increasingly safe place for both patients and all those involved in their care.

Regulation

It is hoped that the clinical practice of dentistry will come to be regulated by modern, 'right touch' regulation, based on the following qualities:

- *Proportionate*: Regulatory intervention only when necessary, with measured, cost-effective remedies appropriate to the risk posed.

- *Consistent*: Interrelated rules and standards implemented fairly.
- *Targeted*: Focused arrangements fit for purpose.
- *Transparent*: Open, simple, user-friendly regulation.
- *Accountable*: Subject to, and satisfying public scrutiny.
- *Agility*: Forward-looking and evolving to meet changing needs.

Good regulation should first and foremost protect the public, but with measures which support and encourage the profession to comply with the relevant code of conduct.

The main elements (pillars) of codes of conduct relevant to the practice of dentistry are anticipated to remain:

- Patient respect and autonomy.
- Do no harm (non-maleficence).
- Act in the best interest of the patient – ‘do good’ (beneficence).
- Honesty and truthfulness (veracity).

In essence, treat others the way you would wish to be treated.

Developments in regulation will sooner or later include revalidation (recertification) including requirements for lifelong learning (continuing professional development, CPD) and possibly some form of self-assessment and peer review or appraisal. Transformational innovations in dental technologies may bring about the need for top-up training, or new arrangements for dental specialties, possibly including the demise or merger of existing specialties and the introduction of new specialties. To remain fit for purpose, the regulation of dentistry must change with changes in, amongst other factors, clinical practice, the regulation of other healthcare professionals, the dental workforce, relevant technologies and the needs and expectations of patients and the public.

The day of self-regulation, once considered to be a defining characteristic of a profession, may have passed, in favour of ‘lay dominated’ regulation, but this should not disadvantage or cause concern to the vast majority of regulated dental healthcare professionals who practise ethically, satisfy expectations of ‘24/7’ professional behaviour, and always put the interests of their patients first and foremost.

Scope of Practice

With the growing body of evidence that oral health is important to general health and wellbeing, the challenge of many more older, dentate patients with increasingly complex medical and dental histories, the ever increasing sophistication of existing techniques, innovations in, for example, regenerative techniques and salivary diagnosis,

trends towards the shared care of patients, and new evolving expectations of treatment, the scope of dentistry will need to be updated and modernised. With anticipated expansion in the scope of dentistry, it is considered unlikely that dentists can continue to graduate and remain competent in the many different, diverse procedures involved in the provision of comprehensive primary dental care. As a consequence, dentistry may have to look to adopting a medical model of skill mix, with a range of primary care procedures being delegated to team members. With such developments, dentists will, in all probability, become as much oral physicians as dental surgeons.

Patient-Centred Care

Gone are the days of ‘just do as you think best’ or, worse, clinical paternalism: ‘I have decided that that you should have...’. To practise patient-centred care, the patient must be involved in treatment decision-making. To achieve this, the patient must understand the problem, the need for treatment, and the ‘pros’ and ‘cons’ of the various treatment options. This can be time consuming, in particular when a patient presented with complex treatment needs. However, such patient involvement is considered central to obtaining informed consent, prior to commencing any programme of care.

In providing patient-centred care there may be conflicts between practising clinical excellence and complying with the wishes of the patient. For example, clinical excellence may only be achieved in a case by providing surgery and reconstruction, but the patient, who is not experiencing any pain or discomfort and is unconcerned by their compromised dental appearance, simply wishes to be monitored and given advice as to how best to prevent further deterioration of their condition. In such situations, detailed clinical records, which should be a matter of routine, will be a safeguard against possible future criticism of less than ideal care, let alone supervised neglect.

Preventatively Orientated Care

Prevention is always better than cure. In dentistry, prevention, unlike vaccination against an infectious disease, does not impart immunity; it merely reduces susceptibility and the risk of disease – primary and recurrent.

The guidance available on the prevention of dental disease tends to be supported by a substantial body of evidence, a notable exception being tooth wear. Indeed, preventive dentistry may be considered to be the most evidence-based aspect of clinical practice.

The application of best preventive practice in the provision of treatment is what constitutes preventatively oriented care. This is in sharp contrast to treatment which leaves a patient more susceptible to disease. For example, if an early occlusal lesion of caries were to be managed by means of fissure sealing, or a preventive resin restoration, this would be best practice, both in terms of preservation of tooth tissues and preventatively orientated care. In contrast, if the lesion were to be managed by means of aggressive restoratively orientated care, resulting in weakening of the remaining tooth tissues and a restoration susceptible to secondary caries, overall the benefits to the patient may quickly be outweighed by the negative consequences.

Minimum Intervention

Very often, the easy option in dentistry is to extract a tooth, resort to a full coverage crown, or extirpate a troublesome pulp. Much more challenging, skilful and professionally rewarding, let alone beneficial for the patient, is to identify and successfully apply the least interventive, yet effective means to resolve presenting problems and establish and subsequently maintain oral health. Once lost or removed, tooth and associated soft tissues are lost for life, certainly until such times that major, anticipated advances in regenerative dentistry can be translated into clinical practice. Furthermore, the loss of tooth tissues leaves remaining tooth tissues substantially weakened and possibly more susceptible to disease. As a general rule, the less interventive the care, the more beneficial treatment is to the patient, both immediately and in the longer term, assuming the care is effective and the patient maintains good oral health. It is encouraging that increasing attention is being paid to the long-term consequences of interventive forms of treatment, recognising that the only 'permanent' restorations and prostheses are the ones patients die with, and that 'replacement dentistry' invariably results in the further loss of irreplaceable tissues. Minimum intervention dentistry is a key feature of care aimed at achieving 'teeth for life'. All that said, there are circumstances where interventive forms of treatment are indicated, if not necessary to achieve a satisfactory clinical outcome. Under such circumstances, all possible efforts should be made to limit the immediate and longer-term iatrogenic effects of the care.

Patient Empowerment

Based on the premise that the maintenance of oral health is the responsibility of the patient, rather than the dental team, which is the 'occasional visitor' in the patient's mouth, patients need to be educated and charged with

undertaking all the measures necessary to prevent new disease. Identifying these measures and styling education to best meet the needs of the patient may best be achieved through risk assessment. Success in patient empowerment often involves behavioural interventions, aimed at behavioural change. As with most behavioural changes, such as smoking cessation and weight loss, the tipping point in oral health maintenance is patient acceptance: acceptance that they must look after the teeth they wish to retain, hopefully for life – only clean the teeth and gums you want to keep! 'Teeth for life' may also be viewed as partnership working between the patient and the dental team, with the patient assuming responsibility for the control of risk factors and day to day measures, and the dental team monitoring and, where necessary, prescribing and explaining changes to the agreed oral health regimen – in effect an oral health 'contract', which is amended from time to time by mutual agreement.

Pain and Anxiety

Regrettably, fear of pain and anxiety remain barriers to many individuals seeking and reaping the benefits of dental care. Developments in the fields of pain control and anxiety management (anxiolysis) have been remarkable, with dentistry being at the forefront of certain elements of relevant research and innovation. Although certain dental procedures may not be pleasant, they should be pain free, with a minimum of discomfort. For anxious patients, various forms of anxiety management, up to and including conscious sedation, should be available to facilitate acceptance of care. In many cases, anxiety and fear of pain associated with dental procedures stem from a traumatic episode, often early in life, highlighting the value and benefits of effective prevention in early childhood. Reaching out to and engaging anxious patients can be one of the most demanding challenges in addressing unmet treatment needs in a community. Success in such endeavours not only transforms the dental prognosis for those who become regular dental attenders, but can give a sense of huge professional fulfilment.

Funding

Where third party funding of oral healthcare exists, it tends to be under ever increasing budgetary pressure, with the available funding tending to be directed to care of the most vulnerable members of society, individuals with special needs and severe forms of disease, and to addressing ever expanding health inequalities – poor oral health and disease tending to increase in low-income families in many countries. Funding through insurance schemes and private contract should, as a consequence, be set to

increase with increasing interest in dental attractiveness and appreciation of the importance of oral health to general health and wellbeing, in particular amongst the 'worried well' with disposable income. For many practices the shift from the bulk of income coming from third party funding to insurance and private contract arrangements may be transformational – running a business rather than providing a service. Whatever the future arrangements for funding, there will be an expectation of value for money, with value being judged more by the health enjoyed rather than the number of procedures undertaken.

Continuous Quality Improvement

As in most, if not all aspects of modern life there is an expectation that there is always opportunity to enhance quality, if for no other reason as a consequence of new advances in knowledge, understanding and technologies. Dentistry is no exception. Setting aside savings through the dental industry responding to demands for 'faster, quicker, easier and cheaper' materials and devices, efficiency gains and effectiveness may be achieved through audit, critical self-assessment by the dental team, and constructive feedback from patients. In addition, good management of patient complaints and concerns, including bottoming out causation, can help identify ways to do things better. For patients who tend to have several months, if not a year or more between encounters with the dental team, the cumulative effect of many small, quality enhancing changes can be immediately apparent, helping them 'bond' with the practice as a 'go ahead' enterprise.

Ethics versus Cosmetics

Growing interest and the new value being placed in dental attractiveness plays a large part in dentistry moving away from the service to the business model.

Further Reading

Department of Health (UK) and British Association for the Study of Community Dentistry (2014) Delivering better oral health: an evidence-based toolkit for prevention, 3rd edn. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/367563/DBOHv32014OCTMainDocument_3.pdf (accessed 27th June, 2017).

In particular, growth in the demand for cosmetic procedures (as distinct to aesthetic treatments to address a need) is increasing the 'business element' of dentistry. In providing cosmetic enhancements to a patient's smile, the dental team must strike the correct balance between meeting the demands of the patient, maintaining professional standards and acting ethically, despite powerful financial incentives to just seize the opportunity. Professionalism – the set of values, behaviours and relationships that underpins the trust the public has in the dental team – must not be sacrificed by unethical approaches to the provision of cosmetic dentistry. There is no justification for any breach of the professional code of conduct in providing enhancements to dental attractiveness, albeit that certain cosmetic procedures which a dental team may provide may not be considered to constitute the practice of dentistry.

The Unexpected

Futurology is far from being an exact science. In particular, expectations of what the future may hold cannot take account of the unexpected. In dentistry, the unexpected may take many different forms, for example, some new form of disease, a ground-breaking development in regenerative dentistry or dental biomaterials science, or new evidence which questions the value of some long established approach to patient care. Dealing with the unexpected in the provision of dental care can draw heavily on the knowledge and understanding of the dental team, and may involve the adoption of new procedures and mastering new competences. Any long established practitioner will confirm that clinical practice has undergone profound, unexpected change in their professional career. There is no reason to believe that things will be different for future generations of practitioners. This, it is suggested, adds to the appeal and challenge of a career in dentistry.

Trathen, A. and Gallagher, J.E. (2009) Dental professionalism: definitions and debate. *British Dental Journal* 206:249–253.

Wilson, N.H.F. (ed.) (2009) *Clinical Dental Medicine 2020*. London: Quintessence Publishing Co. Ltd.

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2

An Overview of Patterns and Trends in Oral and Dental Diseases

Jenny Gallagher

Introduction

What do people from different parts of the world have in common (Figure 2.1)? They will almost all suffer from one or more oral diseases at some stage in their lives, diseases that are largely preventable. As a result they will require oral and dental care. Some will be fortunate and receive high-quality dental care in a timely manner; others will not, continuing to suffer either from the symptoms of disease or at the hands of non-qualified personnel in its treatment. As dental professionals, we should do everything possible to improve oral health and to ensure equitable access to oral healthcare for everyone in the world. Getting to grips with patterns and trends in oral health can assist us with this challenge and help us think through our roles and responsibilities. Even in high-income countries with well-developed dental services many adults suffer from urgent conditions and the impact of disease.

Oral Diseases

- 1) Sixty to ninety per cent of schoolchildren and nearly 100% of adults worldwide have dental caries
- 2) Severe periodontal disease, which may result in tooth loss, is found in 15–20% of middle-aged (35–44 years) adults
- 3) About 30% of people aged 65–74 have no natural teeth
- 4) Oral disease in children and adults is higher among poor and disadvantaged population groups

Data from WHO, 2012a.

Why Is It Important to Examine Population Oral Health?

Why should clinicians who are largely concerned about the health of individuals be concerned with the health of populations? And the global population at that? Why not skip this chapter to discover more about the business of dentistry given that as dental professionals we are largely trained to identify and treat disease? Can I suggest a few reasons to explore these issues in more detail?

First, we are health professionals and therefore have a professional responsibility to be advocates for oral health and the patients whom we serve. Many think of dentistry as a business and, taking that approach, any business needs to understand the market, which for dentistry includes the population whom we serve, their health trends and the determinants of health. This will equip us better in our overarching goal to improve oral health – the ultimate business of dentistry.

Second, they can act as a mirror to our professional action. As dentists we become absorbed in minutiae; trained to consider details, we often fail to stand back and look at the big picture. Once in a while it is helpful to do so. One example which had a particular impact on me was the story of an epidemiologist who visited the same schools in England at regular intervals to undertake surveys of dental caries in 12-year-old schoolchildren during the period when oral health was improving. The team identified that caries prevalence (numbers of Decayed, Missing and Filled Teeth = DMFT) was not reducing in one school and they explored why this was the case. It came down to the fact that the local dentist was using an outmoded treatment approach and the profile of fillings in primary molars, the 'F' component, was



Figure 2.1 Global connections. Source: <https://commons.wikimedia.org/wiki/File:GDJ-World-Flags-Globe.svg>. Public Domain.

excessive. Once one first permanent molar became — carious, there was the assumption that all would do so. After discussions with that dental practice, the pattern of treatment changed and, interestingly, so did the epidemiology statistics for that school. So this reminds us that monitoring trends in oral health has wide implications including informing the practice of appropriate dental care in support of oral health.

Third, global mobility means that clinicians are increasingly faced with new patient groups from different parts of the world. Furthermore, clinicians themselves may take the opportunity to work in different countries during their professional careers. Data on oral health are available from many countries across the globe and within countries. Even within the UK there is significant variation between different geographic areas. An understanding of population health information helps us to better understand the risk factors amongst different communities and their impact on oral health. For example Chinese populations have a higher prevalence of nasopharyngeal cancer (Yu and Yuan, 2002; Donaldson et al., 2012) and Bangladeshis have a higher rate of oral cancer (Efroymson et al., 2001; Donaldson et al., 2012), associated with viruses and cultural health behaviours respectively.

Fourth, and finally, consideration of trends in oral health and the determinants of health should therefore empower us to challenge environmental factors in culture, society and politics in support of health and inform our provision and planning of oral and dental care to

individuals. This is the best way to promote health and address inequalities. Given the importance of promoting health and preventing disease, this chapter therefore links closely with Chapter 7 on prevention of oral diseases.

This chapter will provide you with an overview of global oral health patterns and trends and consider the public health implications for us as health professionals wherever we practise. As an introduction to considering trends and patterns in oral health, it is important to start first with the demography or composition of the global population.

The Global Population

It is staggering to consider how the world is changing in our lifetime. The global population has doubled in the past 50 years and will continue to expand exponentially. Between 2011 and 2050, the world population is expected to increase by 2.3 billion, from 7.0 to 9.3 billion (United Nations, 2011). Websites such as <http://www.worldlifeexpectancy.com/world-population-pyramid> show how the age-based population pyramid changes over time from a traditional pyramid with a large base towards a more rectilinear shape.

We each view the world map from our physical perspective — usually our country is centre stage— but also in relation to land mass (Figure 2.2); however, the global population is not evenly distributed, as demonstrated by Figure 2.3 which cleverly adapts the land mass to represent population size, providing us with a startling view of the world.

In more developed regions of the world, the majority of the population live in cities whilst in less developed regions the majority live in rural populations; however, this is predicted to change as outlined below.

The population living in urban areas is projected to increase by 2.6 billion, rising from 3.6 billion in 2011 to 6.3 billion by 2050 (United Nations, 2011). The United Nations (UN) also suggest that the rural population is projected to decrease from 3.1 to 2.9 billion over the same time period. Therefore, the urban areas of the world are expected to absorb all the anticipated population growth over the next four decades while at the same time drawing in some of the rural population. There are currently 23 megacities (>10 million) and by 2025 this is expected to increase to 37. By 2025, the population living in megacities is expected to reach almost 8% of the overall world population; one in 13 people globally will then reside in a megacity (United Nations, 2011).

According to UN reports, most of the predicted growth will be absorbed by developing countries (United

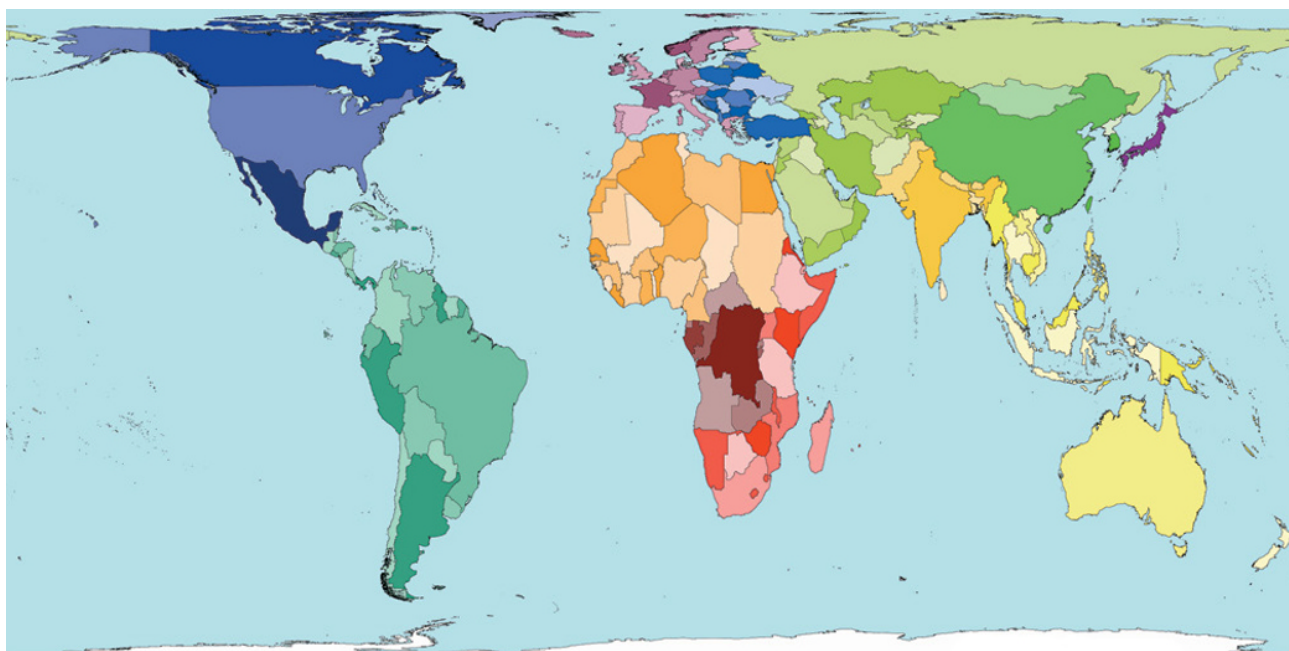


Figure 2.2 Global perspective: land area. *Source:* <http://www.worldmapper.org/display.php?selected=1>. © Copyright Worldmapper.org / Sasi Group (University of Sheffield) and Mark Newman (University of Michigan).

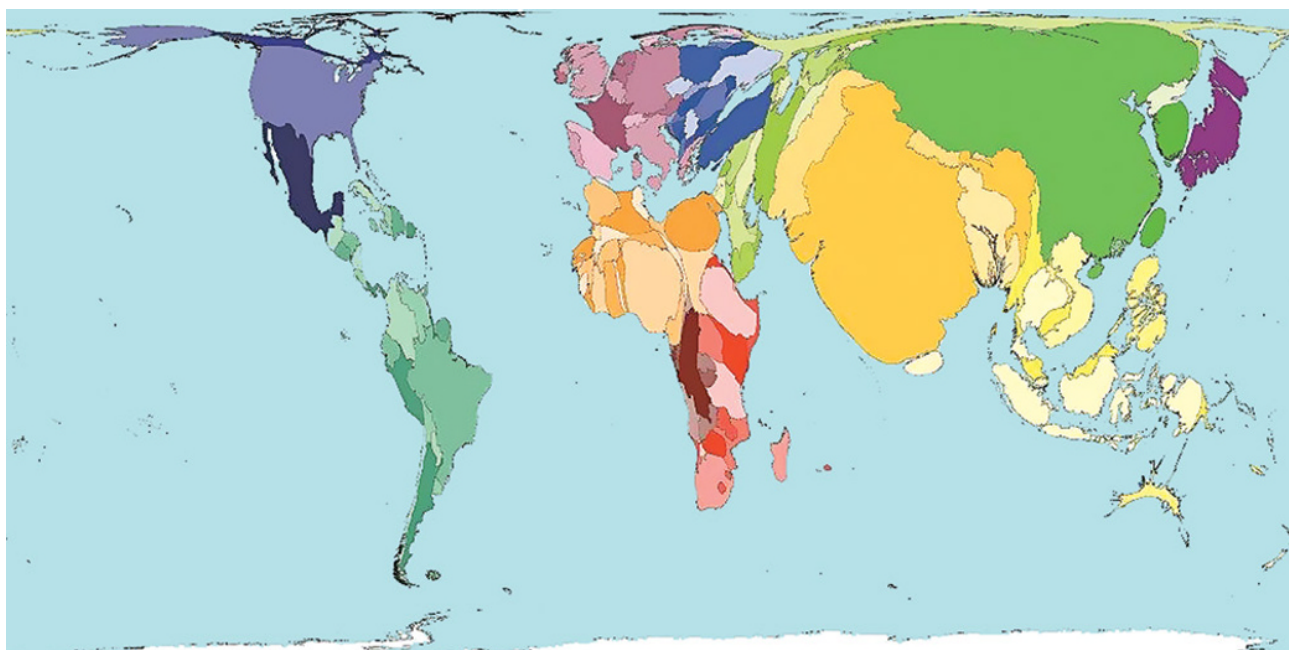


Figure 2.3 Global perspective: total population (population cartogram). *Source:* <http://www.worldmapper.org/display.php?selected=1>. © Copyright Worldmapper.org / Sasi Group (University of Sheffield) and Mark Newman (University of Michigan).

Nations, 2011). Whereas between 2011 and 2050 the population of the more developed regions will remain largely unchanged at 1.3 billion inhabitants, the population of the less developed regions is projected to rise from 5.7 billion in 2011 to 8 billion in 2050. At the same time, the population of the least developed countries is

projected to more than double from 851 million inhabitants in 2011 to over 1.7 billion in 2050. Consequently, by 2050, 90% of the world's population is expected to live in the less developed regions, including 18.6% in the least developed countries, whereas only 14% will live in the more developed regions (Figure 2.4).

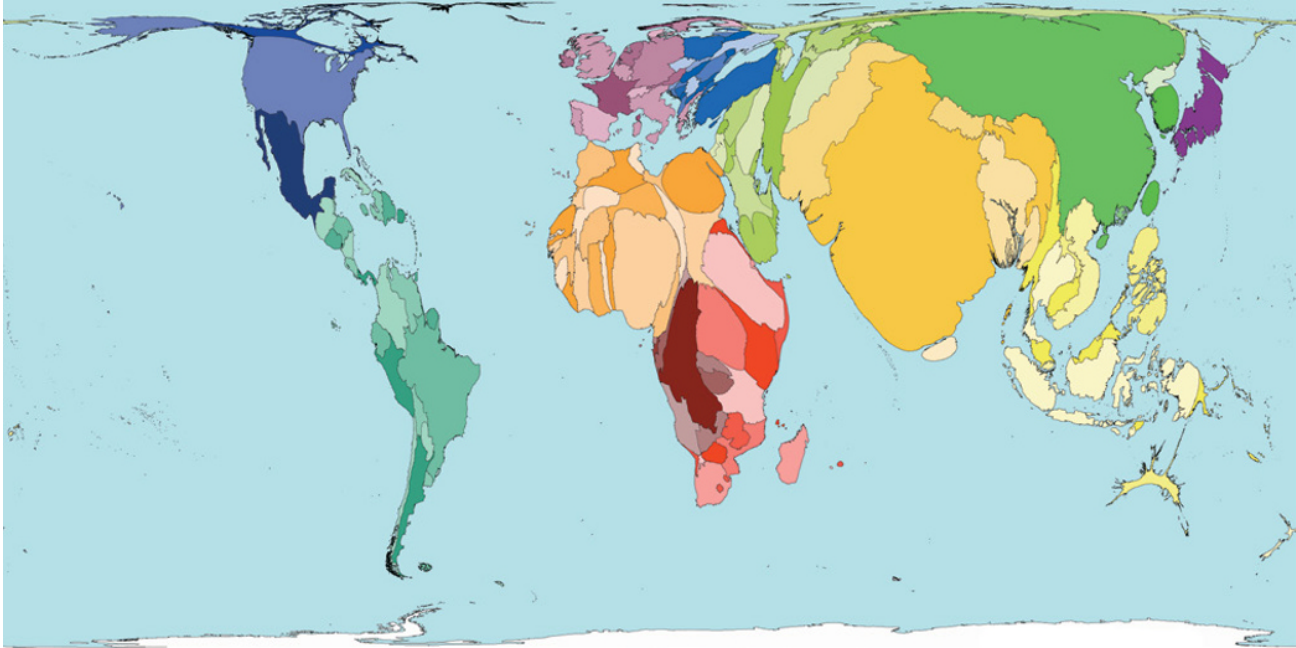


Figure 2.4 Global population prediction: 2050. Source: <http://www.worldmapper.org/display.php?selected=2>. © Copyright Sasi Group (University of Sheffield) and Mark Newman (University of Michigan).

To properly interpret the significance of health trends it is really important to consider the size and distribution of the population within our geographical sphere of work. Relatively low levels of disease in a large population may represent a much bigger challenge than high levels of disease in a small population, particularly because many larger countries tend to be less affluent at present and have less well developed health promotion and treatment services.

Oral Health

A recent definition from the World Dental Federation (FDI) highlights that ‘oral health is multifaceted and includes the ability to speak, smile, smell, taste, touch, chew, swallow, and convey a range of emotions through facial expressions with confidence and without pain, discomfort, and disease of the craniofacial complex’ (Glick et al., 2016).

Poor oral health can limit the ability to eat, speak and socialise. Oral diseases are largely preventable and yet remain common in most societies across the lifespan (WHO, 2012a). Within any community, there is great diversity of oral health by age, gender, geography and socio-economic status, as well as changes over time. Diseases and conditions that threaten oral health may be considered a ‘silent epidemic’ affecting our most vulnerable citizens in society (Benzian, Monse and Helderma, 2011).

Oral Health Needs

This chapter focuses on oral health needs globally as well as some local examples, particularly from the UK. ‘Need’ is a concept that requires some ‘unpacking’. Bradshaw’s taxonomy provides a simple overview of the concept of ‘need’ (Bradshaw, 1972) and has remained an important concept in health and social care over recent decades (Cookson, Sainsbury and Glendinning, 2013). Bradshaw described different types of need as normative, expressed and perceived, as outlined in Table 2.1.

Oral health needs, as considered from the clinician’s perspective, or that of an epidemiologist, are termed ‘normative’ need. In public health circles, when we describe oral health and oral health trends we generally use epidemiological data that report the clinical epidemiologist’s perspective on need. Examples include the wealth of data collected in national decennial surveys (The Information Centre for Health and Social Care, 2011a), or by the public health service in England (Public Health England, 2014). In more recent years we have begun to place more emphasis on perceived oral health with the development of special questionnaire instruments to measure the impact on health and wellbeing for which there is a raft of measures such as the Oral Health Impact Profile (Slade and Spencer, 1994). Expressed oral health needs tend to be measured as the level of uptake of dental care, i.e. the use of dental services. None of these measures alone provides a perfect overview of oral health, but

Table 2.1 Bradshaw's taxonomy of need.

Type of need	Definition	Example of how this need is measured
Normative need	Need that is defined by experts. Normative needs are not absolute and there may be different standards laid down by different experts.	Epidemiological surveys
Felt need	Need perceived by an individual. Felt needs may be limited by individual perceptions and knowledge of services.	Quality of life indicators
Expressed need or Demanded need	Felt needs turned into action. Help seeking.	Uptake of dental care (emergency and routine)
Comparative need	Individuals (or populations) with similar characteristics to those receiving help.	Comparison between areas and populations

Adapted from Bradshaw, 1972.

together they contribute a population profile that can assist in setting targets for improvement. Comparative need is the difference between two populations. In addition to the above, 'unmet need' is the difference between perceived and expressed need.

At an individual patient level, the same applies. Patients may perceive a need and complain of pain and express their need by attending for dental care, whilst others may suffer pain or discomfort without expressing their need (unmet need). When we as clinicians identify the presence of dental caries following clinical and/or radiological examination, this is evidence of 'normative need', which may or may not relate to perceived need.

As with individual patient care, it is important to understand the needs of the population, their help-seeking behaviour and how they are changing over time.

Chapter Aims

Having set the scene by examining the importance of understanding our population and their health needs, the aims of this chapter are as follows: first, to outline very briefly how oral health is measured, and provide examples of oral health surveys; second, to describe key trends and patterns in oral diseases and conditions; third, to highlight inequalities in health and wellbeing; and fourth, to explore the implications of these oral health trends for policy makers and clinicians.

Surveys of Oral Health – Epidemiology

Epidemiology can help to answer some important questions. What are the trends and patterns of oral health? What sections of society are most affected? What are the risk factors for the disease or condition? This includes

social, physical, behavioural and genetic factors. Epidemiology is the study of disease or condition (*logos*) upon (*epi*) a population (*demos*) and has been defined by Mausner, Kramer and Bahn (1985) as 'the orderly study of diseases and other conditions in human populations where the group rather than the individual is the unit of interest'.

Unlike many aspects of general health, oral disease and morbidity can be measured directly. However, this is an expensive process as it generally involves using dentists, and support staff who have been trained and calibrated, to undertake epidemiological surveys. Epidemiologists first need to be trained to measure dental disease according to set criteria so that when we consider trends over time or compare one survey finding with another we can be reasonably confident that we are comparing like with like. Epidemiological surveys of oral health generally involve dental examinations of a representative or random sample of the population. Most of our data come from cross-sectional surveys and thus reflect the prevalence of a disease or condition. Cross-sectional studies give us a snapshot in time, and trends over time may be inferred from regular cross-sectional studies in the population. Longitudinal studies are particularly important to look at changes over time but are much more difficult and expensive to conduct given population mobility. They can, however, provide rich data on the incidence rate of a disease, i.e. the number of new cases per population at risk in a given time period. A good example of a current longitudinal study which is providing the global dental community with important and interesting findings is the Dunedin study in New Zealand, where the birth cohort of 1972–73 has been followed up regularly over the decades (Dunedin Health and Multidisciplinary Research and Development Unit, 2014). Great effort is made to follow up as many people as possible, even those who have left the country. The findings are reviewed at key points in this chapter.

Some studies will combine an epidemiological survey or normative needs assessment with a questionnaire survey to explore perceived needs, thereby providing a better overview of the population's oral health. Where resources permit, this may be undertaken in conjunction with questionnaire surveys which examine perceived oral health and wellbeing, the impact of oral disease and health behaviours. The latter include diet, oral hygiene, tobacco, alcohol, fluoride use and dental attendance.

A wide range of oral diseases is measured by means of epidemiological surveys including those listed in Table 2.2. From the data collected, other dimensions of oral health may be reported such as edentulousness, having 'excellent' oral health or a 'functional dentition', as explored in later sections of this chapter. Other conditions such as cancers tend to be measured through health services data, both from registries (all cancer data have to be shared with the national cancer registry) and routine activity data where diagnoses are part of the data set.

As one would expect, the most commonly measured diseases are the most prevalent: dental caries and periodontal diseases. The World Health Organization (WHO) global oral health database is currently held by Malmo University, <http://www.mah.se/CAPP/>, and the periodontal database in Japan, on behalf of WHO/FDI, <http://www.dent.niigata-u.ac.jp/prevent/periodo/contents.html>. They provide a very useful, but sadly sometimes outdated, source of information, either because national surveys have not been undertaken, or not reported to the WHO. Additionally the FDI is launching a new oral health observatory app on which it is possible to look at available data by country: <https://www.fdiworlddental.org>

National statistics on oral health need to be treated with caution because they are not all collected at the same time and may not be fully representative of their country, depending on whether they come from a national survey involving a random sample of the population or a local survey of a particular area. They may

Table 2.2 Data sources on the prevalence of oral diseases and conditions.

Epidemiological surveys	Health services registry and activity data
Dental caries	Cancers (oral, oropharyngeal, etc.)
Periodontal diseases	Cleft lip and/or palate
Tooth wear	Noma
Fluorosis	HIV/AIDS
Trauma to teeth	
Orthodontic need	
Other, e.g. soft tissue abnormalities	

include data on age ranges rather than one specific age. Whatever data are presented, we recognise that even within one country patterns of oral health will vary greatly, so even where data are representative of the national picture, they are average values and will not reflect the variation within society. Therefore clinicians may find themselves practising in areas where disease levels are higher or lower than the national average.

The incidence and prevalence of other serious conditions such as oral cancer are measured in high-income countries, such as the UK, by means of data from cancer registries, and supplemented by information from health services. Similarly, there is also registration of cleft lip and palate and HIV/AIDS which require formal reporting, thus providing robust information at local and national levels. In low-income countries the incidence may be estimated based on hospital activity and registries in the urban areas only. Hence, many of these diseases and conditions are likely to be under-reported and the incidence and prevalence likely to be much greater than the statistics suggest. For example, information on oral cancer in India only exists for patients who attend urban hospitals, whilst many attend only rural hospitals, or none. Global data must therefore be interpreted in light of data quality as outlined in subsequent sections.

Challenges of Measuring Oral Diseases and Conditions

Ethics

Epidemiology is generally undertaken for population rather than direct individual benefit. People are encouraged to take part for the good of society. Thus, it is important that the data from epidemiological surveys or questionnaire surveys are used to inform the planning of oral health services including health promotion. A further ethical consideration is that individuals taking part in epidemiological examinations should have the opportunity to have any serious oral health needs addressed appropriately; thus, all survey protocols should outline how someone with an acute or serious lesion will be facilitated to access care in a timely manner.

Sampling

Population studies are rarely conducted as they are expensive and generally not necessary; instead a representative sample is selected. Sampling of populations is informed by science but requires practical consideration of which sections of the population may be measured and where. There is always consideration of keeping costs to a minimum whilst ensuring that the sample is large enough to be

representative but selected in a random manner. Hence, the majority of what is known about common oral diseases and conditions comes from cross-sectional studies involving a random sample of the population. It is always worth checking if nationally available data come from a national or a local sample randomly selected or merely a convenience sample; and also whether there have been power calculations to check if the sample size is sufficient. This will provide an indication of its representativeness. Birth cohort studies involve following up a specific section of the population, e.g. the birth cohort of 1972–73 in Dunedin, New Zealand (Dunedin Health and Multidisciplinary Research and Development Unit, 2014), or the Avon Longitudinal Study of Parents and Children (ALSPAC, 2014), both of which are population-based, prospective cohort studies, with an important oral health component.

Indices

Table 2.3 shows the most common indices of oral health used in surveys, of which dmft/DMFT is the most frequently used. Dental caries has been measured by epidemiologists and clinicians counting the number of decayed [dt or DT], missing [mt or MT] and filled [ft or FT] teeth. This provides a composite score or number of affected teeth. This index was first described by Klein and colleagues in 1938 and adapted by the World Health Organization in 1986. It has been universally used in dentistry and advocated by the WHO in their 'Survey Methods' (WHO, 2013a).

Lower case 'dmft' denotes the primary dentition and upper case the permanent dentition; dmft/DMFT numerically expresses caries prevalence and is obtained by calculating the number of affected teeth at 'tooth' or 'surface' level. If the data relate to tooth surfaces, then they are reported as dmfs or DMFS and teeth dmft or DMFT. In countries where caries prevalence is high, the simple measure of dmft/DMFT is sufficient. The index does have a number of limitations in that caries is cumulative and therefore it is less helpful in adults than in children, particularly when teeth have been extracted.

Indices for measuring dental caries are undergoing further development: where caries levels are lower, there is increasing emphasis on developing more sophisticated dental indices to measure the depth and extent of dental caries, and to link the index to clinical care. Where disease levels are low and careful planning of both preventative and treatment services is required, it is important to begin to explore the use of more sophisticated clinical indices. An increasingly used index in clinical care is ICDAS, which may also be used as an epidemiological tool. ICDAS is the International Caries Detection and Assessment System (ICDAS Foundation, 2014), which is a 'system for detection and classification of caries

in dental education, clinical practice, dental research, and dental public health'.

Historically, the majority of surveys of oral health worldwide have been conducted in schoolchildren for the following reasons. First, because most children attend school, they are the easiest section of the population to identify and access. Second, given that oral disease is one of the most prevalent conditions in children, it is important to measure in childhood, before (5 or 6 years) and after (12 or 14/15 years) they develop their permanent dentition. Third, it is important to inform action such as oral health promotion and plan healthcare so that children are given the best start in life with healthy lifestyle and free from disease. This is particularly important because much oral disease is cumulative and patterns of oral health are established at an early age. However, as all countries have an ageing population it becomes increasingly important to understand and reflect on how best to address the various sub-groups, giving increasing importance to the oral health needs of the older population (Petersen and Yamamoto, 2005). Cohort studies in high-income countries are now suggesting that older people are a caries-active group, experiencing new disease at a rate which is at least as great as that of adolescents (Thomson, 2004).

Training and Calibration

Much effort goes into planning an oral health survey. It is important to develop a clear written protocol for the study and ensure that all those administering a survey are trained in the criteria for diagnosing and recording diseases and conditions. Once staff have been trained then they need to be calibrated against a 'gold standard', to assess how accurately they use the survey criteria. Epidemiologists need to be reliable both internally and externally. Their findings should correlate with the 'gold standard', thus confirming that they are externally reliable. Internal consistency is demonstrated by re-examining a sub-sample of subjects (usually 10%), and comparing the scores to determine their level of consistency.

Surveys of Health and Wellbeing

Increasingly, information on the perceived needs of populations' oral health and wellbeing is being collected. This involves using quality of life surveys, often as part of a general or oral health survey. One of the most popular indices is the Oral Health Impact Profile; the main measure has 49 items (Slade and Spencer, 1994), and the short-form OHIP-14 has 14 (Slade, 1997). It is one of the most common measures used in national surveys (Nuttall et al., 2006; The Information Centre for Health and Social Care, 2011b).

Table 2.3 Epidemiological indices by disease and condition.

Diseases and conditions	Index name (abbreviation)	Reference		
		Authors	Year	
Dental caries	deft/defs: primary dentition (usually younger children) d – decayed e – tooth indicated for extraction f – filled t – teeth <i>or</i> s – surfaces of the teeth	Gruebbel	1944	
	dmft/dmfs: primary dentition d – decayed m– missing f – filled t – teeth <i>or</i> s – surfaces of the teeth	H. Klein, C.E. Palmer, and J.W. Knutson Modified by WHO	1938 1986	
	DMFT/DMFS: permanent dentition D – decayed M– missing F – filled T – teeth <i>or</i> S – surfaces of the teeth	H. Klein, C.E. Palmer, and J.W. Knutson Modified by WHO	1938 1986	
	Root caries index	R.V. Ratz	1979	
	Significant caries index	D. Bratthall	2000	
	Care index = FT/DMFT%	n/a	n/a	
	The International Caries Detection and Assessment System, or ICDAS, is a simple, logical, evidence-based system for detection and classification of caries in dental education, clinical practice, dental research, and dental public health https://www.icdas.org/	Ismail et al.	2007	
	Periodontal diseases	Periodontal index	A.L. Russell	1956
		Gingival index (GI)	J. Silness and H. Loe	1963
		Plaque index (PI)	H. Loe and J. Silness	1964
Community Periodontal Index of Treatment Needs (CPITN)		World Health Organization (WHO) and Fédération Dentaire Internationale (FDI)	1978	
Orthodontic conditions	IOTN – Index of Orthodontic Treatment Need	P.H. Brook and W.C. Shaw	1989	
	PAR Index – Peer Assessment Rating	S. Richmond et al.	1992	
	ICON – Index of Complexity, Outcome and Need	C. Daniels and S. Richmond	2000	
Tooth wear	Eccles index for dental erosion of non-industrial origin	J.D. Eccles	1979	
	TWI – tooth wear index	B.G. Smith and J.K Knight	1984	
	Lussi's index for erosion	A. Lussi	1996	

Table 2.3 (Continued)

Diseases and conditions	Index name (abbreviation)	Reference	
		Authors	Year
Fluorosis	O'Sullivan index	E.A. O'Sullivan	2000
	Simplified TWI (tooth wear index)	P.F. Bardsley, S. Taylor and A. Milosevic	2004
	Basic erosive wear examination (BEWE). http://elearningerosion.com/en/elearning_erosion/scientific-background/erosion-diagnosis/basic-erosive.html	Bartlett et al.	2008
	Dean's index	H.T. Dean	1934
	TF Index – Thylstrup and Fejerskov's index for fluorosis	A. Thylstrup and O. Fejerskov	1978
	Horowitz et al. index of fluorosis	H.S.Horowitz, W.S. Driscoll, R.J. Meyers, S.B. Heifetz, and A. Kingman	1984
Dental trauma	Trauma index: developed during Child Dental Health Survey in the UK	M. O'Brien	1993

How Are Data Used?

Epidemiological and quality of life data may be used in the planning of oral health services and preventive programmes. One of the most dramatic uses of epidemiology in the last century was the study of fluoride in water by Trendley Dean, who in his '21 cities study' identified the optimal level of fluoride in water to reduce dental caries whilst minimising the level of fluorosis and therefore bring great benefit to oral health; a good example of public health initiatives (Murray et al., 2003).

Evidence of poor oral health, obtained through population surveys, can stimulate action on tooth brushing and application of fluoride varnish in schools, together with action to improve the uptake of dental care, as with the Childsmile programme in Scotland (NHS Scotland, 2014). However, in many countries without state funded dental services there is not always such obvious use of information for planning dental care because of the way dentistry is organised and delivered – largely as a business. However, as outlined in the introduction, the use of epidemiology and health service data to demonstrate unmet need can be extremely helpful when considering where to invest existing time and resources and perhaps gain additional resources to address problems.

How Does Epidemiology Differ from Screening?

Sometimes there is confusion between screening for oral disease and epidemiology – often because the two have historically been combined for schoolchildren. Screening has been defined as 'A public health service in which members of a defined population, who do not necessarily perceive they are at risk of, or are already affected by a disease or its complications, are asked a question or offered a test, to identify those individuals who are more likely to be helped than harmed by further tests or treatment to reduce the risk of a disease or its complications' (UK National Screening Committee, 2014). Essentially epidemiology is primarily conducted for the benefit of the population, and screening for the benefit of the individual. People testing positive at screening are sent for an examination and further investigations.

In dentistry, oral screening for dental caries or cancer generally involves a visual examination to determine if there is possible disease, which means it is easy to get epidemiology and screening confused.

Global Oral Health

The World Health Organization (WHO), working closely with the World Dental Federation (Fédération Dentaire Internationale, or FDI), plays an important role

in monitoring oral health. This involves producing a manual, *Oral Health Surveys – Basic Methods*, which is now in its fifth edition (WHO, 2013a). This guidance, which includes advice on pathfinder surveys, is available online via WHO publications. The WHO manual has encouraged countries to conduct standardised oral health surveys that are comparable internationally. It facilitates development of procedures for management and analysis of data based on the use of information technology. The findings of national surveys are lodged in the Global Oral Health Data Bank, which is an important component of the Country/Area Profile Programme information system.

Because there may be so much difference in oral health within a population, it is important to ensure that there are robust data on key age groups to enable comparison over time and across countries. The key age groups as advised by the WHO (2013a) are:

- 5 years: dental caries in primary teeth (or later if children start school at 6 or 7 years).
- 12 years: dental caries in secondary teeth.
- 15 years: dental caries in secondary teeth.
- 35–44 and 65–74 years for dental caries in permanent teeth and periodontal disease.
- 65 years and over: edentulousness.

Pathfinder survey methods outlined by the WHO (2013b) are designed to assist those beginning epidemiological work in a given country and to assist in planning the provision of oral healthcare or further survey work and thus provide a practical, economic survey sampling method. A pathfinder survey is a stratified cluster sampling technique of key age groups. The sites are usually based on administrative districts and include the most important population sub-groups likely to have different disease levels. For example, a sample design for a national pathfinder survey for each ‘index age’ as shown in Box 2.1 may include 300 per group.

Box 2.1 Sampling for national pathfinder survey by index age and location as advised by WHO (2013b).

Urban:

- 4 sites in the capital city or metropolitan area ($4 \times 25 = 100$)
- 2 sites in each of 2 large towns ($2 \times 2 \times 25 = 100$)

Rural:

- 1 site in each of 4 villages in different regions ($4 \times 25 = 100$)

Total for one index age or age group:

- 12 sites \times 25 subjects = 300

Data from WHO, 2013b.

At the time of writing there are 196 countries in the world. Countries are encouraged to report their epidemiological findings centrally. The WHO oral health databank contains information on the oral health of many countries for certain diseases and the key age groups. The most common data held relate to dental caries in 12-year-olds. Data on 12-year-olds are available for over 90% of countries worldwide, <http://www.mah.se/CAPP/>. There are some data on periodontal diseases in adults, <http://www.dent.niigata-u.ac.jp/prevent/periodontal/contents.html>, and oral cancer data are available through Cancer Today at <http://gco.iarc.fr/today/home>

What Do We Learn from Countries with Surveys of Oral Health?

The following sections will examine oral health using a series of markers relating to the common oral conditions as well as perceived oral health. Each section will examine global information on the size of the problem, as well as reviewing risk factors and interesting facts. Each section will conclude with consideration of the relevant global targets for oral health which should be formulated at country level (Hobdell et al., 2003a) to reflect the local disease levels rather than having the same targets for all. Finally, each section explores the challenges for those of us who seek to promote oral health.

The most basic of marker of oral health, and the easiest to measure, is whether people have retained any natural teeth; this will be considered first.

Edentulousness

Becoming edentate is the ultimate marker of dental morbidity and has significant implications for general health and wellbeing. Interestingly, as surveys of adults are less common than those of children, there are limited data on edentulousness worldwide.

Size of the Problem

The CAPP (WHO/FDI) database has information on adults of 65 years and over (CAPP, 2014a). Looking across global oral health data, it is clear that relatively few countries ($n = 56$) have conducted surveys of adults in older age groups and that data that are available cover several decades, thus the findings are not directly comparable. Furthermore, there is little indication of the extent to which the data are representative of the population as a whole. Nonetheless, there are some interesting findings and the variation in reported levels