

Oral health 2



Ending the neglect of global oral health: time for radical action

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Oral diseases are a major global public health problem affecting over 3·5 billion people. However, dentistry has so far been unable to tackle this problem. A fundamentally different approach is now needed. In this second of two papers in a Series on oral health, we present a critique of dentistry, highlighting its key limitations and the urgent need for system reform. In high-income countries, the current treatment-dominated, increasingly high-technology, interventionist, and specialised approach is not tackling the underlying causes of disease and is not addressing inequalities in oral health. In low-income and middle-income countries (LMICs), the limitations of so-called westernised dentistry are at their most acute; dentistry is often unavailable, unaffordable, and inappropriate for the majority of these populations, but particularly the rural poor. Rather than being isolated and separated from the mainstream health-care system, dentistry needs to be more integrated, in particular with primary care services. The global drive for universal health coverage provides an ideal opportunity for this integration. Dental care systems should focus more on promoting and maintaining oral health and achieving greater oral health equity. Sugar, alcohol, and tobacco consumption, and their underlying social and commercial determinants, are common risk factors shared with a range of other non-communicable diseases (NCDs). Coherent and comprehensive regulation and legislation are needed to tackle these shared risk factors. In this Series paper, we focus on the need to reduce sugar consumption and describe how this can be achieved through the adoption of a range of upstream policies designed to combat the corporate strategies used by the global sugar industry to promote sugar consumption and profits. At present, the sugar industry is influencing dental research, oral health policy, and professional organisations through its well developed corporate strategies. The development of clearer and more transparent conflict of interest policies and procedures to limit and clarify the influence of the sugar industry on research, policy, and practice is needed. Combating the commercial determinants of oral diseases and other NCDs should be a major policy priority.

Introduction

Despite considerable scientific progress in the understanding of the pathogenesis and causes of oral diseases over recent decades, the global burden of oral conditions has persisted, and is indeed likely to worsen.¹ As outlined in the first paper in this Series,² oral diseases affect over 3·5 billion people across the world, with untreated dental caries being the most prevalent health condition globally. In high-income countries (HICs), where the overall prevalence of caries has decreased in the child population, the progressive and cumulative nature of the condition into adulthood and later life remains a major problem.^{3,4} Stark socioeconomic inequalities in oral health mean that poor and vulnerable groups in society are particularly affected. Thus, oral diseases continue to cause pain, infection, and low quality of life for vast numbers of people around the world, and the costs of dental treatment can have a major effect on household budgets⁵ and wider health-care systems.⁶

In this second paper of a two-part Series on oral health,² we present a critique of dentistry, highlighting its key limitations and the urgent need for radical reform. The global perspective on dentistry comprises of three contrasting but interconnected realities. In HICs, the current treatment-dominated and increasingly technology-focused system of oral health care is trapped in an interventionist cycle that does not tackle the underlying causes of diseases, nor meet the needs

of large proportions of the population. In many middle-income countries, the burden of oral diseases is substantial, but oral care systems are often underdeveloped and unaffordable to the majority of the population.⁷ In low-income countries (LICs), the situation is most bleak. Although the overall disease burden is still comparatively low, oral diseases are increasing in prevalence.¹ With other competing demands on scarce resources, investment in oral health is very restricted, making dentistry an unavailable and unaffordable luxury reserved for the wealthy. Most disease therefore remains untreated in the majority of the population, but particularly the rural poor, who have very restricted access to dental care. To effectively tackle the global burden of oral diseases requires a fundamentally different approach. We argue that a system change is needed—more of the current interventionist approach will achieve little. The need for system change is particularly relevant in LICs where the so-called westernised model of dentistry is unaffordable, unsustainable, and inappropriate.^{8–10} In addition to a reform of dental services, we also highlight the urgent need to change the individualistic, downstream preventive approach that currently dominates, but which has not been able to achieve marked population oral health gain or to effectively tackle inequalities. We particularly focus on the need for cohesive, comprehensive, and integrated policy action to reduce free sugar consumption, as an

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Key messages

- Dentistry continues to adopt a treatment-dominated, interventionist, technical, and increasingly high-technology and specialised approach to care
- Such an approach has not successfully tackled the global burden of oral disease; radical reform of dental care systems is now urgently needed
- Universal health coverage provides an opportunity for dental services to become more integrated in the wider health-care system and to be more accessible and responsive to the oral health needs of the population
- Provider payment systems should put more emphasis on incentivising prevention instead of rewarding restorative and interventionist dental care
- A different preventive approach, focusing on population-wide effects, is also needed, as the current individualistic clinical paradigm has not achieved sustained improvements in population oral health or addressed the persistent inequalities
- Integrated public health policies are needed to tackle the shared common risk factors (ie, free sugar consumption, tobacco use, alcohol consumption, and their driving social and commercial determinants) of oral diseases and other non-communicable diseases
- A range of highly developed corporate strategies are used by the global sugar industry to increase their sales and profits, and to undermine public health efforts to reduce free sugar consumption
- A pressing need exists to develop clearer and more transparent conflict of interest policies and procedures, to restrict and clarify the influence of the sugar industry on dental research and oral health policy

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important shared risk factor for dental caries and other non-communicable diseases (NCDs).¹¹ We recommend that bold action be taken to address the power and influence of the global sugar industry, which uses a wide range of measures to promote their products globally and lessen the effect of any public health efforts attempting to reduce free sugar consumption. These commercial determinants of oral health highlight the urgent need for strong regulation and legislation, and the importance of developing clear and transparent conflict of interest policies to shield industry influence away from dental research, oral health policy, and professional dental organisations. We close this paper with a plea to step up global advocacy efforts in the wider health and human development fields, to end the widespread neglect of oral health globally.

Limitations of dentistry: a system no longer fit for purpose

Dentistry is in a state of crisis. 21st century dentistry has largely been unable to combat the global challenge of oral diseases.^{1,12,13} This shortcoming is not the fault of individual dental clinicians committed to caring for their patients. The overall philosophical approach, system, and model of dental care delivery are at fault (appendix p 1).

The dental profession and the practice of dentistry are still very much dominated by a treatment-focused, interventionist, and technical philosophy that reflects patterns and understandings of dental disease that were current over 80 years ago, and ultimately date back to the surgical origins of the profession.^{7,9} This approach emphasises a biomedical and reductionist understanding

of disease causation and a belief that treatment and high-technology intervention will ultimately restore oral health and so-called dental fitness.⁷ The fundamental principles of dental training have remained broadly unchanged for decades. Although teaching on certain techniques and approaches has evolved, the dental surgeon paradigm persists, with dentists largely trained to intervene reactively (ie, once the disease or problem has started to manifest itself) and surgically (using a drill, scalpel, or other instruments) rather than proactively and preventively. As such, the training of dentists prepares them to be disease-centred rather than patient-centred or health-centred.^{7,14}

For a variety of historical, professional, political, and economic reasons, dentistry around the world is largely provided by dentists working independently in the private sector in single-handed or small group practices, often isolated from mainstream health services.^{9,15} Many countries are showing increasing growth in large corporate bodies and insurance companies that provide health care, including dentistry. These commercial, for-profit organisations can provide high-quality care, but also need to ensure adequate returns on their investments for their shareholders, and therefore have an inherent tendency for promoting excessive diagnostic testing and overprovision of treatment.^{12,16,17} Such commercial pressures and incentives fuel an interventionist approach and risk unnecessary and inappropriate care. Treatment becomes incentivised and drives further treatment rather than health.

A substantial mismatch exists between the oral health needs of communities and the availability, location, and type of dental services provided. Dentistry is mainly a demand-led service, often poorly planned as a result of entrepreneurial choices, and is therefore poorly aligned to the oral health needs of the local population. In high-income and middle-income countries (HMICs), young children, low-income families, marginalised groups such as homeless people and prisoners, and people living with disabilities are generally underserved,^{18–22} whereas dental services often tend to be located in wealthy urban neighbourhoods where affluent, healthy adults might be receiving unnecessary dental care—a perfect example of the inverse care law.^{23–25} In many low-income settings the situation is far worse. Across much of sub-Saharan Africa and in many LICs, dental services tend to be located in urban areas inaccessible to the majority of the rural poor. Individuals with dental problems might need to travel far to reach a dentist, or need to resort to using local traditional street providers of dental care, and as a result be exposed to the risks of using these unregulated providers.²⁶ Although concepts for integrating basic oral health care in primary health care exist, they have not gained widespread traction, which further contributes to the challenge of providing access to even basic oral health care.^{27–29} Population coverage for oral health care in low-income and

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middle-income countries (LMICs) is generally lower than in HICs, with median estimates ranging from 35% in LICs, 60% in lower-middle-income countries, 75% in upper-middle-income countries, and 82% in HICs.³⁰ Within countries, the poorest quintiles have the lowest coverage rates—for example, in Lao in southeast Asia, coverage of the richest quintile is more than eight times higher than for the poorest quintile.³⁰

The extent to which patients have to pay or co-pay for dental care and the manner in which dental care providers are reimbursed for their services have important bearings on the use and quality of care.⁶ Evidence from high-income settings, such as that from the US RAND Health Insurance Experiment, has shown that individuals who have to co-pay more tend to access less dental care than those who have to co-pay less.³¹ Worldwide, substantial differences exist in patient co-payment fees for dental care,³² and the higher levels of fees might limit access to and the use of care among people on low incomes. Households in LMICs that pay for dental care face a significantly higher risk of spending large portions of their disposable income, and have a higher risk of impoverishment, compared with households that do not pay for dental care.⁵

The conventional types of provider payment in dentistry include fee-for-service, fixed salary, and capitation payments.^{6,33} Empirical evidence for the effects of the various reimbursement schemes on dental care is relatively scarce.³⁴ Capitation and salary payments provide good incentives for cost-containment but impose risks of patient selection and undertreatment. Fee-for-service payments foster higher use of care but might impede cost-containment. In 2018, Chalkley and Listl³⁵ identified significant increases in the provision of potentially harmful dental radiographs when dentists received fee-for-service rather than salary payments.

Little planning has been done concerning the numbers or distribution of dentists and the wider oral health workforce, or for the skill sets they require. Although dentist-to-population ratios are only a crude measure of oral health-care service availability, and are not correlated to disease prevalence, the numbers of dental personnel show stark variations across countries, as well as within countries.^{36,37}

Some countries have recently seen major increases in the numbers of dental schools, such as Brazil,³⁸ Chile,^{39,40} Colombia,⁴¹ India,⁴² and the USA;⁴³ however, many of these schools are private, for-profit institutions responding to competition and demand for dental courses, with no reflection on the needs of their local populations⁴⁴ (figure 1). The rapid increases in dentist-to-population ratios particularly seen in HMICs are likely to lead to an oversupply of dentists, increased risk of iatrogenic overtreatment, and increasing unemployment amongst dentists.⁴⁵ Furthermore, few of these growing numbers of dentists move into rural and remote, low dentist-to-population-ratio areas, and so the

vulnerable groups with greatest need for dental treatment remain without care. In many LICs, few dental schools exist, and so the supply of dental personnel is very low. This situation is not helped by the so-called brain drain of dentists to higher-income countries, where they can earn higher incomes, have better career perspectives, practice the high-technology dentistry that they were taught at dental school, and enjoy a better quality of life than in LICs.³⁶

The problems in dental training and the mismatch between the need for and the provision of care are compounded by the expansion of specialist practices in dentistry.⁴⁵ In the UK, for example, 13 different dental specialities are now established according to specialist lists of the UK General Dental Council (number as of 2019). Although a proportion of patients undoubtedly have complex oral health needs requiring additional specialist skills, most oral health needs can be met by primary care dentists, and some debate exists around whether the expansion in specialist dental practices truly reflects and aligns with the oral health needs in the community.⁴⁶ The growth of specialist practice increases the cost of care and access is often sparse in areas of most need. The interface between primary and secondary dental care can be problematical in terms of equity in referral to secondary care, seamless care, effectiveness, and efficiency.⁴⁷ Additionally, an increasing number of specialists reduces the stability and continuity of dental care and preventive support provided in primary care services, the so-called dental home. Continuity of care is of particular relevance to children and adults at high risk of developing oral conditions, such as those living with disabilities and long-term conditions.

Unlike in medicine, in dentistry, the use of a wider professional team to deliver care is less common.⁴⁵ This is partly a legacy of the dental surgeon paradigm, in which the dentist was seen as solely responsible for the diagnosis of disease and the provision of treatment.⁷

For more on the specialist lists of the UK General Dental Council see <https://www.gdc-uk.org/professionals/specialist-lists>

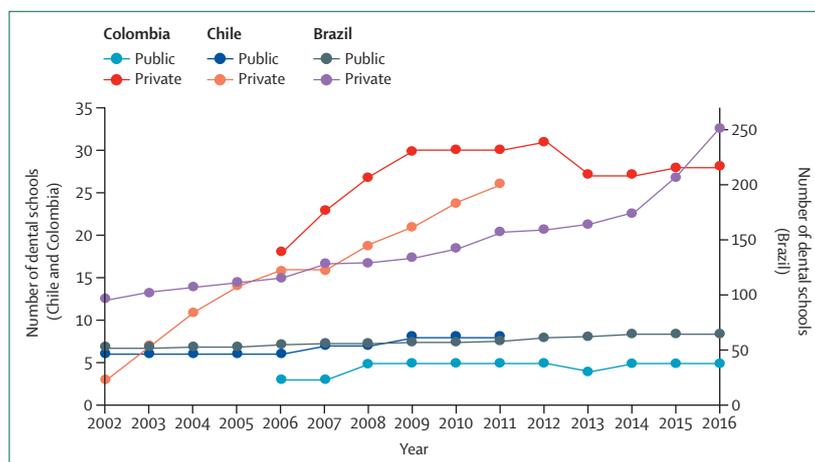


Figure 1: Expansion of private dental schools in Brazil, Chile, and Colombia between 2002 and 2016. Data obtained from Saliba et al,³⁸ Venturelli Garay and Watt,³⁹ Cartes-Velásquez,⁴⁰ and Jaramillo et al.⁴¹

Many dental schools around the world continue to teach dentists to treat and work in isolation, instead of training a wide range of dental care professionals with different and complementary skills who are able to address the oral care needs of their patients and local populations.^{44,45} Treatment needs range, from very simple preventive procedures (such as topical fluoride application), to complex treatments (such as implant-retained prosthesis). These treatments can be delivered with improved efficiency, effectiveness, and coverage by an oral health workforce with an appropriate and mixed skills set. Mid-level care providers are also instrumental in increasing access to dental care in underserved and remote population groups. Indeed, in many settings, and particularly in LMICs, training a more community-oriented oral health workforce rather than dentists is a realistic solution to address the acute workforce shortages and access challenges.⁴⁹ The types and designations of dental professionals trained vary across different countries and jurisdictions, but commonly include dental hygienists, dental therapists, denturists, dental assistants or nurses, and dental technicians, amongst others. As with many other professional fields, discussions over scopes of practice and the independence of these different professional groups are often complex and fractious. The debate over which of these professionals can do what, and under what circumstances, is often decided as a compromise between professional groups rather than in view of the public's wellbeing or needs.⁵⁰

Despite the advances made by the Cochrane Collaboration and other groups in promoting evidence-based dentistry, the scarcity of evidence for many dental procedures remains a major challenge. For example the management of caries has traditionally been to remove the decay and place a filling, which, regardless of the initial size of the cavity, enters the tooth into a cycle of repeat restoration with increasing complexity, and eventual treatment failure and tooth loss.^{7,51–55} This traditional treatment approach does not acknowledge that caries cannot be treated away, neither does it reflect contemporary understanding of the pathogenesis of caries.^{56–59} Clinical evidence shows that caries is preventable, and once established, might also be reversible, if detected and addressed in its early stages.^{58–60} New developments in adhesive dental materials mean that the treatment of established disease, which includes appropriate use of topical fluorides,^{61,62} might be managed with less destruction of tooth tissue⁵⁸ and less need for high technological and rehabilitative dentistry than the current restorative approach.⁷ Since 2017, dental amalgam, the filling material central to the restorative approach, is being phased down as part of the UN Minamata Convention on Mercury.⁶³ Other long established treatments used in routine dental practice have also been challenged because of the absence of evidence on their effectiveness.^{64–66} Two pillars of routine clinical dental

practice might serve as examples: the 6-month dental recall, and scale and polish for the management of gingival and periodontal diseases. The UK National Institute for Health and Care Excellence found no scientific basis to the 6-month dental recall and recommended that recall intervals should instead be specifically tailored for each patient based on disease prevalence and disease risk.⁶⁷ A UK trial completed in 2018 also showed no clinical benefit in providing either 6 monthly or 12 monthly scales and polishes.⁶⁸

An additional shortcoming in dentistry is the narrow and somewhat simplistic approach adopted to prevent oral diseases. The use of clinical preventive interventions such as topical fluorides to control caries is proven to be highly effective,^{59–62,69} yet is often seen as a panacea, thereby losing sight of the fact that sugar consumption remains the primary causative factor in caries development. Although the use of topical fluorides is a proven clinical preventive intervention and access to this preventive approach should be promoted and improved,^{61,62,69} caries will still develop in the presence of free sugars above 10% of an individual's total energy intake.⁷⁰ Even if exposure to fluoride is optimal, evidence suggests that free sugar exposures as low as 2–3% of total energy intake might still carry a risk of caries.⁷¹ The general approach to the prevention of caries has been individualistic and reductionist, focusing on educating patients and the public about individual risk behaviours in oral hygiene and nutrition, with little regard to when and how these behaviours can be developed and shaped. This clinical approach to prevention has been unsuccessful at achieving long-term oral health gains or in tackling oral health inequalities.^{72–74}

In summary, dentistry and oral health-care systems need radical reform. The current outdated and treatment-focused approach is not meeting the oral health needs of large segments of the global population, and is inappropriate and unaffordable for most low-income settings. A different approach is now needed.

Rethinking oral health care and improving population outcomes

The described limitations of the dominant approach in dentistry (appendix p 1) indicate its complexity, yet also reveal its inadequacy in reducing the global oral disease burden. From a public health perspective, this absence of global effect would seem to be a good starting point and might motivate major, even disruptive innovation in the way dentistry delivers care. In many HICs, reforms of oral health-care systems are often in response to concerns over cost containment, rather than being more proactive efforts to improve the quality of care. In instances in which LMICs are establishing or strengthening oral health-care systems, they often strive to follow the example of HICs by liberalising health-care markets or reducing public health services. Public oral health care is

often the first service to be reduced as it is considered to be expensive and not essential, resulting in increased unmet oral health-care needs.⁷⁵⁻⁷⁷

Key features of an ideal oral health-care system have been postulated: it should have no divide between dental and general health care; it should emphasise health

Panel 1: Recommendations of the Series

Improving epidemiology and oral health surveillance systems

Standardised and comparable oral disease surveillance systems are needed to assess the full extent and severity of oral conditions globally. The use of a range of clinical epidemiological disease measures should be complemented with appropriate indicators that assess the wider population effects of oral conditions. Established and commonly used oral health indicators should be aligned and integrated with non-communicable disease (NCD) surveillance systems to allow for comparability with and monitoring of global NCD targets and the UN Sustainable Development Goals. WHO has a key role in leading the development and strengthening of integrated oral health surveillance systems globally.

Reform of oral health-care systems

System-wide reform of oral health services is urgently needed. The reformed system needs to integrate with wider health care, incentivise and encourage the prevention and maintenance of oral health, use the skills and competencies of a wider team of oral health-care professionals and other health workers, deliver high-quality, evidence-based treatment, and respond to the diverse needs of local populations and promote oral health equity. The growing international momentum towards universal health coverage is a unique opportunity to integrate and reform oral health care.

Education and training of the future oral health workforce

To achieve the goals and aspirations of a reformed oral health-care system requires a suitably trained and skilled oral health workforce. Shifting the dentist-centred model of care delivery towards a team approach is essential. Integrated community-based models of training are needed to ensure that the future workforce understand and are equipped to respond to population-wide oral health needs and to deliver high-quality, appropriate, and evidence-based care.

Tackling oral health inequalities

Oral health personnel have a professional and ethical responsibility to provide care in an equitable and fair manner to meet the diverse needs of their patients and local communities. Oral health-care systems need to be more inclusive, accessible, and accommodating for socially deprived and vulnerable groups. Staff training and resources and closer liaison with support and relevant agencies will be needed to achieve improved oral health equity. Advocacy and widespread policy change are also needed to address the broader social determinants of oral health inequalities that lie outside the remit of health systems.

Moving upstream to maximise oral health improvement

Individualistic, clinical, and educational preventive approaches might achieve short-term benefits, but these benefits soon

diminish unless the underlying causes of disease are tackled. Priority should be given to investment in upstream, coherent, and integrated population-wide policies, such as taxes on sugary drinks, stronger regulation on the advertising and promotion of sugary foods and drinks targeting children, and the promotion of appropriate exposure to fluoride with toothpaste and water; as well as embracing a common risk factor approach to reduce tobacco use and harmful consumption of alcohol.

Addressing commercial determinants of oral diseases

Stricter regulation and legislation are needed to overcome corporate strategies that threaten and undermine oral health and related NCDs. Based on experience gained from tobacco control, dental professional organisations, academic institutions, individual researchers, and policy makers should not accept any funding, sponsorship, or support from the sugar industry. Clear and transparent procedures and policies need to be adopted to identify and mitigate any possible objective or perceived conflicts of interest.

Advancing research agendas

Research focusing on oral diseases is often given low priority by research funding agencies. Given the global public health burden of oral diseases, more funding should in future be allocated in this important area. Defining a global oral health research agenda would help to direct resources and efforts to address vital knowledge gaps, including in the fields of translational and implementation research. Future dental research should focus more on population oral health needs, particularly in low-income and middle-income countries, and evaluate oral health improvement interventions that promote oral health equity. Cross-disciplinary research partnerships with a range of appropriate methodologies and study designs are essential.

Amplifying global advocacy

The neglect of oral health in global and national health discussions should be addressed through multilevel advocacy efforts aiming to (1) improve knowledge and awareness of the magnitude of the oral health challenges; (2) create a culture of inclusiveness and recognition regarding oral conditions and the various ways of addressing them in the context of existing policies and programmes (ie, oral health in all policies), to ensure alignment of efforts to prioritise oral conditions with international policies and frameworks (such as the Sustainable Development Goals and the WHO global action plan on NCDs); and (4) use existing momentum to promote oral health (such as the provisions related to oral health promotion in the UN Minamata Convention on Mercury).

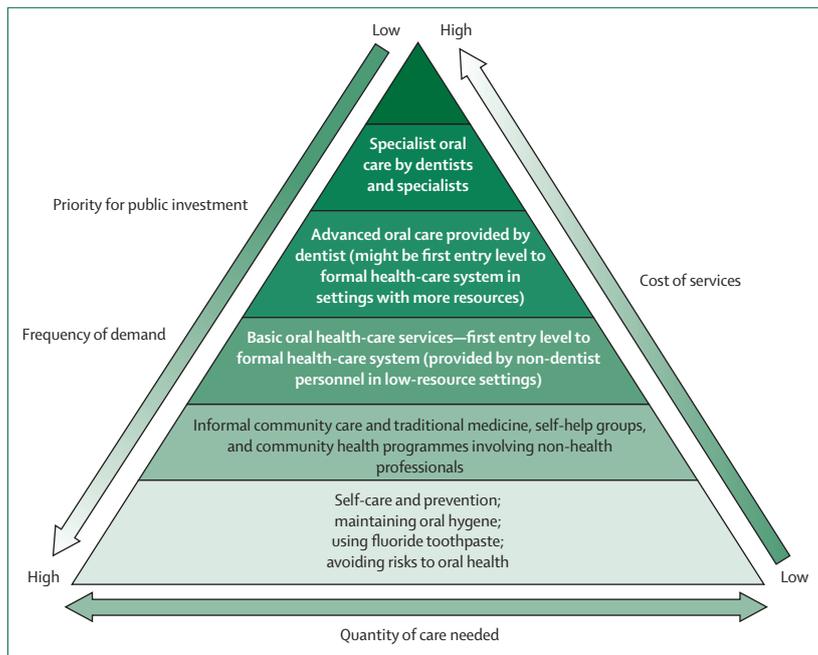


Figure 2: Oral health care in universal oral health coverage: a focus on providing essential care for the most common needs with a package of locally determined cost-effective interventions
Adapted from Benjian and Williams,³⁶ by permission of FDI World Dental Federation 2015.

promotion and disease prevention; it should monitor and respond to population needs; it should be evidence-based, clinically effective, and cost-effective, as well as sustainable, equitable, and universal; and it should be empowering for individuals and populations.⁷⁸ The overall goal of an ideal system would be to achieve improved and equitable oral health for all through making oral health care integral to a framework of universal health coverage, empowering people in self-care, providing protection against health risks, and preventing inadequate out-of-pocket expenditures for patients accessing quality oral health care.

Looking at the current practice of dentistry, major reforms in five key areas would be required to achieve these fundamental goals: (1) the provision of universally available, essential oral health-care services that meet the most common population needs; (2) innovative oral health workforce models and training; (3) an enabling health system governance context that facilitates a flexible continuum of patient-centred support, with the appropriate quality of services; (4) integrated surveillance, programme monitoring, and implementation research to ensure appropriate health outcomes; and (5) a shift in intervention focus to upstream population-wide policies. The implementation of any reforms needs to take into account the local context and prioritise population needs. We summarise our recommendations for reform in panel 1.

Universal oral health care

The growing international momentum towards universal health coverage is a unique opportunity to

integrate oral health care (figure 2).^{79,80} Bold examples from Brazil (appendix p 2) and Thailand⁸¹ have shown that major reforms are possible and yield positive effects on oral health. Public health concepts are needed to inform decision making by policy makers, to select interventions for essential oral health care, which should include prevention and self-care. The WHO-endorsed Basic Package of Oral Care, which aimed to direct scarce resources for oral health towards evidence-based interventions addressing essential and common needs,²⁷ should be reviewed and adapted in light of implementation experience and recent evidence. The concept of best buy interventions established by WHO to tackle NCDs should be expanded to include cost-effective priority interventions for the prevention and treatment of oral diseases. Appropriate universal oral health coverage tracer indicators need to be defined to measure all three dimensions of universal health coverage: coverage, financial protection, and service quality. Ideally, cost-effective and evidence-based essential services for the most common needs should be available for all segments of a population, with a pro-poor focus and delivery through primary health care; while more costly specialised services would be available at higher secondary levels of the health-care system. The balance between service availability and inclusion in essential universal health coverage, organising delivery through the wider dental team, and appropriate financial protection needs to be locally determined.

Innovating the oral health workforce

Achieving universal oral health coverage requires appropriately trained oral health-care workers with the relevant skill mix at all levels of primary and secondary services. This involves shifting the dentist-centred model of care towards a team approach, with non-dentist providers delivering the majority of essential care at the entry level of the primary health-care system. More specialised services, provided by dentists and specialists in referral settings, should complement the care spectrum with advanced care options. Such a model requires a new approach to dental education and training not limited by predefined job descriptions or scopes of practice, but rather that focuses on community needs and evidence-informed care pathways, so that the required care can be flexibly provided in an integrated manner.^{82,83} The focus of training should be on prevention and health promotion, which would include liaison and collaboration within integrated public health services and community colleagues working on upstream determinants,² and referral for complex care.⁸⁴ Continuing professional development, on-the-job training, and appropriate supervision should be mandatory, including training on professional ethics, public health values, social responsibility, and avoidance of conflicts of interest.

Enabling health system context

Integrated, publicly funded (oral) health-care systems require infrastructure, financing, and governance structures that are all tailored to foster collaborative practice and quality services with maximum reach. Professional licensure and regulation should be able to accept overlapping, complementary, and flexible scopes of practice to enable needs-based patient care. Payment and remuneration concepts favouring health outcomes, such as pay-for-performance systems, have shown some potential in improving the quality and outcomes of care.^{85–87} The share of services delivered by public and private providers can vary and change over time depending on country context, resources, and political priorities. The priority of public spending should remain to be the provision and strengthening of public (oral) health-care services,⁸⁸ with private sector providers continuing to provide specialist care for population segments able to afford the services or with relevant insurance coverage. Quality assurance measures, practice regulations, and professional legislation should apply equally to the private and public sectors to prevent differential service quality and the common patient perception that public services are of inferior quality.

Integrated surveillance, monitoring, and implementation research

Clinical evidence, health-care service data, and impact evaluations are essential to advocate for, conceptualise, manage, fine-tune, and provide services at scale. Appropriate disease surveillance, integrated with NCD surveillance and other appropriate surveillance contexts, using relevant existing or new indicators, should be put in place. Priorities for oral health research should be to promote applied health service and implementation research with methodologies such as health impact assessment, economic evaluation, and qualitative and mixed methods, so that planners are able to assess programme performance comprehensively, particularly focusing on improving equity. Advocacy for the inclusion of relevant oral health information in monitoring and accounting for the UN Sustainable Development Goals in the context of NCDs should be encouraged.

Shifting intervention focus on upstream population-wide policies

Oral diseases and inequalities in oral health are caused by a complex array of individual, social, environmental, economic, political, and commercial determinants, mostly shared with other NCDs. Although this array of determinants is increasingly acknowledged across the dental profession globally,^{89,90} the predominant response continues to prioritise downstream interventions. These downstream interventions focus on delivering clinical preventive measures and traditional health education aiming at behaviour change. The evidence, however, shows that such approaches are effective only in the short

term,^{72,73,91,92} and might increase, rather than decrease, socioeconomic inequalities in oral health.^{93–95} A bolder and more radical preventive approach is now needed. More of the same will achieve little and is indeed unaffordable in most LMICs. Integrated and coordinated strategic policies targeting upstream, midstream, and downstream policies are required to tackle the underlying social and commercial causes of oral diseases. These approaches need to be integrated with the broader NCD prevention agenda and require multisectoral collaboration beyond the confines of dental services and health-care systems. Placing (oral) health in all policies requires effective advocacy to achieve broader societal change. Interventions should be tailored to the needs of communities and delivered in a proportionate manner to ensure oral health equity.

Sugar reduction strategies

From being a somewhat peripheral topic, tackling overconsumption of free sugar is now a mainstream global public health priority. National and international nutrition guidelines, informed by comprehensive and detailed reviews of the international scientific evidence on the role of free sugars on weight gain and dental caries,^{70,96} now advocate for a global population-wide reduction in free sugar consumption.^{11,97,98} WHO recommends that both children and adults reduce their free-sugar consumption to less than 10% of total energy intake, and further conditionally recommends that sugar should make up less than 5% of total energy intake.¹¹ In most countries around the world, free sugar consumption is considerably higher than the WHO recommendation, particularly amongst children and young people, and low-income and disadvantaged groups. Another major concern is the high content of free sugars in commercial baby foods (panel 2 and figure 3). To achieve the WHO guideline intake will

Panel 2: Commercial baby foods: a sugary start to life

The global commercial baby food market was estimated to be worth over US\$37 billion in 2010, with Europe, the USA, and Asia holding the major share of the market. However, emerging economies are expected to see high growth in sales.⁹⁹ Analysis of sales data in selected countries show high growth in sales between 2004 and 2017, particularly in China, the United Arab Emirates, Russia, Vietnam, Peru, and Indonesia, although sales have also risen steadily in the Czech Republic, Colombia, Brazil, and South Africa (figure 3).

Commercial baby foods are generally highly processed products often containing high sugar content. A 2018 European Commission report of over 4200 commercial baby foods and drinks sold across Europe revealed that 41% of the products analysed contained free sugars.¹⁰⁰ Free sugars were particularly abundant in baby biscuits and rusks, baby cereals, baby juices and drinks, baby fruit products, desserts and yoghurts, and other baby snacks. Also in 2018, an Australian study reported that nearly a quarter (23%) of 12–14-month-old babies had consumed free sugars above the WHO recommended 5% of total energy intake, and that the major sources of sugars were commercial baby foods (27%), cereal-based products (20%), and yoghurts (10%).¹⁰¹ The consumption of sweetened commercial baby foods during the earliest years of life is a major concern, as it is a risk for early childhood caries, encourages infants to develop a preference for sweetness, and might contribute to overweight in later childhood.

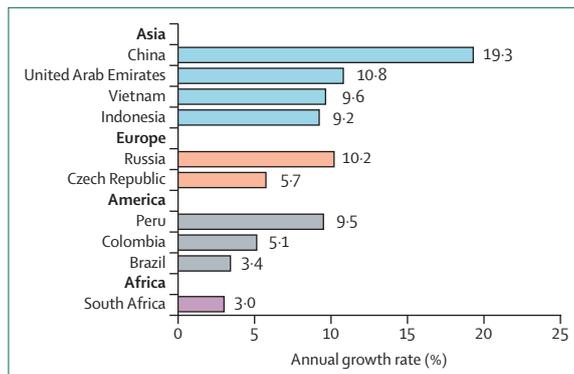


Figure 3: Compound annual growth rate of sales of commercial baby foods between 2004 and 2017 in selected low-income and middle-income countries
Raw data were provided by Euromonitor International, 2018.

require an ambitious, systematic, and coherent sugar reduction strategy.^{98,102,103} Upstream policies need to include international trade agreements on sugar production quotas, price subsidies, minimum pricing, and trade mechanisms. Other upstream policies might include industry action in the reformulation of products to reduce their sugar content (similar to what has been achieved in salt reduction), government taxes or levies on sugary products (a 20% price increase is most effective⁹⁸), improved labelling of products to enable consumers to make informed choices, and restriction of the marketing and promotion of sugary foods and drinks, especially to children. Midstream strategies should include restrictions on retailers selling high-sugar foods and drinks at checkouts, ending price promotions on sugary products (eg, buy one, get one free offers), and a reduction in the portion sizes of sugary foods and drinks sold in cinemas and other public spaces. Public sector organisations should not be supporting the sales of sugary products to their users and staff, and mandatory food guidelines should be introduced in preschools and schools, which should include tighter restrictions on free sugars. Voluntary agreements with industry to reduce sugar consumption have been unsuccessful.^{104–106} Regulatory and legislative mechanisms are now needed with specific quantifiable targets set and independent monitoring processes established. Upstream sugar reduction policies need to be evaluated using appropriate methods and should include oral health outcomes.

Substantial progress has been made with the introduction of sugar taxes and levies on sugar sweetened beverages in over 59 countries.¹⁰⁷ Data from Mexico highlight that pricing policies on sugar sweetened beverages are able to reduce sales and consumption and numbers of overweight individuals in the general population.^{108,109} The positive outcomes resulting from the pricing policies have particularly benefited low-income groups who generally consume higher quantities of sugar sweetened beverages.¹⁰⁹ The introduction of a national sugar levy can also have a major influence on

industry, which might seek to reformulate products to reduce sugar content and thus avoid price increases as seen in the UK. But pricing policies alone cannot deal with the sugar-related epidemic; a package of coherent policies are needed. The dental profession has an important role in supporting the implementation of WHO guidelines to reduce sugar consumption; however, undeclared and opaque conflicts of interest between the sugar industry and some dental organisations and academic institutions need to be addressed.¹¹⁰

Improved political priority for oral health: the role of global advocacy

In view of the substantial burden and effects of oral diseases, the inadequate health system responses, and the proposed concepts for reform, a global roadmap or action plan might be a logical next step, with global advocacy as a key strategy to move from concepts to action. Oral health advocates and professional organisations have repeatedly highlighted the neglect of global oral health, but without offering a realistic vision about how oral health for half of the world's population can be sustainably improved. On the contrary, the discourse of neglect has been so deeply internalised within the dental professional community that often it appears to be the only and central challenge for oral health globally. The priority accorded to oral health is indeed inadequate in many contexts; the symptoms and consequences of this neglect are manifold.

The ensuing debate, however, is often rather limited and reactive, focusing on justifying more resources towards expanding current oral health-care models, thus doing more of the same. This points to a key weakness hampering effective advocacy. Instead, a clear objective to argue for or against innovative health policy is needed. The narrow focus of advocating a higher priority for oral health might have deflected resources and efforts from generating a broad consensus among key sector stakeholders on a joint problem definition, agreement on population-level interventions, and approaches to reform and strengthen oral health systems. The current state of global oral health is hence not only a result of external factors such as competing disease priorities or scarcity of resources, but also related to inadequate coalescence and leadership among global oral health actors, further increasing the disconnect with the wider global health mainstream.¹¹¹

The processes and politics behind changing global health priorities has been studied and key elements for change have been identified.¹¹² At present, the situation is far from giving oral health the bold priority that it received in 1994, when WHO declared the first-ever International Year of Oral Health, following up on the 1984 declaration of global goals for oral health, to be achieved by the year 2000.^{113–115} Since the early 1990s, WHO's Global Oral Health programme has been scaled down from a well staffed unit to a single position at

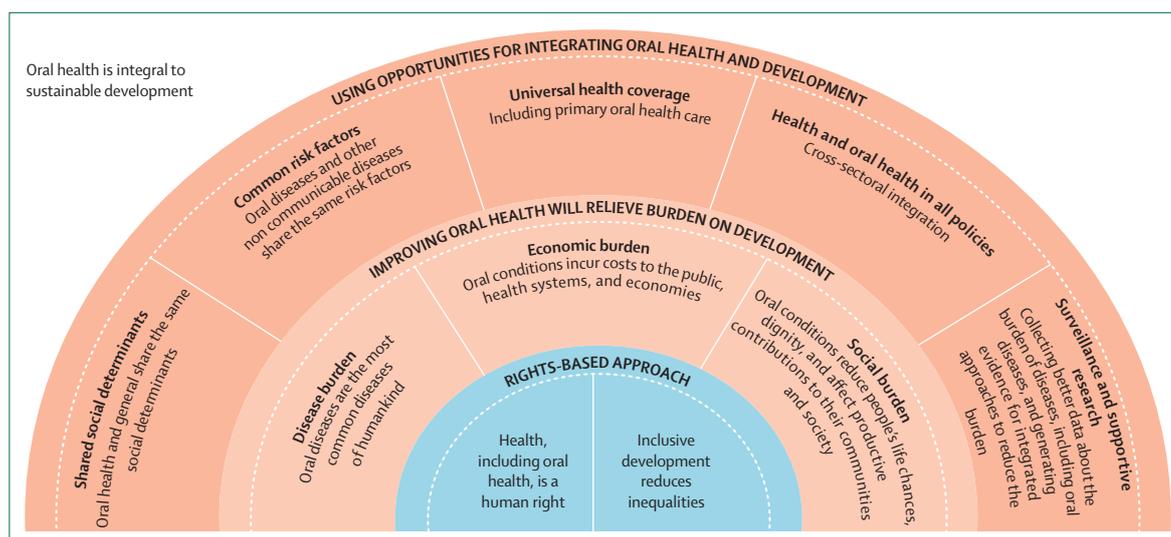


Figure 4: Oral health in the wider context of sustainable development
Reproduced from Benzian and Williams,³⁶ by permission of FDI World Dental Federation 2015.

headquarter level. Such changes were subsequently mirrored by WHO member states, who also reduced their oral health resources or did not even establish national oral health programmes. The ongoing organisational reform of WHO might be an advocacy opportunity to correct the under-resourced field of oral health at the WHO headquarters and regional levels.

Oral health is part of the basic human right to health and integral to sustainable human development—two key notions of a rights-based approach to global advocacy.³⁶ Promoting oral health has positive contributions to overall development by easing the disease, economic, and social burdens caused by oral conditions (figure 4).

The global health agenda continues to provide many opportunities for advocacy, yet they need to be monitored, filtered, and seized upon (appendix pp 3–5). In recent years, the commercial determinants have been given increasing attention, and their various interlinkages with other determinants of health have been highlighted. Together with other international health frameworks, the commercial determinants agenda provides opportunities for effective advocacy, benefiting not only oral health but also NCDs and sustainable development at large.

Conclusion

Oral diseases are a major global public health problem. The current public health and health system responses are largely inadequate, inequitable, and costly, leaving billions of people without access to even basic oral health care. Simple, cost-effective, and equitable interventions do exist, as well as population-wide upstream policy measures to reduce risks that are common to NCDs and oral diseases. Aligning the priorities of oral health, public health, and health systems, and of the associated

education, training, research, and health policy on a path towards universal oral health coverage requires sustained and concerted political support and the engagement of all stakeholders, including patients and communities. Achieving such a convergence of efforts needs bold leadership, solid evidence of intervention effectiveness, innovative policies, and openness to an agenda of global change on all levels. As the world intensifies efforts to reach the Sustainable Development Goals within the coming decade, oral health can no longer be left behind and requires urgent and decisive action.

Contributors

All authors jointly formulated the major concepts of this paper and approved the final version. RGW, BD, PA, SL, HB, and CK initially drafted and edited sections of this paper. RGW and CCG-H analysed the growth in commercial baby foods in selected countries, and BD, RV, RKC, and CCG-H assessed changes in dental schools in selected countries. LMDM, RKC, and MAP made critical revisions for important scientific content. RGW and HB assume full responsibility. All authors provided information and references for this paper.

Declaration of interests

CK reports a grant from the Laura and John Arnold Foundation, unrelated to this paper. All other authors declare no competing interests.

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References

- 1 Kassebaum NJ, Smith AGC, Bernabé E, et al. Global, regional, and national prevalence, incidence, and disability-adjusted life years for oral conditions for 195 countries, 1990–2015: a systematic analysis for the global burden of diseases, injuries, and risk factors. *J Dent Res* 2017; **96**: 380–87.
- 2 Peres MA, Macpherson LMD, Weyant RJ, et al. Oral diseases: a global public health challenge. *Lancet* 2019; **394**: 249–60.
- 3 Steele J, Clark J, Rooney E, Wilson, T. NHS dental services in England: an independent review led by Professor Jimmy Steele. London: National Health Service, 2009.

- 4 Bernabe E, Sheiham A. Age, period and cohort trends in caries of permanent teeth in four developed countries. *Am J Public Health* 2014; **104**: e115–21.
- 5 Bernabé E, Masood M, Vujicic M. The impact of out-of-pocket payments for dental care on household finances in low and middle income countries. *BMC Public Health* 2017; **17**: 109.
- 6 Birch S, Listl S. The economics of oral health and health care. Max Planck Institute for Social Law and Social Policy discussion paper no 07-2015. May 2018, 2015. <https://ssrn.com/abstract=2611060> (accessed Oct 20, 2018).
- 7 Fejerskov O, Escobar G, Jøssing M, Baelum V. A functional natural dentition for all—and for life? The oral healthcare system needs revision. *J Oral Rehabil* 2013; **40**: 707–22.
- 8 Yee R, Sheiham A. The burden of restorative dental treatment for children in third world countries. *Int Dent J* 2002; **52**: 1–9.
- 9 Baelum V, van Palestein Helderma WH, Hugoson A, Yee R, Fejerskov O. A global perspective on changes in the burden of caries and periodontitis: implications for dentistry. *J Oral Rehabil* 2007; **34**: 872–906.
- 10 van Palenstein Helderma WH, Groeneveld A, et al. Adequate evidence to challenge the paradigm of dental caries prevention in early age? *Am J Public Health* 2015; **105**: e5–6.
- 11 WHO. Guideline: sugars intake for adults and children. Geneva: World Health Organization, 2015.
- 12 Cohen L, Dahlen G, Escobar A, Fejerskov O, Johnson N, Manji F. Dentistry in crisis: time to change. La Cascada Declaration. *Aust Dent J* 2017; **62**: 258–60.
- 13 Vujicic M. Our dental care system is stuck. *J Am Dent Assoc* 2018; **149**: 167–69.
- 14 Mills I, Frost J, Cooper C, Moles DR, Kay E. Patient-centred care in general dental practice—a systematic review of the literature. *BMC Oral Health* 2014; **14**: 64.
- 15 Holst D, Sheiham A, Petersen P. Regulating entrepreneurial behaviour in oral care health services. In: Saltman R, Busse R, Mossialos E, eds. *Regulating entrepreneurial behaviour in European health care systems*. Philadelphia: Open University Press, 2002; 215–31.
- 16 Bader JD, Shugars DA. What do we know about how dentists make caries-related treatment decisions? *Community Dent Oral Epidemiol* 1997; **25**: 97–103.
- 17 Hayashi M, Haapasalo M, Imazato S, et al. Dentistry in the 21st century: challenges of a globalising world. *Int Dent J* 2014; **64**: 333–42.
- 18 Anders PL, Davis EL. Oral health of patients with intellectual disabilities: a systematic review. *Spec Care Dentist* 2010; **30**: 110–17.
- 19 Daly B, Newton T, Batchelor P, Jones K. Oral health care needs and oral health-related quality of life (OHIP-14) in homeless people. *Community Dent Oral Epidemiol* 2010; **38**: 136–44.
- 20 Freitas DJ, Kaplan LM, Tieu L, Ponath C, Guzman D, Kushel M. Oral health and access to dental care among older homeless adults: results from the HOPE HOME study. *J Public Health Dent* 2019; **79**: 3–9.
- 21 Kisely S, Quek L-H, Pais J, Laloo R, Johnson NW, Lawrence D. Advanced dental disease in people with severe mental illness: systematic review and meta-analysis. *Br J Psychiatry* 2011; **199**: 187–93.
- 22 Walsh T, Tickle M, Milsom K, Buchanan K, Zoitopoulos L. An investigation of the nature of research into dental health in prisons: a systematic review. *Br Dent J* 2008; **204**: 683–89.
- 23 Tudor Hart J. The inverse care law. *Lancet* 1971; **297**: 405–12.
- 24 Oberoi S, Gautam G, Oberoi A, Yadav R. Inverse care law still holds for oral health care in India despite so many dental graduates: where do we lack? *J Indian Assoc Public Health Dent* 2017; **15**: 181.
- 25 Dehmoobadsharifabadi A, Singhal S, Quiñonez C. Investigating the “inverse care law” in dental care: a comparative analysis of Canadian jurisdictions. *Can J Public Health* 2017; **107**: 538.
- 26 Benzia H, Jean J, van Palenstein Helderma WH. Illegal oral care: more than a legal issue. *Int Dent J* 2010; **60**: 399–406.
- 27 Frencken JE, Holmgren CJ, van Palenstein Helderma WH. Basic Package of Oral Care. 2002. <http://www.chdentalinstitute.org/images/bpoc.pdf> (accessed Oct 10, 2018).
- 28 Chher T, Hak S, Courtel F, Durward C. Improving the provision of the basic package of oral care in Cambodia. *Int Dent J* 2009; **59**: 47–52.
- 29 Kumar S, Ravishankar N, Sumit K, Saran A. Basic package for oral care: relevance and implementation strategies in Indian scenario: a review. *Int J Basic Appl Med Sci* 2013; **3**: 166–70.
- 30 Hosseinpoor AR, Itani L, Petersen PE. Socio-economic inequality in oral healthcare coverage. *J Dent Res* 2012; **91**: 275–81.
- 31 Newhouse JP, Insurance Experiment Group. Free for all? Lessons from the RAND Health Insurance Experiment. Cambridge: Harvard University Press, 1993.
- 32 Organisation for Economic Co-operation and Development. Health at a glance 2013: OECD indicators. 2013. <https://www.oecd.org/els/health-systems/Health-at-a-Glance-2013.pdf> (accessed Oct 15, 2018).
- 33 Grytten J. Payment systems and incentives in dentistry. *Community Dent Oral Epidemiol* 2017; **45**: 1–11.
- 34 Brocklehurst P, Price J, Glennly A-M, et al. The effect of different methods of remuneration on the behaviour of primary care dentists. *Cochrane Database Syst Rev* 2013; **11**: CD009853.
- 35 Chalkley M, Listl S. First do no harm—the impact of financial incentives on dental X-rays. *J Health Econ* 2018; **58**: 1–9.
- 36 Benzia H, Williams D, eds. The challenge of oral diseases—a call for global action. The Oral Health Atlas, 2nd edn. Geneva: Fédération Dentaire Internationale World Dental Federation, 2015. <https://www.fdiworlddental.org/resources/oral-health-atlas/oral-health-atlas-2015> (accessed April 15, 2019).
- 37 Pereira F, de Mendonça I, Werneck R, Moysés S, Gabardo M, Moysés S. Human development index, ratio of dentists and inhabitants, and the decayed, missing or filled teeth index in large cities. *J Contemp Dent Pract* 2018; **19**: 1363–69.
- 38 Saliba NA, Moimaz SAS, Garbin CAS, Diniz DG. Dentistry in Brazil: its history and current trends. *J Dent Educ* 2009; **73**: 225–31.
- 39 Venturelli Garay RE, Watt RG. Review and analysis of Chilean dental undergraduate education: curriculum composition and profiles of first year dental students. *Hum Resour Health* 2018; **16**: 48.
- 40 Cartes-Velásquez RA. Exponential growth of dental schools in Chile: effects on academic, economic and workforce issues. *Braz Oral Res* 2013; **27**: 471–77.
- 41 Jaramillo JA, Pulido JHT, Castro Núñez JA, Bird WF, Komabayashi T. Dental education in Colombia. *J Oral Sci* 2010; **52**: 137–43.
- 42 Jaiswal AK, Srinivas P, Suresh S. Dental manpower in India: changing trends since 1920. *Int Dent J* 2014; **64**: 213–18.
- 43 American Dental Education Association. Snapshot of dental education 2017–2018. Washington, DC: American Dental Education Association, 2017.
- 44 Frenk J, Chen L, Bhutta ZA, et al. Health professionals for a new century: transforming education to strengthen health systems in an interdependent world. *Lancet* 2010; **376**: 1923–58.
- 45 Glick M, Monteiro O, Seeberger GK, et al. FDI Vision 2020: shaping the future of oral health. *Int Dent J* 2012; **62**: 278–91.
- 46 Mosedale R, Batchelor P. Dental specialist lists: are they necessary? *Prim Dent Care* 2012; **19**: 111–15.
- 47 Morris A, Burke F. Primary and secondary dental care: the nature of the interface. *Br Dent J* 2001; **191**: 660–64.
- 48 American Academy of Pediatric Dentistry. Policy on the dental home. *Pediatr Dent* 2016; **38**: 25–26.
- 49 Kandelman D, Arpin S, Baez RJ, Baehni PC, Petersen PE. Oral health care systems in developing and developed countries. *Periodontol* 2000 2012; **60**: 98–109.
- 50 Canadian Academy of Health Sciences. Improving access to oral health care for vulnerable people living in Canada. Ottawa: Canadian Academy of Health Sciences, 2014.
- 51 Brantley CF, Bader JD, Shugars DA, Nesbit SP. Does the cycle of rerestitution lead to larger restorations? *J Am Dent Assoc* 1995; **126**: 1407–13.
- 52 Elderton RJ. Clinical studies concerning re-restoration of teeth. *Adv Dent Res* 1990; **4**: 4–9.
- 53 Burke FJT, Lucarotti PSK. Ten-year outcome of crowns placed within the general dental services in England and Wales. *J Dent* 2009; **37**: 12–24.
- 54 Lumley PJ, Lucarotti PSK, Burke FJT. Ten-year outcome of root fillings in the general dental services in England and Wales. *Int Endod J* 2008; **41**: 577–85.
- 55 Burke FJT, Lucarotti PSK. Ten year survival of bridges placed in the general dental services in England and Wales. *J Dent* 2012; **40**: 886–95.

- 56 Featherstone JDB, Domejean-Orliaguet S, Jenson L, Wolff M, Young DA. Caries risk assessment in practice for age 6 through adult. *J Calif Dent Assoc* 2007; **35**: 703–13.
- 57 The American Academy of Pediatric Dentistry. Caries-risk assessment and management for infants, children, and adolescents. 2014. https://www.aapd.org/media/Policies_Guidelines/BP_CariesRiskAssessment.pdf (accessed Nov 5, 2018).
- 58 Banerjee A, Doméjean S. The contemporary approach to tooth preservation: minimum intervention (MI) caries management in general practice. *Prim Dent J* 2013; **2**: 30–37.
- 59 Fejerskov O. Concepts of dental caries and their consequences for understanding the disease. *Community Dent Oral Epidemiol* 1997; **25**: 5–12.
- 60 Fejerskov O. Changing paradigms in concepts on dental caries: consequences for oral health care. *Caries Res* 2004; **38**: 182–91.
- 61 Marinho VC, Higgins J, Logan S, Sheiham A. Fluoride toothpastes for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev* 2003; **1**: CD002278.
- 62 Marinho VCC, Higgins JPT, Sheiham A, Logan S. Combinations of topical fluoride (toothpastes, mouthrinses, gels, varnishes) versus single topical fluoride for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev* 2004; **1**: CD002781.
- 63 Fisher J, Varenne B, Narvaez D, Vickers C. The Minamata Convention and the phase down of dental amalgam. *Bull World Health Organ* 2018; **96**: 436–38.
- 64 Bader JD. Challenges in quality assessment of dental care. *J Am Dent Assoc* 2009; **140**: 1456–64.
- 65 Bader JD. Stumbling into the age of evidence. *Dent Clin North Am* 2009; **53**: 15–22.
- 66 Sheiham A. Is there a scientific basis for six-monthly dental examinations? *Lancet* 1977; **310**: 442–44.
- 67 National Institute for Health and Care Excellence. Dental checks: intervals between oral health reviews. Clinical guideline [CG19]. October, 2004. <https://www.nice.org.uk/guidance/cg19> (accessed Oct 15, 2018).
- 68 Ramsay CR, Clarkson JE, Duncan A, et al. Improving the Quality of Dentistry (IQuaD): a cluster factorial randomised controlled trial comparing the effectiveness and cost-benefit of oral hygiene advice and/or periodontal instrumentation with routine care for the prevention and management of periodontal disease in dentate adults attending dental primary care. *Health Technol Assess* 2018; **22**: 1–144.
- 69 Public Health England. Delivering better oral health: an evidence-based toolkit for prevention, 3rd edn. London: Public Health England, 2017.
- 70 Moynihan PJ, Kelly SAM. Effect on caries of restricting sugars intake. *J Dent Res* 2014; **93**: 8–18.
- 71 Sheiham A, James WPT. Diet and dental caries. *J Dent Res* 2015; **94**: 1341–47.
- 72 Kay EJ, Locker D. Is dental health education effective? A systematic review of current evidence. *Community Dent Oral Epidemiol* 1996; **24**: 231–35.
- 73 Watt RG, Marinho VC. Does oral health promotion improve oral hygiene and gingival health? *Periodontol* 2000 2005; **37**: 35–47.
- 74 Harris R, Gamboa A, Dailey Y, Ashcroft A. One-to-one dietary interventions undertaken in a dental setting to change dietary behaviour. *Cochrane Database Syst Rev* 2012; **3**: CD006540.
- 75 Masters R, Anwar E, Collins B, Cookson R, Capewell S. Return on investment of public health interventions: a systematic review. *J Epidemiol Community Health* 2017; **71**: 827–34.
- 76 Zavras D, Zavras AI, Kyriopoulos I-I, Kyriopoulos J. Economic crisis, austerity and unmet healthcare needs: the case of Greece. *BMC Health Serv Res* 2016; **16**: 309.
- 77 Calzón Fernández S, Fernández Ajuria A, Martín JJ, Murphy MJ. The impact of the economic crisis on unmet dental care needs in Spain. *J Epidemiol Community Health* 2015; **69**: 880–85.
- 78 Tomar SL, Cohen LK. Attributes of an ideal oral health care system. *J Public Health Dent* 2010; **70**: S6–14.
- 79 Fisher J, Selikowitz H-S, Mathur M, Varenne B. Strengthening oral health for universal health coverage. *Lancet* 2018; **392**: 899–901.
- 80 Mathur MR, Williams DM, Reddy KS, Watt RG. Universal health coverage: a unique policy opportunity for oral health. *J Dent Res* 2015; **94**: 3–5S.
- 81 Somkotra T, Detsomboonrat P. Is there equity in oral healthcare utilization: experience after achieving universal coverage. *Community Dent Oral Epidemiol* 2009; **37**: 85–96.
- 82 Albino JEN, Inglehart MR, Tedesco LA. Dental education and changing oral health care needs: disparities and demands. *J Dent Educ* 2012; **76**: 75–88.
- 83 Association of Canadian Faculties of Dentistry. ACFD educational framework for the development of competency in dental programs. 2016. https://acfd.ca/wp-content/uploads/ACFD-Educational-Framework-for-the-Development-of-Competency-in-Dental-Programs_2016.pdf (accessed Nov 8, 2018).
- 84 Tubert-Jeannin S, Jourdan D. Renovating dental education: a public health issue. *Eur J Dent Educ* 2018; **22**: e644–47.
- 85 Lidert K. Brazil Bolsa Familia Program: scaling-up cash transfers for the poor. 2006. <http://www.mfdr.org/sourcebook/6-1Brazil-BolsaFamilia.pdf> (accessed Nov 5, 2018).
- 86 World Bank. Brazil – Bolsa Familia Project (English). Washington DC: World Bank, 2004. <http://documents.worldbank.org/curated/en/792901468770374532/Brazil-Bolsa-Familia-Project> (accessed Nov 5, 2018).
- 87 Eichler R. Can “pay for performance” increase utilization by the poor and improve the quality of health services? Washington, DC: Center for Global Development, 2009.
- 88 Ramji S, Quiñonez C. Public preferences for government spending in Canada. *Int J Equity Health* 2012; **11**: 64.
- 89 Sgan-Cohen HD, Evans RW, Whelton H, et al. IADR global oral health inequalities research agenda (IADR-GOHIRA®): a call to action. *J Dent Res* 2013; **92**: 209–11.
- 90 Fédération Dentaire Internationale World Dental Federation. Sugars and dental caries: a practical guide to reduce sugars consumption and curb the epidemic of dental caries. Geneva: Fédération Dentaire Internationale, 2016. https://www.fdiworlddental.org/sites/default/files/media/resources/sugar_toolkit-fdi-2016.pdf (accessed Sept 15, 2018).
- 91 Yevlahova D, Satur J. Models for individual oral health promotion and their effectiveness: a systematic review. *Aust Dent J* 2009; **54**: 190–97.
- 92 Public Health England. Local authorities improving oral health: commissioning better oral health for children and young people. An evidence-informed toolkit for local authorities. June, 2014. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/321503/CBOHMain_documentJUNE2014.pdf (accessed Aug 21, 2018).
- 93 Schou L, Wight C. Does dental health education affect inequalities in dental health? *Community Dent Health* 1994; **11**: 97–100.
- 94 National Institute for Health and Care Excellence. Behaviour change at population, community and individual levels. NICE public health guidance 6. London: National Institute for Health and Care Excellence, 2007.
- 95 Qadri G, Alkilzy M, Franze M, Hoffmann W, Splieth C. School-based oral health education increases caries inequalities. *Community Dent Health* 2018; **35**: 153–59.
- 96 Te Morenga L, Mallard S, Mann J. Dietary sugars and body weight: systematic review and meta-analyses of randomised controlled trials and cohort studies. *BMJ* 2012; **346**: e7492.
- 97 Scientific Advisory Committee on Nutrition. Report on carbohydrates and health. London: Scientific Advisory Committee on Nutrition, 2015.
- 98 Public Health England. Sugar reduction: the evidence for action. London: Public Health England, 2015.
- 99 Internal Markets Bureau. Global pathfinder report–baby food. July, 2011. http://publications.gc.ca/collections/collection_2011/agr/A74-1-18-2011-eng.pdf (accessed Sept 15, 2018).
- 100 Grammatikaki E, Wollgast J, Caldeira S. Feeding infants and young children. A compilation of national food-based dietary guidelines and specific products available in the EU market. 2019. https://ec.europa.eu/jrc/sites/jrcsh/files/processed_cereal_baby_food_online.pdf (accessed Feb 15, 2019).
- 101 Devenish G, Ytterstad E, Begley A, Do L, Scott J. Intake, sources, and determinants of free sugars intake in Australian children aged 12–14 months. *Matern Child Nutr* 2019; **15**: e12692.
- 102 Mwatsama M, Landon J. Options for action to support the reduction of sugar intakes in the UK. London: UK Health Forum, 2014.

- 103 James WPT. Taking action on sugar. *Lancet Diabetes Endocrinol* 2016; 4: 92–94.
- 104 Moodie R, Stuckler D, Monteiro C, et al. Profits and pandemics: prevention of harmful effects of tobacco, alcohol, and ultra-processed food and drink industries. *Lancet* 2013; 381: 670–79.
- 105 McKee M, Stuckler D. Realising an election manifesto for public health in the UK. *Lancet* 2015; 385: 665–66.
- 106 Lobstein T. Sugar: a shove to industry rather than a nudge to consumers? *Lancet Diabetes Endocrinol* 2016; 4: 86–87.
- 107 World Cancer Research Fund International. Building momentum: lessons on implementing a robust sugar sweetened beverage tax. London: World Cancer Research Fund International, 2018.
- 108 Barrientos-Gutierrez T, Zepeda-Tello R, Rodrigues ER, et al. Expected population weight and diabetes impact of the 1-peso-per-litre tax to sugar sweetened beverages in Mexico. *PLoS One* 2017; 12: e0176336.
- 109 Colchero MA, Rivera-Dommarco J, Popkin BM, Ng SW. In Mexico, evidence of sustained consumer response two years after implementing a sugar-sweetened beverage tax. *Health Aff (Millwood)* 2017; 36: 564–71.
- 110 Kearns C, Bero LA. Conflicts of interest between the sugary food and beverage industry and dental research organisations: time for reform. *Lancet* 2019; 394: 194–96.
- 111 Benzian H, Hobdell M, Holmgren C, et al. Political priority of global oral health: an analysis of reasons for international neglect. *Int Dent J* 2011; 61: 124–30.
- 112 Maher A, Sridhar D. Political priority in the global fight against non-communicable diseases. *J Glob Health* 2012; 2: 020403.
- 113 Akpabio SP. Achieving oral health by the year 2000. In: Lambo TA, Day SB (eds). *Issues in contemporary international health*. Boston, MA: Springer, 1990; 227–51.
- 114 Zillén PA. 1994—the world year of oral health. *FDI World* 1994; 3: 13–15.
- 115 Aggeryd T. Goals for oral health in the year 2000: cooperation between WHO, FDI and the national dental associations. *Int Dent J* 1983; 33: 55–59.

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