

Commentary

Measuring oral health – how can the International Classification of Functioning help?

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Commentary

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Abstract

There is need for a theoretically-informed, contextualised approach to measuring oral health from a multi-disciplinary perspective that goes beyond the commonly used clinical indices and sociodental measures. This commentary aims to discuss the potential for the WHO's International Classification of Functioning, Disability and Health (ICF) to provide a model for the development of indicators for oral health. It is suggested that the ICF might provide both a theoretical model and an operational classification for indicators of oral health. The ICF model states that human experience of physical, cognitive and social functioning is universal, and thus can be described and qualified. Human function is given social and environmental context within the model at both an individual and population level. The ICF can capture data regarding oral health and function at the physiological level (e.g. chewing) but also at the social level (e.g. sharing meals). It is able to capture aspects of preventive behaviour (e.g. caring for teeth) but also aspects of social facilitation (e.g. economic self-sufficiency) or ability to fulfil a social role (e.g. remunerative employment). **It also includes aspects of social environment, such as health care services or political, economic and legal systems.** Case studies are given as examples of the potential use of the ICF in the oral health domain. Examples are also given of the first steps that have been made towards operationalisation of the ICF in data collection and oral health research. **The challenges of encompassing such a comprehensive model into a practical oral health measure are discussed.**

Keywords

Oral health, Health status indicators, International Classification of Functioning, Disability and Health

Introduction

There is need for a theoretically-informed, contextualised approach to measuring oral health from a multi-disciplinary perspective¹⁻⁵. This need has been translated into the creation of consensus groups that are revisiting existing tools and developing novel oral health indicators. This activity is witnessed by initiatives such as the FDI/ICHOM Adult Oral Health Standard Set*³, the European Global Oral Health Indicators Development project (EGOHID)⁴, the EU project ADVOCATE**¹ and a current project led by the WHO HQ Geneva Oral Health Programme and supported by the WHO Collaborating Centre for Oral Health Inequalities and Public Health at UCL, London. The most widely used epidemiological tool in oral health has traditionally been the WHO Oral Health Surveys but this has not been updated since 2013⁶, and remains a largely clinical set of measures of dental diseases. The epidemiological tradition of recording caries prevalence as the main indicator of oral health in large national or regional surveys is increasingly being questioned and gradually abandoned, as the limits and costs of such an approach are recognised⁷. It is now widely recognised that the concept of oral health cannot be reduced to the measurement of disease. The lack of appropriate tools for the measurement of oral health is particularly obvious in the study of inequalities in oral health. Marginalised populations that represent the extreme aspects of inequalities are, by definition, hard to reach and often explicitly excluded from epidemiology and research⁸. Despite agreement that epidemiology is essential in order to identify oral health differences between different groups, with the overarching aim to act upon them⁹, there is unresolved debate over what should be measured and how to capture the essential elements of whole population health. In particular, the data collected needs to be easy to interpret and easy to integrate into health policy decision making¹⁰.

* FDI / ICHOM Adult Oral Health Standard Set: *Fédération Dentaire Internationale / International Consortium for Health Outcomes Measurement*.

<https://www.fdiworlddental.org/news/20200806/fdi-and-ichom-develop-baselines-and-indicators-to-measure-oral-health-outcomes>

** EU project ADVOCATE: *Added Value for Oral Care, European Commission Horizon 2020*

<https://cordis.europa.eu/project/id/635183>

<http://www.advocateoralhealth.com/>

This commentary aims to discuss the potential for the International Classification of Functioning (ICF)¹¹ to provide a model for the development of indicators for oral health. As a first step, we will discuss the limitations of the existing tools for measuring oral health and the gaps in data collection with regards to the lived experience of health in a social context (meaning the day to day experience of health as one element of social functioning).

Critique of existing measures

The majority of oral health data is currently reported in terms of clinical measures or/and self-reported measures. There are issues with both approaches, even when used in combination¹², though clearly the limitations are more evident when either of these is used in isolation. This is because both are essential and also distinct as parts of health measurement and the use of one as a substitute for the other is neither conceptually appropriate nor empirically evidenced.

In terms of clinical measures, traditional indicators were not designed around a theoretical model but focus on reporting clinically identifiable dental disease. Only more recent indicators, such as ICDAS (International caries assessment and detection system)¹³, are based on current understanding of aetiology and pathological processes. Clinical oral health measures provide a cross-sectional assessment of both current and accumulated disease. However, in the absence of standardised contextual data regarding the lived experience of the individual or population, these findings shed limited light on aetiology, physiopathology, oral health risk or potential paths of curative or preventive intervention. The data provided by such studies lack the overall context both in terms of the individual and of their social and physical environment, and are therefore difficult to interpret for the non-initiated and near impossible to translate into health policy^{10,14}. The vast majority of clinical measures report on the teeth or periodontal structures in isolation, devoid of either functional purpose or the individual behind the mouth¹⁵⁻¹⁸. By their own remit, they do not attempt to take into account the life-course experience of disease and treatment¹⁸⁻²⁰, whilst nevertheless reporting the accumulated impact of both on the oral structures¹⁰. In practical terms, such measures may serve primarily to attempt to deduce normative treatment need which although pragmatic, is reductive. Progressively, clinical tools have been developed that attempt to evaluate normative oral function rather than oral disease, such as the Nordic Orofacial Test²¹, but these remain relatively rare and under-utilised.

Historically, and in recognition of these limitations, self-reported oral health measures were developed. Initially termed sociodental indicators, then oral health related quality of life

measures, these indices were promoted as a means of introducing elements of individual context into the oral health picture²². Seminal conceptual contributions on health outcomes measurement, such as the work by Wilson and Cleary²³, have guided relevant work and progress in the field, particularly in terms of pathways towards oral health and quality of life^{21,22}. However, many of the common sociodental measures were either not explicitly based on theory or were based on theories that have since been outmoded. For example, both the widely used Oral Health Impact Profile²⁶ and Oral Impacts on Daily Performances²⁷ were based on the theoretical framework provided by Locker's adaptation of the ICIDH model for oral health (International Classification of Impairments, Disabilities and Health, 1980)^{15,28}. This adaptation of the then predominant conceptual model also included pain and discomfort, thereby indirectly attempting to expand beyond the functionalistic focus of the ICIDH. However, the ICIDH framework was replaced by the ICF model in 2001¹¹, therefore presenting the challenge of aligning these indicators with present-day concepts of health and functioning²⁹. **This challenge is discussed in the work of MacEntee and Brondani, who explored the evolving biopsychosocial models and their application in oral health³⁰⁻³². They conclude that most oral health models remain 'linear' and are frequently focused on dysfunction and disability³².** Moreover, Locker and Gibson³³ note the “unresolved methodological and theoretical issues” within research relating to positive oral health and the lack of appropriate measures of this construct. A further methodological point is that the majority of measures were developed, validated and tested using general population surveys³⁴ or clinical patient samples, which traditionally exclude those marginalised groups who experience the greatest burden of oral diseases. Current methodological rigour with regards to the development of new oral health indicators would impose an explicit theoretical basis, extensive stakeholder participation, multidisciplinary collaboration and preliminary qualitative study to ensure content validity within the proposed population context^{1,22,29,30}. Very few of the existing sociodental measures meet these requirements^{17,22,29}.

The interpretation and utility of these sociodental measures for the development of health policy is complex and incomplete^{3,35}. There are also many misconceptions as to the interpretation of the sociodental indicators. These measures are, by definition, subjective; that is they reflect the views of an individual. Misinterpretation is therefore a risk when extrapolating to describe population-level health^{2,36}. A major concern is the tendency to analyse for statistically significant difference between groups, without the necessary calculation of minimally important difference, for example^{36,37}. **Statistical analysis based solely on statistical**

significance potentially leads to the distortion or misrepresentation of experience³⁸. In addition, subjectivity requires that the results should be interpreted in relation to patient expectations and perceptions thus making the need for an explicit theoretical framework even more important²³. The classic ‘disability paradox’ dilemma is an illustration of this point – people adapt their perception of quality of life and their satisfaction in relation to their current social and functional context. People with disability are as likely as members of the general population to express satisfaction with their health³⁹. In the same way, problems of oral health become normalised by the individual, particularly if these problems are highly prevalent within their immediate social and family/community circle^{2,29}. Individual expectations are therefore highly related to sociocultural, socioeconomic and socio-environmental factors and the use of **self-reported** measures of oral health therefore carries the risk of perpetuating inequalities by masking the impact of disease among the more deprived or marginalised groups in the society^{40,41}. It is thus probable that such tools underestimate the prevalence of poor oral health in populations with low socio-cultural expectations and overestimate the prevalence in those with high expectations. For example, this could partly explain reports of poorer OHIP ratings in young adults compared to older persons². On the other hand, there is no empirical support for the notion that the use of **self-reported** measures can risk perpetuating socioeconomic inequalities in oral health, as many studies have documented clear social gradients in both clinical and **self-reported** indicators of oral health⁴²⁻⁴⁶. The use of **self-reported** measures to evaluate oral health over time is also problematic. The relevance of oral health to a person can change rapidly in relation to their relationships, evolving life priorities and expectations, healthcare encounters, consumer behaviour, and other health priorities or events⁴⁰. All the above factors suggest that health and quality of life are different constructs²².

Another way in which the **self-reported** measures may be misinterpreted is when they are presumed to objectively measure oral function¹². **Such measures confront the ontological stance of objective truth and the constructionist notion of subjective truth.** Most **self-reported** indices include questions relating to the ability or satisfaction of the individual to perform certain activities of daily life, such as eating. Interpretation of the results must take into account the ability of many people to adapt to their functional limits²⁹ and to cognitively reassemble their situation as normal; that is a person can honestly declare that she has no problems eating if her preferred diet has gradually evolved to exclude food that is difficult to chew and swallow. These items should be recognised as being equally socially charged as questions such as ‘Are you happy with the appearance of your teeth?’. Again, it is local social expectations that dictate

what an individual feels they are ‘supposed’ to be able to eat, what they feel they are ‘supposed’ to look like, and therefore their expressed degree of satisfaction with their functional capacity. In addition, replies to functional questions are often interpreted in the literature as dysfunction that requires treatment to correct. This underlying medical paradigm does not necessarily fit with patient expectations – many people do not wish to be ‘fixed’ and this may apply equally to matters of oral health^{29,40,47,48}. Another key aspect that is often overlooked by the **self-reported** measures, is the explicit investigation of the impact of oral health on the person’s environment, such as their family, working life or need for support². Oral health impacts on the individual’s environment just as the environment impacts on oral health, yet this reciprocal process is rarely unpicked. **It is essential that the implicit ontological and epistemological assumptions underlying the interpretation of self-reported measures are made explicit.**

A small number of sociodental measures integrate certain aspects of the ‘Knowledge, beliefs, behaviours’ model⁴⁹. These items aid in the interpretation of **self-reported** oral health indicators as they may shed light on patient expectations and some of the social and psychological aspects of the impacts of oral conditions on the person. However, they do not record or account for the characteristics of the social environment that play a key role in how health and function is perceived and determined^{50,51}.

Beyond the standard clinical or **self-reported** items, some tools attempt to evaluate individual oral health risk⁵². The best of these individual risk assessments collate dental and functional clinical data with self-reported health related behaviour⁵³. These tools may be useful in terms of identifying oral health inequalities but again only if sufficient data are linked to the individual regarding social context and environment. In addition, these measures do not take into account the common risk factor approach and focus only on oral health⁵⁴⁻⁵⁶. Indicators of oral health need to be assimilated with those of the other non-communicable diseases (NCDs)⁵⁷. Other aspects of oral health that may be measured in the literature include access to dental services, dental attendance and dental expenditure. Caution should be exercised in the interpretation of these data, in that a direct relationship between dental treatment and oral health is generally assumed. Use of and demand for dental services is also closely related to social status, culture and expectations^{58,59}.

In summary, the vast majority of oral health literature currently reports data regarding either dental disease prevalence and/or self-reported impact of dental disease. Considerable theoretical contributions to the conceptualisation of health outcomes^{15,23,60} have helped move the agenda forward in terms of oral health outcomes measurement, though the extent to which

these are covered by existing measures remains questionable⁶¹. The extensive quantity of data in the literature provides necessary information and sheds light on the experience of dental disease. However, these approaches have proven insufficient to comprehensively capture the contextualised reality of oral health and function, whether in terms of population level inequalities or in terms of the future implementation of oral health interventions or services. While conceptually relevant and practically helpful, it is not a given that all these constructs should be captured by a single measure or set of measures and it may well be the case that different measures (and related frameworks) tap into different underlying constructs and may serve for different purposes. **Both a systematic review and a qualitative synthesis** of oral health indicators **are** necessary to look at the conceptual underpinnings and practical applicability of the relevant work in this field.

The theoretical model of the International Classification of Functioning (ICF)

The International Classification of Functioning (ICF)¹¹ provides a theoretical model that could be applied to oral health^{29,62,63}. The central premise of the model is that human functioning is universal. Human experience of physical, cognitive and social functioning is a constant, shared experience⁶⁴. Human experience can thus be described and the factors influencing, and influenced by, human functioning listed. The comprehensive nature and the simplicity of this concept are its strengths. The ICF is about all people – it classifies human ability, not human disability. The model takes a neutral stance – its components are statements of fact. Human function is given social and environmental context within the model. The ICF takes a multi-disciplinary approach and aims to improve and encourage communication between medical, paramedical, medico-social, policy and lay views. Its design is multi-cultural as befits the premise of universality. It is an internationally recognised and well-established tool that integrates with other health descriptors. Criticism of the ICF has largely been levelled at its misuse as a classification of disability. Whilst acknowledged as a substantial step forward from previous models of health, some feel that it is still too closely aligned to the medical model and focuses insufficiently on identifying barriers faced by disabled people^{65,66}.

The ICF model⁶⁷ is illustrated in Figure 1 and an overview given in Table 1. The central basis is that of human function. Human function is described within the ICF in terms of Body functions (physiological processes, such as swallowing or voice production); Body structures (anatomical structures, such as the tongue or the larynx); Activities (coordinated actions, such as eating or speaking) and Participation (social interactions, such as sharing a meal or a having a conversation). Human function is contextualised by Environmental factors (inherent in the

physical, material, social or political environment, such as the availability of food, the support of friends, the existence of services) and by Personal factors (inherent to the individual, such as cultural norms or gender). Human functioning also influences, and is influenced by, general Health status (which may be intrinsic, such as age or fitness; or related to health conditions, such as presence of a disease, syndrome or disorder). With regards to Figure 1, the WHO conventionally places Health condition at the top of the figure, and Contextual factors below⁶⁷, but the authors feel this over-emphasises the medical aspects of functioning to the detriment of the environment, and so prefer to inverse the figure as shown^{66,68}.

The ICF classification and qualifiers

The ICF classification is a practical tool that provides an extensive description of all elements of the ICF model with the exception of Personal factors and of Health conditions (which are listed in the complementary ICD International Classification of Diseases)⁶⁹. The premise is thus that human functioning can be described, classified and qualified. **The classification can be explored online via the ICF Browser⁷⁰**. Traditionally, each item of the ICF classification is **scored** using a 5 point ordinal scale that **measures** the degree of impairment or restriction, ranging from 'No impairment' through mild, moderate, severe and complete (see Box 1)^{71,72}. **These scores are termed qualifiers within the ICF model**. Environmental factors can be scored as facilitators (+1 to +4) or barriers (-1 to -4). Examples of the use of the ICF is given in Case Studies 1 to 3, using fictive case studies as illustration. Unfortunately, this scoring system as it stands reports impairment, restriction and disability rather than positive states of health^{33,67,68,71,72} (Table 1). The authors feel that the qualifiers for all domains should be placed on positive and negative scales, as is already the case for the environmental domain, thus reporting positive aspects of integrity, participation and functioning (Table 1)⁶⁷. An example of this use is given in Case study 4. This conceptual strength might be a limitation in terms of operationalisation of an ICF measure, particularly in terms of relevance for policy making, but it captures lived experience more closely than a purely negative scale. Caution would need to be taken to avoid aggregating positive and negative aspects into an overall rating, as in many cases the positive aspects may help explain or moderate the rating of an item without eliminating its impact. Thus positive and negative aspects should not be considered as two sides of the same coin^{73,74}. With this proviso, the use of positive and negative scales would bring the evaluation of the ICF items in line with the ICF philosophy of universalism⁶⁷, and also counter the criticism that despite best intentions, the ICF reverts to the medical paradigm when used as an outcome measure.

Towards an ICF Core Set in Oral Health

The comprehensive nature of the ICF is simultaneously an advantage and a hindrance to its widespread implementation. The full classification consists of over 1400 items, which means that it is often perceived as unwieldy and impractical in the field of epidemiology. However, the development of discipline-specific ICF Core Sets somewhat mitigates this problem. An ICF Core Set is a restricted list of ICF items that are relevant to a particular field – the Comprehensive Core Set for a given discipline consists of around 100 items and the Brief Core Set consists of a dozen items. Core Set development is regulated by WHO methodology that imposes four preliminary studies (empirical, qualitative, professional opinion and literature review), the results of which are collated at a subsequent consensus conference^{71,75,76}. The ICF Core Set for Oral Health is ongoing, three of the preliminary studies have been completed and the fourth is underway⁷⁷⁻⁸⁰. While these developments will go some way into addressing the comprehensive measurement of oral health through a practical set of measures, it is important to make sure that the wider concepts are not lost, particularly from the ICF Brief Core Sets.

In terms of operationalisation, ICF Core Sets have now been published for 37 different health conditions or states⁸¹, although not all of these have yet been fully validated in the field⁸². Whilst ICF Core Sets are not measurement tools, they can be used to define the scope of aspects that are relevant and necessary for assessment⁸³. The ICF has thus been used to develop new measures, to validate existing tools or to identify gaps in standard data collection⁸⁴. ~~Examples of the use of the Core Sets are given in Table 2. As examples, they have been used to develop self-reported outcome measures⁷⁶⁻⁷⁸, professionally assessed outcome measures⁷⁹⁻⁸¹, health-related quality of life measures⁸², minimum data sets for health outcomes⁸³, graphical models of factors associated with functioning when living with a given condition^{84,85}, to identify treatment and rehabilitation goals⁸⁶⁻⁸⁸ and to provide information regarding functional status for administrative purposes⁸⁹.~~

~~Examples of use of the ICF in oral health~~

Researchers have started to integrate the ICF into studies of oral health. The ‘ICF Checklist for Oral Health’ is a tool consisting of 118 items covering all the ICF domains^{77,79}. This clinical measure is designed to be completed by the clinician, combining clinical information with written records and interview. This format attempts to combine ‘normative’ assessment of function by the clinician and ‘subjective’ assessment of function by the individual. For example, if the individual reports that s/he is able to chew hard foods but the

dentist is aware that s/he has no remaining molars, discussion is engaged to arrive at an appropriate rating of the severity of impact. The Checklist tool is comprehensive and records in-depth information regarding function and social context. As such, it provides insight into the items that impact most frequently or most severely on oral health, or that are impacted by oral health. Unfortunately, this tool is inappropriate for large-scale epidemiology because it is professionally-administered and time-consuming. It is also unlikely to be used with population groups that do not or cannot access a dental care provider.

The ICF has also been used to gauge professional opinion of the factors influencing, and influenced by, oral health in a global oral health survey^{78,80}. This study resulted in a list of ICF items relevant to oral health from the professional perspective. A complementary qualitative study is now underway to solicit lay opinions on the subject (Registered at ClinicalTrials.gov: NCT04815434). *The ICF has also been used as an 11-item oral health self-report measure, although these results are unpublished, and are given as examples only (see Table 3).* Petrovic et al.⁸⁵ used the ICF to identify patients requiring dental treatment under general anaesthesia (GA), with items selected by the authors to relate to ability to tolerate dental treatment. Environmental factors, such as transport services were shown to have a major influence on referral to GA⁸⁵. In 2015, Norderyd et al.⁸⁶ used the ICF to look at the functioning profiles of children requiring special care dentistry but did not find that functioning was related to oral health status. In 2016, the same team linked functional level and need for multidisciplinary treatment under GA⁸⁷, and in 2018 reported that dental health service organisation had the biggest impact on referral for treatment under GA in children with disabilities compared with functioning or caries experience⁸⁸.

An ICF Core Set for Head and Neck Cancer (HNC) has been developed⁸⁹⁻⁹⁴ and validated⁹⁵⁻⁹⁷. It has been adapted as a self-report outcome measure (the BSQN- H&N questionnaire)⁹⁸, used to define the priorities of HNC patients⁹⁹, and to develop a clinical guideline and screening tool¹⁰⁰. The ICF has also been used to describe the impact of dysphagia following HNC¹⁰¹ and as an assessment tool in cleft lip and palate¹⁰².

~~A French online survey of 39,596 adults relating to nutrition used 11 of the ICF items to give a brief picture of respondent oral health and function (Alimassens project, ANR 14-CE20-0003). The items were re-phrased as questions for this self-report survey using the format: "Over the last month, have you had difficulty chewing food (that is crushing and grinding food with your back teeth)?" The items were chosen by the researchers in the absence of an official Brief ICF Core Set and included items from the Body Functions and Activities~~

~~and Participation domains. The survey also included the GOHAI (General Oral Health Assessment Index)⁹⁰ and the Xerostomia Inventory⁹¹, and these measures were used to test the content validity and reliability of the 11 ICF questions. In addition, the ICF questions have been validated against physiological parameters (at rest and stimulated saliva flow; number of posterior functional teeth; chewing performance evaluated using two coloured chewing gum⁹²) in a group of 50 older persons (mean age 71 years). In another project, test-retest data have also been analysed at a two-week interval for 60 adults with good or poor oral function (\geq or $<$ 7 functional posterior teeth). In addition, proxy report of the 11 ICF questions were collected for 34 adults with severe disability and validated against GOHAI⁹⁰, the Xerostomia Inventory⁹¹ and NOT-S (Nordic Orofacial Test-Screening Test)¹⁸, in addition to a clinical examination.~~

Advantages and disadvantages of the use of the ICF in oral health

The advantage of the ICF model is that it captures a relatively comprehensive picture of oral function at the physiological level (e.g. chewing) but also at the social level (e.g. sharing meals). It is able to capture aspects of preventive behaviour (e.g. caring for teeth) but also aspects of social facilitation (e.g. economic self-sufficiency) or ability to fulfil a social role (e.g. remunerative employment). As it is a universal health tool, it can also be used to report common risk factors shared with concurrent chronic conditions. In addition, external facilitators and barriers can be described, such as social security systems or attitudes of healthcare providers. ~~The environmental domain can be used to identify barriers to health within political, economic and legal systems, services and policies, which could help to elucidate some of the corporate influences that come to bear in oral health⁵⁷.~~ This means that the collected data can place oral health and function firmly within a social and societal context. Preliminary studies demonstrate that the ICF can be used as a self-report measure, making it potentially suitable for epidemiological data collection on a large scale. Due to its comprehensive nature, the ICF could also be potentially used for the evaluation of oral health promotion interventions in that it is able to describe behaviours, attitudes and service/policy level change. The operational framework of the ICF might thus help fill a gap in terms of measurement of the lived experience of oral health^{103,104}.

Subsequent studies must now determine the model's relevance for both research applications and for public health strategy. This will mean assessing the capacity of ICF-related epidemiological data to provide outcome measures for both treatment and services but also to provide clear guidance regarding the design and evaluation of interventions and policies. Additional research will also be required to complete and validate the ICF Core Set in Oral

Health among various population groups, to integrate the use of positive qualifiers and to validate a set of tools derived from this with varying levels of complexity. Multidisciplinary work will be important to integrate the ICF and measures of oral health into the wider field of NCDs. Oral health professionals must join the push to develop a health monitoring and evaluation framework that includes not only outcome measures but also enables monitoring of access to care and universal health coverage and tracing of the wider healthcare process¹⁰⁵.

The ICF is a conceptually inclusive and potentially practically relevant framework of functioning. However, as with all conceptual frameworks, it also contains implicit assumptions; for example, one could argue that it is implied that changes in body functions or anatomy may restrict activities and participation in the social context (or vice versa). Furthermore, there are certain aspects of the experience of oral health that are not measured within the ICF model. For example, although the ICF inherently integrates notions such as quality of life and social participation, the ICF was not designed to be a **self-reported** measure. As such, it does not give information regarding individual attitudes or values. This may not necessarily be seen as a limitation as no single theoretical framework and resulting set of measures needs to be suitable to cover all aspects and purposes in relation to oral health outcomes measurement. Another important aspect is that the ICF does not explicitly measure many of the social determinants of health. Some aspects are covered, such as economic self-sufficiency, but for epidemiological purposes certain socio-demographic questions remain essential (age, gender, socioeconomic position, ethnicity, disability status etc.), as does a theoretical framework for the interpretation of socio-demographic data.

Conclusion

Over the last 30 years, oral health data have provided a picture of disease prevalence and of the impact of oral conditions on quality of life. Questions have been raised regarding clinical practice, oral health services and health policy, but a biopsychosocial approach that integrates physiological, anatomical and social aspects of human functioning is still lacking. The ICF provides both a theoretical model and an operational classification that can be used to develop indicators of oral health that inform on social context within a multi-disciplinary perspective. The ICF may be an encouraging way forward in the search for suitable tools to measure oral health and to investigate inequalities in oral health at population level. **Given the exhaustive nature of the ICF classification, the main challenge in terms of operationalisation is to develop practical tools without losing the wider social and environmental context that the ICF provides.** Further research is still necessary to complete the ICF Core Set for Oral Health,

to validate existing tools in the field and to assess the capacity of the model to inform health policy.

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Table 1. An overview of the ICF (adapted from ⁶⁷)

	Human Functioning		Contextual Factors	
Components	Body Functions and Structures	Activities and Participation	Environmental Factors	Personal Factors
Domains	Body functions Body structures	Life areas (tasks, actions)	External influences on functioning	Internal influences on functioning
Constructs	Change in body functions (physiological) Change in body structures (anatomical)	Capacity Executing tasks in a standard environment Performance Executing tasks in the current environment	Facilitating or hindering impact of features of the physical, social and attitudinal world	Impact of the attributes of the person
Positive aspect	Functional and structural integrity	Activities Participation	Facilitators	Not applicable
	Functioning			
Negative aspect	Impairment	Activity Limitation Participation restriction	Barriers / hindrances	Not applicable
	Disability			

Box 1. ICF qualifiers

The ICF includes generic qualifiers which denote the magnitude or severity of the problem in question⁷¹. These negative scales evaluate impairment of Body function; impairment of Body structure; limitation of Activity (ability to execute a task without assistance); restriction of Participation (ability to execute a task within usual environment); and barriers within the Environment. Qualifiers are coded as one or more numbers after a decimal point.

xxx.0	NO problem (none, absent, negligible, ...)	0-4%
xxx.1	MILD problem (slight, low, ...)	5-24%
xxx.2	MODERATE problem (medium, fair, ...)	25-49%
xxx.3	SEVERE problem (high, extreme, ...)	50-95%
xxx.4	COMPLETE problem (total, ...)	96-100%
xxx.8	not specified	
xxx.9	not applicable	

For example, moderate limitation of the activity of eating would be coded d550.2 (d550: Eating - *Carrying out the coordinated tasks and actions of eating food that has been served, bringing it to the mouth and consuming it in culturally acceptable ways, cutting or breaking food into pieces, opening bottles and cans, using eating implements, having meals, feasting or dining*).

The generic ICF Checklist proposes a more detailed description of the ICF Qualifiers⁷². These negative scales again evaluate impairment, limitation and restriction but allow a positive impact on Environment:

<p>0 <u>No impairment</u> means the person has no problem</p> <p>1 <u>Mild impairment</u> means a problem that is present less than 25% of the time, with an intensity which is tolerable and which happens rarely over the last 30 days</p> <p>2 <u>Moderate impairment</u> means that a problem is present less than 50% of the time, with an intensity which interferes in day to day life and which happens occasionally over the last 30 days</p> <p>3 <u>Severe impairment</u> means that a problem is present more than 50% of the time, with an intensity which partially disrupts day to day life and which happens frequently over the last 30 days</p> <p>4 <u>Complete impairment</u> means that a problem is present over 95% of the time, with an intensity that totally disrupts day to day life and happens every day over the last 30 days.</p> <p>8 <u>Not specified</u> means there is insufficient information to specify the severity of the impairment</p> <p>9 <u>Not applicable</u> means it is inappropriate (e.g. menstruation functions for males)</p>
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The ICF Environmental factors are qualified as barriers or facilitators:

<p><i>Environmental factors</i></p> <p>0 No barrier</p> <p>1 Mild barrier</p> <p>2 Moderate barrier</p> <p>3 Severe barrier</p> <p>4 Complete barrier</p>	<p>0 No facilitator</p> <p>+1 Mild facilitator</p> <p>+2 Moderate facilitator</p> <p>+3 Substantial facilitator</p> <p>+4 Complete facilitator</p>
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Case study 1. Mrs A, a 62 year-old woman, wakes in the night in acute throbbing pain from a lower right molar. She cannot sleep, starts to cry and wakes her husband who reassures her and goes to find the painkillers. She is swollen and finds it difficult to swallow a tablet. In the morning, her husband makes her breakfast but she is unable to eat and only drinks a little tea. She phones her workplace to say that she cannot come in. Her boss is sympathetic and asks her to get a medical certificate to justify the sick leave. She phones her dentist who gives her an emergency appointment for later in the day. She is very worried about her tooth because she is diabetic and has high blood pressure. She asks her neighbour to drive her to the dental appointment, as she feels unable to take the bus.

Pain: b280.3 / Molar: s3200.3 / Sleep: b134.2 / Cry – Emotional function: b152.2 / Attitudes of immediate family: e410.+3 / Painkillers – Drugs: e1101.+2 / Swallowing: b5105.2 / Support of immediate family: e310.+2 / Eating: d550.3 / Drinking: d560.0 / Remunerative employment: d850.4 / Attitudes of people in authority: e430.+3 / Employment services, systems and policies: e590.+3 / Social security services systems and policies: e570.+3 / Support of healthcare professionals: e355.+3 / Health services: e5800.+3 / Handling stress and other demands: d240.2 / Diabetes: E11 (ICD) / Arterial hypertension: I15 (ICD) / Support of acquaintances and community members: e325.+3 / Using public motorised transport: d4702.-2

Case study 2. Mr B is 17 years old. He has severe spastic cerebral palsy and epilepsy. He uses an electric wheelchair but cannot transfer himself to and from his chair. His verbal communication is poor but his comprehension is good. He attends a day centre where he spends a lot of time on the computer writing a blog via an adapted device. He lives with his parents who accompany him to the dental appointment. He arrives with a dedicated transport service because his wheelchair doesn't fit in the family car. Mr B's parents are worried that his ability to chew and to swallow is getting worse as there have been several incidents of intense coughing at meals over the last few months. His food is always cut very small for him, but his tongue thrust makes it difficult for him to manage his food and eating is a messy business.

Spastic cerebral palsy: G80.2 (ICD) / Epilepsy: G40 (ICD) : Wheelchair: Assistive products for mobility: e1201.+4 / Transferring oneself: d420.2 / Speaking: d330.3 / Articulation function: b320.3 / Receiving spoken messages: d310.0 / Mental function of language: b167.0 / Social support services: e5750.+3 / Assistive products for communication: e125.+4 / Support of immediate family: e310.+3 / Health services: e5800.+1 / Transport services: e540.+3 / Attitudes of immediate family: e410.+2 / Chewing: b1502.3 / Swallowing: b5105.2 / Additional respiratory functions, coughing b450.0 / Food: e1100.+2 / Tongue: s3203.3 / Tone of isolated muscle groups: b7350.3 / Involuntary contraction of muscles: b7650.3 / Manipulation of food in mouth: b5103.3 / Eating in socially acceptable ways: d550.3

Case study 3. Mr C is 48 years old. He has no fixed address and sometimes sleeps at friends, sometimes in the street or in shelters. He got sacked from his last job on a construction site and has been out of work for the last 4 years. He is alcohol dependent. His oral hygiene is erratic and he has not seen a dentist for many years. He has recently lost two of his lower incisors that were getting increasingly loose. His upper incisors are broken and he has several cavities in his back teeth. One of his upper left molars is regularly painful. Last time it was bad he queued at the hospital emergency service where he was given antibiotics. His diet is poor but is made worse by the fact that he can't bite into food or chew anything hard. He is ashamed of his teeth and feels that people judge him because of his broken smile.

Housing services systems and policies: e525.+1 / Social support services, systems and policies: e575.+1 / Acquiring, keeping and terminating a job: d845.4 / Remunerative employment: d840.4 / Alcohol dependency: F10.2 (ICD) / Caring for teeth: d5201.3 / Health services: e5800.+1 / Teeth: s3200.3 / Dental caries: K02 (ICD) / Pain: b280.2 / Drugs: e1101.+1 / Managing diet and fitness: d5701.3 / Biting/incising: b5101.3 / Food: e1100.-2 / Chewing: b5102.3 / Societal norms: e465.-3 / Emotional function: b152.2 / Experience of self and time, including body image: b180.-2 / Individual attitudes of strangers: e455.-2

Case study 4 scored using positive and negative qualifiers (+4 to 0; 0 to -4), a method suggested by the authors.

Miss D is 31 years old. She is an administrative officer at a university but finds her job repetitive. She is engaged to be married. Miss D suffered a lot from her teeth as a child and she remembers episodes of severe pain. She reports having been 'held down' at the dentists for an extraction. She worked up the courage to seek dental care again last year as she was ashamed of her teeth and wanted to have a 'proper smile' for her wedding day. She underwent a course of cognitive behavioural therapy before being gradually able to accept dental treatment in the chair under local anaesthesia. She now declares that she is pain free for the first time in years and that her self-confidence has been boosted to the extent that she has applied for a job promotion. She is delighted that she no longer has to avoid certain foods and has set a date for the wedding.

Remunerative employment: d840.+2 / Repetitive job: d840, -2 / Intimate relationships: d770.+4 / Teeth: s3200.-3 /
Pain: b280.-3 / Support of health professional: e355.-4 / Individual attitudes of health professionals: e450.-4 /
Courage: Handling stress and other psychological demands d240.+2 / Seek dental care: Looking after one's health d570.+2 /
Health services, systems and policies e580.+2 / Ashamed of teeth: Body image b1801.-3 /
Smile: producing body language d3350.-2/ CBT: Health services, systems and policies e580.+4 /
Higher level cognitive function b164. +2 / Local anaesthesia: drugs e1101.+3 / Pain: b280.+4 /
Self-confidence: Body image b1801.+3 / Self-confidence: personal factor /
Job promotion: Acquiring, keeping terminating a job d845.+3 / Food: e1100.+3

Table 2. Examples of published uses of the ICF Core Sets

Examples of uses of ICF Core Sets	References
Identification of gaps in standard data collection	84
Development of self-reported outcome measures	98,106,107
Development of professionally assessed outcome measures	102,108,109
Development of health-related quality of life measures	110
Provision of minimum data sets for health outcomes	111
Development of graphical models of factors associated with functioning when living with a given condition	112,113
Identification of treatment and rehabilitation goals	114,115
Provision of information regarding functional status for administrative purposes	116

Table 3. Use of the ICF as a self-reported oral health measure - examples of unpublished studies. Eleven items in the Body Function or Activities and Participation domains were included in a self-reported tool. An example of the format of the questions is “Over the last month, have you had difficulty chewing food (that is crushing and grinding food with your back teeth)?”.

Study type		
Online survey of 39,596 adults (Alimassens project, ANR-14-CE20-0003)	Used to give a brief picture of respondent oral health and function	ICF responses compared to GOHAI ^a and XI ^b responses
Clinical study of 50 older adults (mean age 71 years)	ICF responses compared to physiological parameters (at rest and stimulated saliva flow; number of posterior functional teeth; chewing performance evaluated using two coloured chewing gum ¹¹⁷)	ICF responses compared to GOHAI ^a and XI ^b responses
Test-retest data with two week interval for 60 adults with good or poor oral function (\geq or $<$ 7 functional posterior teeth)	Responses used to test reliability of self-reported variables	
Proxy report for 34 adults with severe disability and clinical examination	ICF proxy responses compared to clinician assessment on examination	ICF responses compared to proxy GOHAI ^a and XI ^b responses and to NOT-S ^c

^a: GOHAI General Oral Health Assessment¹¹⁸

^b: XI Xerostomia Inventory¹¹⁹

^c: NOT-S Nordic Orofacial Test - Screening Test²¹

Figure Legends

Figure 1. The ICF Model (adapted from ⁶⁷). The ICF classification lists Body structures, Body Functions, Activities and Participation, and Environmental factors.