An Opportunity for Inclusive and Human-Centred Design

# Authors

Isobel Leason,

Division of Industrial Design,

University of Liverpool

Dr Nicholas Longridge,

Clinical Lecturer in Restorative Dentistry and Specialist in Endodontics,

University of Liverpool

Prof. Manu Raj Mathur

Professor in Dental Public Health

Queen Mary University of London

Dr Farnaz Nickpour,

Reader in Inclusive Design and Human-Centred Innovation,

University of Liverpool

# Key points

1. Introduces inclusive and human-centred design and its significance to the trends and challenges in contemporary oral health systems.
2. Highlights the broad capabilities and potential contributions of design.
3. Discusses barriers and drivers to the adoption of inclusive and human-centred design in oral health.

# Abstract

Challenges and trends such as person-centred care, demographic shifts, and technological advancements are transforming oral health systems. Inclusive design and human-centred design are disciplines highly relevant and potentially instrumental to these oral healthcare transformations. This paper provides an overview of the definitions and characteristics of inclusive and human-centred design, which centre on understanding people’s multifaceted needs, expectations, behaviours and relationships, and engaging with diverse and often excluded populations. Design’s broad capabilities are outlined across outcome and contribution types, and the potential role of inclusive and human-centred design to oral health is explored by outlining its relevance to key transformational, societal and technological shifts. Finally, barriers and drivers to the adoption of inclusive and human-centred design in oral health are discussed around three themes; awareness and understanding of the role and value of design; disciplinary differences; and the wider healthcare systems context.

# Introduction

Oral healthcare is in a period of change, with shifts towards person-centred, preventative approaches and advancements in technology transforming current models of care. Simultaneously, key challenges such as oral health inequalities and sociodemographic shifts are placing increasing and unsustainable pressures on oral healthcare systems.

Across the wider landscape of design and innovation, inclusive design and human-centred design are two core approaches that are increasingly valued by and integrated into general health and social care organisations. In contrast, their recognition and uptake in oral healthcare remains limited.[1](https://www.zotero.org/google-docs/?HyDoJo) We propose that inclusive and human-centred design are highly relevant and potentially instrumental to oral healthcare systems. The symbiosis of the two offers robust and holistic methodologies for design-driven problem-framing, problem-solving and innovation. Inclusive and human-centred design emphasises placing people at the centre of the design process while acknowledging their multifaceted needs, expectations, behaviours and relationships. It seeks to understand and engage with diverse populations and co-create solutions with and for them that accommodate all, not only the mainstream user groups.

This paper examines how a timely meeting between these fields could be strategic in facilitating transformational change; promoting inclusive and human-centred design as a suitable and effective approach to help understand, address and innovate key and complex challenges facing oral healthcare.

# Challenges and transitions in oral healthcare

## Person-centred and prevention-oriented care

The FDI World Dental Federation’s revised definition of oral health states *“Oral health is multi-faceted and includes the ability to speak, smile, smell, taste, touch, chew, swallow and convey a range of emotions through facial expressions with confidence and without pain, discomfort and disease of the craniofacial complex.*”[2](https://www.zotero.org/google-docs/?cOIJth) This definition is significant in overcoming the traditional perspective of oral health simply as the absence of disease. The definition and accompanying framework[3](https://www.zotero.org/google-docs/?4oh0Uw) treat oral health as a fluid state of wellbeing, taking into account physiological, mental and psychosocial aspects while also addressing the demands of life and daily function.

This change in perspective is increasingly evident across the field of oral health. There is a growing focus on oral health-related quality of life[4,5](https://www.zotero.org/google-docs/?T9jcwx) and the long-term physical and psychosocial impacts that poor oral health can have. Moving on from a long‐established approach focused on the treatment of established disease, dentistry is evolving towards a patient‐centred,[6](https://www.zotero.org/google-docs/?unET1E) prevention-orientated[7](https://www.zotero.org/google-docs/?plS037) system of care.

Patient-centred care (PCC)is an increasingly prominent concept in dentistry. Several theoretical models for PCC in dentistry have been proposed which highlight the importance of providing humane care and making a connection with patients.[6,8,9,10,11](https://www.zotero.org/google-docs/?kvE9rM)

In recent years, the concept of *person*-centred (or people-centred) care has emerged as an expansion of *patient*-centred care, recognising people’s experiences, needs and preferences beyond the medical perspective.[12](https://www.zotero.org/google-docs/?hjNdYK) People-centred care is a central goal throughout the FDI’s Vision 2030 report, where it is defined as follows:

*“People-centred care is focused and organized around the health needs and expectations of people and communities rather than on diseases. People-centred care extends the concept of patient-centred care to individuals, families, communities and society. Whereas patient-centred care is commonly understood as focusing on the individual seeking care—the patient—people centred care encompasses these clinical encounters and also includes attention to the health of people in their communities and their crucial role in shaping health policy and health services”* [*13*](https://www.zotero.org/google-docs/?uCcs9E)

Fostering people-centred services is also an important strategy to strengthen oral health services in the WHO Global Oral Health Strategy; and a suggested action in the WHO director-general’s 2021 report, which informed the World Health Assembly resolutions on oral health.[14,15](https://www.zotero.org/google-docs/?j5HmhQ) The WHO resolutions are significant in policy discourse, boosting people-centred care in national and international oral health policy agendas.

Despite guidelines, recommendations and standards at policy level, there is limited understanding and facilitation, and subsequently uptake and implementation of PCC on an institutional level and in day-to-day practice.[16,17](https://www.zotero.org/google-docs/?OqSG6s) This gap between policy and practice of PCC is evident across the wider healthcare sector;[18,19](https://www.zotero.org/google-docs/?rlWGfZ) as Hawkes notes in reference to the wider medical field, “*patient-centred care has many evangelists but few practitioners*”.[20](https://www.zotero.org/google-docs/?WCfzh2) However, progress towards PCC in dentistry lags behind other health professions and the field remains largely anchored in a biomedical vision.[16](https://www.zotero.org/google-docs/?QEpi1y) This may be due to dentists misunderstanding or reluctance towards PCC,[16](https://www.zotero.org/google-docs/?hKAIbN) as well as current target-driven contracts and systems not rewarding PCC. It has been demonstrated that treatments can be selected based on improved remuneration, which may not align with a patient-centred approach.[21](https://www.zotero.org/google-docs/?4MPVAG)

There are also shifts towards prevention-orientated care. Prevention features as a dimension in a number of PCC models,[22](https://www.zotero.org/google-docs/?2yIhds) and is recommended at an organisational level. While key recommendations of prevention-focused approaches have been made, current dental contracts don’t adequately reward preventative activity.[23](https://www.zotero.org/google-docs/?2tJLVY) Much of dental care remains treatment rather than prevention orientated,[24](https://www.zotero.org/google-docs/?mmZu5v) and preventable diseases such as dental caries and periodontal disease remain prevalent across all age groups.[25](https://www.zotero.org/google-docs/?JoOFaM)

## Societal challenges; health inequalities and population ageing

Alongside the slow and limited transition to new models of patient-centred and prevention-orientated care, oral healthcare is faced with key societal challenges.

The first pillar of FDI’s Vision 2030 advocacy strategy stresses on Universal Coverage for Oral Health and states that *“quality oral healthcare should become available, accessible, and affordable to all, with special attention paid to marginalized and vulnerable populations”*.[13](https://www.zotero.org/google-docs/?UqBALu)

Tackling oral health inequalities is a major problem facing public bodies and dental policymakers.[13,26](https://www.zotero.org/google-docs/?NedRr2) A myriad of biological, physical, psychosocial, sociodemographic and socioeconomic factors such as age and stage, education, gender and identity, physical and mental health, physical and neuro-cognitive ability, and economic status and social class have been identified as impacting an individual’s access to and quality of dental care.[27](https://www.zotero.org/google-docs/?YjbNuc) Furthermore, these factors have an intersectional and interrelated nature, potentially leading to compound systemic discrimination or disadvantage to those populations at their convergence. Understanding the factors involved in health inequalities and their complex interrelation is necessary to inform equally complex and effective interventions to address them.[28](https://www.zotero.org/google-docs/?0vn4Di)

Population ageing presents an additional societal challenge. Rapidly ageing populations and the associated dramatic increases in chronic, long-term conditions are placing increased demands on health and social care systems.[29](https://www.zotero.org/google-docs/?HHrTiQ) It is estimated that across England, Wales and Northern Ireland the number of people aged 65 or over with an urgent dental condition could rise by more than 50% by 2040 due to population growth alone.[30](https://www.zotero.org/google-docs/?sCNLPk)

In addition to increased oral care demand, the nature of dental services required for older people is changing. An increasing number of people are retaining their natural teeth in old age.[31](https://www.zotero.org/google-docs/?09Dytp) This shifts the challenge from general holistic issues towards more complex dental management that the profession needs to address.[32](https://www.zotero.org/google-docs/?Z0FpjW)

## Technological advancement and adoption

Parallel to these shifts, the advancement and adoption of technology within dentistry is rapidly increasing. This can be observed through examples such as robotic dental implant placement,[33](https://www.zotero.org/google-docs/?xZn8hF) the use of computer-aided design and manufacturing technologies[34](https://www.zotero.org/google-docs/?rFVjGq) and the development of teledentistry services.[35](https://www.zotero.org/google-docs/?D8KUSu) If implemented appropriately, such technologies have the potential to help meet pressures on oral healthcare systems, improving access to and quality of dental care.

We propose that inclusive and human-centred design is highly relevant to these transformational, societal and technological shifts in oral health. To frame this relevance, an overview of these fields and their definitions and capabilities within the wider design landscape is provided.

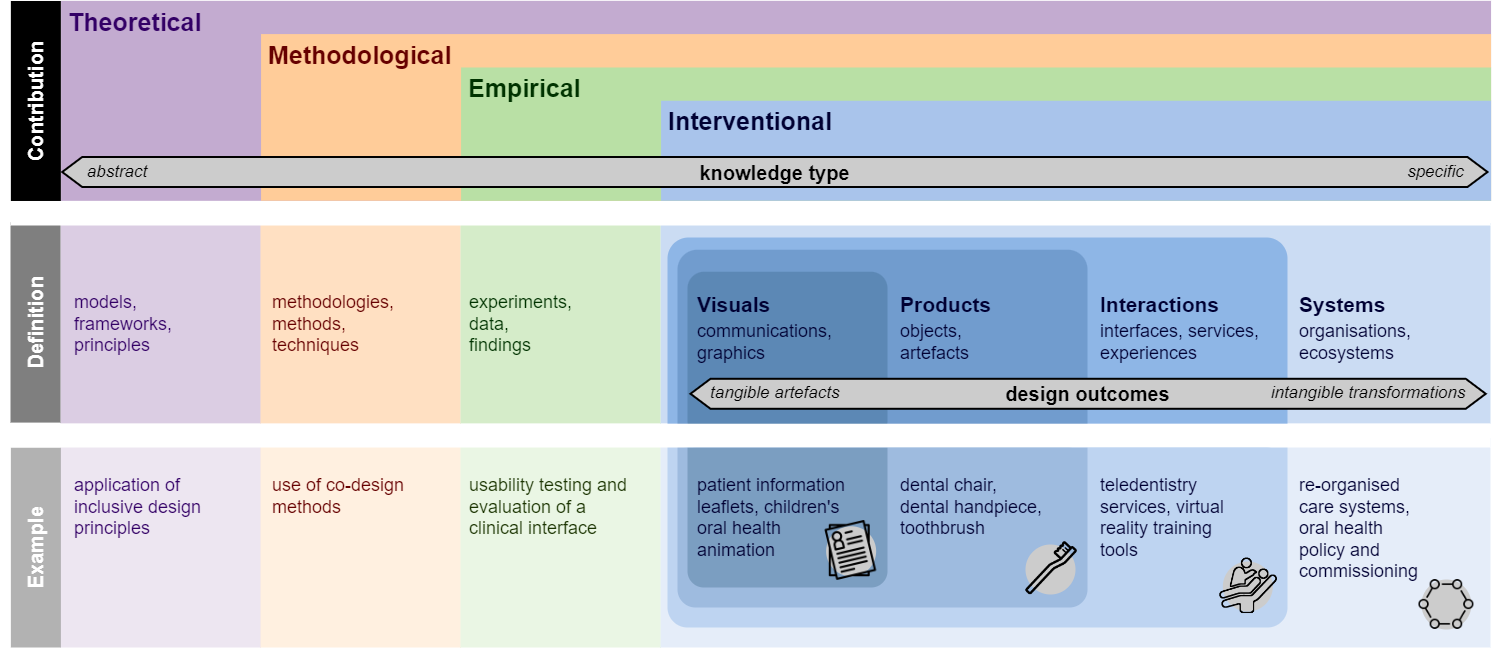
# Design in the context of health; definition and capabilities

Design is widely defined as a creative problem-framing and problem-solving activity. It is a set of principles, mindsets (ways of thinking), practices and processes (ways of working), and methods and techniques (toolkits)[36](https://www.zotero.org/google-docs/?qw6Kb0) which are used to understand and define problems and develop solutions. As such, design can be adopted as generative and creative, as well as an analytical and critical process of problem-framing and problem-solving. These activities are highly relevant across oral healthcare practice, research and policy.

Although everybody can design, it is also a professional practice in which designers gain considerable training, skills and knowledge.[37](https://www.zotero.org/google-docs/?X3E9Ai) The ‘Head, Heart, Hand’ framework provides a basic overview of a designers skill set.[38](https://www.zotero.org/google-docs/?OyQc33) The ‘head’ relates to cognitive problem reframing and solving skills. This includes the ability to visualise and conceptualise the intangible. The ‘heart’ centres on empathy. This means making sure that design solutions work for people and the planet. The ‘hand’ skill includes a designer's practical and technical abilities. Making ideas tangible and learning by doing is central to this.

Design as a discipline is evolving, and these skills are applied in a growing number of contexts where design is making a range of contributions. Figure 1 illustrates the potential contributions and outcomes of design, providing examples to show how each is relevant to oral health.

Design outcomes can be categorised by the Four Orders of Design,[39](https://www.zotero.org/google-docs/?o6h6ra) which are: Visuals (1st), Products (2nd), Interactions (3rd), or Systems (4th). Each order increases in both complexity of problem space and scale of output. For example, in oral healthcare, design outcomes could range from tangible artefacts such as patient information leaflets or dental tools, to services such as teledentistry, or large-scale transformations and oral health policy. Beyond interventions, design can also contribute and add value by offering design methodologies, theories and empirical contributions.[40](https://www.zotero.org/google-docs/?pnwaAq) For example, human-centred design principles, or co-design methods can be applied to oral healthcare research.



*Figure 1: Design Contributions and Outcomes Canvas - Oral Health*

## What is human-centred design?

Human-centred design is defined in ISO 9241-210:2019 as an *“approach to systems design and development that aims to make interactive systems more usable by focusing on the use of the system and applying human factors/ergonomics and usability knowledge and techniques”* [41](https://www.zotero.org/google-docs/?KW3oya)

Human-centred design places human beings at the centre of the design process. This is in contrast to alternative approaches such as technology-driven or sustainable design, which centre on technological novelty or minimising environmental impact.[42](https://www.zotero.org/google-docs/?9wo5JF)

Human-centred design aims to produce outcomes which are useful, usable, desirable and meaningful to the people using them. To do so, it places the needs and experiences of human beings at the centre of the design process, acknowledges them as the experts in their lived experience, and co-creates solutions with and for them. Human-centred design incorporates methods to understand people holistically (including their multifaceted needs, expectations, behaviours and relationships), engages with users and multiple stakeholders throughout the design process, and often involves transdisciplinary collaboration.[43](https://www.zotero.org/google-docs/?juuVIj)

User-centred design is sometimes used synonymously with human-centred design, however, human-centred design emphasises people and context beyond their role as users, and includes different stakeholders' varying needs and broader contexts.[44,45](https://www.zotero.org/google-docs/?wHocCd)This is an important consideration in oral health, where care may be delivered by various healthcare practitioners across a range of services and settings.

Altiparmakogullari et al. applied a human-centred design perspective to investigate dental photography in orthodontic treatment, looking at both the efficiency of the process and the quality of images produced.[46](https://www.zotero.org/google-docs/?oQEbnm) While previous work had focused on equipment based problems, their human-centred approach looked at the whole system of people and equipment, considering ergonomics and human factors such as postural issues, as well as the emotional influences on patients. The outcome was a series of recommendations to improve the dental photography equipment and processes for both clinicians and patients.

## What is inclusive design?

The British Standards Institute defines inclusive design as *“design of mainstream products and/or services that are accessible to, and usable by, as many people with the widest range of abilities within the widest range of situations without the need for special adaptation or specialised design”* [47](https://www.zotero.org/google-docs/?JTl47S)

Inclusive design centres on designing for human diversity. It acknowledges the central role of design as an agent of inclusion or exclusion, and that (dis)ability and exclusion can be thrust upon an individual in temporary, situational or permanent settings, through inadequate or inconsiderate design.[48](https://www.zotero.org/google-docs/?aE7eI1)

Through identifying ‘extremes’ and ‘mainstreams’, inclusive design involves empathising, and ultimately designing with often ignored, marginalised or excluded user groups, whose experiences pose the most extreme and diverse design challenges and opportunities. By investigating barriers to inclusion, it aims to bring those extreme and excluded users into the mainstream and create innovative solutions that include and benefit all.[48](https://www.zotero.org/google-docs/?LttwfY)

Inclusive design is about more than accessibility. It recognises both the physical and psychosocial dimensions of inclusion and exclusion through design, and places value on quality of life and experience.[49](https://www.zotero.org/google-docs/?3LVdlo) As such, it goes beyond disability, ageing and physical accessibility, and considers topics such as neurodiversity, invisible disabilities, lifestyle exclusions and design (in)justice.[50](https://www.zotero.org/google-docs/?CPrTRI)

An example of inclusive design was applied to oral health was the redesign of toothbrush packing.[51](https://www.zotero.org/google-docs/?M4xo0p) Extreme users, including people with arthritis, people with low vision, children and older people were central to the redesign process. Working with these groups uncovered rich insights around the ability to open the packaging, prioritising information and brand visibility. The project resulted in more user-friendly toothbrush packaging that is easier to open for a wider range of people which, in turn, increased sales and strengthened the brand positioning.

# The relevance of inclusive and human-centred design to oral health

The potential for inclusive and human-centred design to address challenges to our societies’ health is increasingly recognised.[52,53](https://www.zotero.org/google-docs/?zDzy5W) Design is being adopted as a central agent of innovation to rethink healthcare services and systems and tackle complex problems.[54,55](https://www.zotero.org/google-docs/?ZeYwFx) For example, through NHS X and NHS Digital designers and design practices, have been embedded as key strategic elements within healthcare innovation and improvement.[56](https://www.zotero.org/google-docs/?XbHOX8)

Despite being increasingly valued and integrated into general health and social care, a recent review of inclusive and human-centred design in oral healthcare found limited recognition and adoption of the approaches, with oral healthcare lagging behind the wider health domain in this regard.[1](https://www.zotero.org/google-docs/?nMkUfm) To promote the uptake and adoption of inclusive and human-centred design, we discuss its potential significance as an agent for transformations in oral healthcare, as well as its relevance to the specific shifts and challenges previously outlined.

## Inclusive and human-centred design as an agent of oral healthcare transformations

Through intentionally embracing complexity, utilising creative approaches and centring on human values, inclusive and human-centred design offers alternative, non-clinical, perspectives and radically different strategies for addressing the challenges and facilitating the systemic transformations occurring in oral healthcare.

The complex nature of oral healthcare systems, the diversity of individuals within them, and the social and political environments in which they are situated mean that many of the challenges facing oral healthcare could be described as ‘wicked’.[57](https://www.zotero.org/google-docs/?VTYuk7) Such problems are interconnected and situated within large spatio-temporal contexts, and addressing them requires an understanding of the wider systems context as well as collaborative, creative, integrative and imaginative approaches.[58,59](https://www.zotero.org/google-docs/?sllryZ)

Inclusive and human-centred design offers a systems-based approach; considering people in different contexts and environments, their lives and experiences, and how these interact within systems.[60](https://www.zotero.org/google-docs/?AG3cQP) Systems-based approaches are important across all contribution types in oral healthcare. Recently, Brocklehurst et al. promoted systems thinking in oral health research, highlighting the importance of understanding the complexity and contextual knowledge of the system in order to mobilise knowledge and successfully implement interventions.[61](https://www.zotero.org/google-docs/?up4BjI)

Involving designers in oral health research brings a non-clinical perspective, which could both offer new ideas and lessen challenges which arise through the dual clinician-researcher role. For example in qualitative research, a clinician's professional status can present issues around maintaining a duty of care while ensuring methodological integrity, and power imbalances which affect participants' responses.[62](https://www.zotero.org/google-docs/?ozM9Xd)

Alongside systems approaches and non-clinical perspectives, design offers creative methods such as visualisations and prototypes which can be used to facilitate communication around systemic transitions and open shared modes of understanding across stakeholders and disciplines.[61,63](https://www.zotero.org/google-docs/?HO2gll) Lievesley and Wassall demonstrate the value of design for describing and reframing complex problems in their development of a person-centred view of Community Dental Health Services.[64](https://www.zotero.org/google-docs/?xjokHe) They produced two visual models establishing an extra-organisational view of service provision, which were key in facilitating collaboration across stakeholders and highlighting the value in taking a person-centred perspective to reframe systemic challenges. Such creative collaboration and shared reframing is relevant to the move to Integrated Care Systems outlined in the Health and Care Bill[65](https://www.zotero.org/google-docs/?BwZm7U) and NHS long term plan,[66](https://www.zotero.org/google-docs/?FCu69h) which requires partnerships between health providers and reorganised health systems. Design approaches might aid the integration of dental practices and their services into the wider healthcare system.

## Facilitating person-centred and prevention-oriented care

The principles and values of inclusive and human-centred design are closely aligned to the person-centred and prevention-orientated approaches being proposed in oral healthcare.

Apelian et al.’s PCC model is based on humility, hospitality and mindfulness,[11](https://www.zotero.org/google-docs/?FthxgN) and Scambler and Asimakopoulou include “feeling empathy and compassion” as one of four foundational components in their hierarchy of PCC.[10](https://www.zotero.org/google-docs/?WYfR1y) This theme of empathy is relevant to the principles of inclusive and human-centred design, where empathising and understanding users is a central concept in order to design for their needs and desires.[42](https://www.zotero.org/google-docs/?esKACl)

Grasp live is an example of a product designed to support a trusting and empathic relationship between dentist and patient, particularly in patients with dental anxiety.[67](https://www.zotero.org/google-docs/?rVTuFY) Grasp is a handheld device which the patient can squeeze to communicate during treatment. It is connected to a smartphone, as well as an Apple Watch worn by the dentist which provides haptic feedback. This communication during treatment allows cooperation between dentist and patient, for example, feedback can be used for quick confirmation of cavities without excessive pain. While Grasp was designed with dental anxiety in mind, it could be of benefit to a range of patients, including those with communication difficulties.

Parallels can be found in other key PCC dimensions such as “the patient as a whole person”,[10](https://www.zotero.org/google-docs/?PRpoaM) and “treated as a person, recognised as an individual”,[9](https://www.zotero.org/google-docs/?i1rTdS) which echo the FDI’s definition of person-centred rather than patient-centred care, and could be linked to the distinction of human-centred design from user-centred design in considering people beyond their role as users.

Another key component of PCC is empowering patients and involving them in their own treatment decisions. Mills et al.’s model includes shared decision making,[9](https://www.zotero.org/google-docs/?I7WnWf) and Apelian et al.’s model includes “sharing power” and “creativity” as key attitudes in co-determining problems and co-authoring treatment plans.[11](https://www.zotero.org/google-docs/?Z9gyHJ) Scambler and Asimakopoulou’s hierarchy of PCC is a tool intended to help clinicians reflect on the level to which patients are involved in decision making.[10](https://www.zotero.org/google-docs/?oKiDmm) This concept of shared decision making and patient involvement encourages a participatory approach; something which is a key skill of designers, who commonly apply methods such as co-design. Brocklehurst et al. have promoted the use of designs participatory methods in oral health, particularly in implementation research[61](https://www.zotero.org/google-docs/?0PkNoZ) and special care dentistry.[68](https://www.zotero.org/google-docs/?aGrrKa)

The Whole Mouth Health project is an example of a project using co-design to explore oral health literacy and behaviour change.[69](https://www.zotero.org/google-docs/?8m0R0W) The project seeks to provide people with the resources and capacity to better understand and enact models of self-care that sustain good oral health through understanding and adapting to individual needs and context. A range of participants across multiple countries and life stages are involved in a series of problem-framing and problem-solving activities, with the aim of co-producing an oral health literacy platform. The project highlights how design could facilitate the delivery of personalised health information and hence drive transformations towards person-centred and prevention-oriented care.

## Reframing and tackling societal challenges

Inclusive design, and the concept of extreme users, is highly relevant to the FDI’s vision of quality oral healthcare that is *“available, accessible, and affordable to all, with special attention paid to marginalized and vulnerable populations”.*[13](https://www.zotero.org/google-docs/?1nRl4o) Design has been applied to facilitate access and improve experiences of typically excluded groups in oral healthcare, for example through the creation of dental chairs for people in wheelchairs and bariatric patients,[70](https://www.zotero.org/google-docs/?824JO0) a communication aid for people with intellectual disability,[71](https://www.zotero.org/google-docs/?Sb97fP) or a device for nurses brushing hospital patients teeth.[72](https://www.zotero.org/google-docs/?tmfYXX)

Beyond these product examples, there is potential for inclusive and human-centred design to explore the implications of societal challenges on oral health systems. In particular, design might help reframe societal challenges and investigate physical and psychosocial experiences of oral health across diverse populations, and uncover barriers and drivers to accessible and inclusive oral care.

This is particularly relevant to the research area of Inclusion Oral Health.[74](https://www.zotero.org/google-docs/?NDc6C8) Advances in Inclusion Oral Health discuss the complexities of oral health inequalities and call for *“multidisciplinary research collaborations to meet the methodological challenges of this urgent new frontier in oral health inequity research”*.[75](https://www.zotero.org/google-docs/?iMkBh2)

The creative participatory approaches of design allow the flattening of hierarchies in bureaucratic health systems; and are democratic and not reliant on traditional forms of research, enabling engagement with traditionally hard to reach groups.[53](https://www.zotero.org/google-docs/?suQX2Y) Moreover, these approaches provide valuable ‘thick data’, for example, in-depth human-centred insights which are vital to understand why people adopt a certain behaviour, which complements ‘big data’ that might indicate what that behaviour is.[73](https://www.zotero.org/google-docs/?P7UL4M)

## Human-centred technology and innovation

Technology has the potential to help meet pressures on oral healthcare systems, and deliver person-centred care. Mills et al.’s model of PCC for dentistry looks beyond patient-dentist relations and recognises the significance of the physical environment and the healthcare system.[9](https://www.zotero.org/google-docs/?v0zba6) As such, the application of technology and innovation to oral healthcare equipment, environment and systems, has a key role in delivering PCC.

Consultation Room 2030 is an example of a project looking at how technology can facilitate changing approaches to care.[70](https://www.zotero.org/google-docs/?SmDiz8) The project explores transformations in healthcare, particularly trends in transferring healthcare experiences from the consultation room to home and how this can be done in a human-centred way. They are examining the process from before a consultation to a patient arriving back at home, identifying things which could be innovated or streamlined through the help of technology, considering how doctors could do their work better, more efficiently and with more satisfaction, and ultimately improve patient experience.

However, poorly designed technology can lead to poor experiences and risks exacerbating exclusion. The integration of inclusive and human-centred perspectives in the design, development, and implementation of technologies would help to ensure that they fit the needs of users and stakeholders, and are developed with consideration for the specific environments and contexts in which they will be used. In oral healthcare, such approaches could seek to enhance effectiveness and efficiency, improve human well-being, user satisfaction, accessibility, and sustainability; and counteract possible adverse effects of use on human health, safety, and performance. One example could be in the delivery of prevention, which could be delivered anywhere and adapted for diverse populations by application of technology.

# Barriers and drivers to adopting inclusive and human-centred design in oral health

There are inherent disciplinary differences in design and oral health cultures, languages and approaches which may pose challenges to a meeting of the fields. Some potential drivers and barriers to the symbiosis of the fields are outlined below.

## Communication and understanding of design

Understanding and awareness of design is a significant barrier to its adoption in oral health. Whilst recognition of design is growing, it is often poorly understood by healthcare practitioners and poorly integrated into healthcare systems.

Design is predominantly seen and implemented as an agent of problem-solving and hence is only engaged with, if or when that stage applies. Such notions can lead to the view of design as a problem-solving toolkit that can be used without designers. These preconceptions not only ignore the problem-framing capabilities of design but also undervalue designers, and can lead to limited and unsuccessful design outcomes. There is a need to build understanding so that oral health can engage with and utilise the full design landscape.

Differences in professional norms for dissemination affect understanding of design in oral health. While the health paradigm focuses on peer-reviewed publications, design takes a more varied approach engaging in areas such as exhibition, performance and making.[53](https://www.zotero.org/google-docs/?Z33qNm) Collaborations between design and oral health should consider how they label and publish work so that design is understood and communicated to the intended audience.

## Disciplinary approaches to evidence

There are disciplinary differences in approaches to data, rigour, evidence and impact. There is debate about the nature of the evidence base (regarding the hierarchy and what is considered evidence) in relation to design versus health.[78](https://www.zotero.org/google-docs/?YoZ4eq) While oral health has an evidence-based nature and typically focuses on quantitative methods, design research often utilises qualitative approaches and design in industry is less tied to academia.

Traditional quantitative approaches don’t always suit wicked problems which have numerous variables that can’t be separated and investigated in isolation. In some cases, evidence on impact, rather than effect, is of value, which is measured through felt, lived experience. Brocklehurst et al. have discussed limitations of the evidence-based paradigm in oral health - highlighting the importance of contextual knowledge, and the value of qualitative processes.[61](https://www.zotero.org/google-docs/?g9p4vT) Such reflections diverge from traditional linear ideas around how evidence is created and put into practice, aiming to rethink knowledge transfer, mobilisation and utilisation in healthcare.

## The context of dental and wider health care systems

The broader context of dental care systems, wider healthcare systems and their political backdrop is another consideration. The adoption of design within these may require culture change, which can be difficult to manage.

Current systems for assessing dental performance and remuneration methods are potential barriers to the implementation of person-centred approaches, and design strategies must be able to adapt to political and societal changes on local, regional and national scales.

# Conclusions and future directions

This paper examines the relevance of inclusive and human-centred design to the transformational, societal and technological shifts occurring in oral health. We suggest that there is an opportunity for oral health to engage with design across all design orders and contribution types; and that designers could be of value to oral health policy, research and practice across issues such as person-centred practice, Inclusion Oral Health, and accessible technological advancement.

Integrating designers and design-led activities into oral health research is a priority for advancing the symbiosis of these fields. Barriers and drivers including; awareness of the role and value of design, disciplinary differences, and the wider healthcare systems context should be considered and addressed. Finally, theoretical contributions should be prioritised as the basis for future methodological, empirical and interventional contributions. In particular, a theoretical framework for inclusive and human-centred design in oral health should provide such foundations, and would push forward the policy, research and practice agenda.

# Author contributions

I.L, N.L and F.N conceived the paper. I. L wrote the first draft, and all authors provided feedback, participated in the editing process and approved the final version.

# References

[1 Leason I, Nickpour F. The State of Inclusive and Human-Centred Design in Oral Healthcare. Bilbao, 2022.](https://www.zotero.org/google-docs/?mHvA8Z)

[2 FDI. FDI’s definition of oral health. 2016.https://www.fdiworlddental.org/fdis-definition-oral-health (accessed 16 Jun2021).](https://www.zotero.org/google-docs/?mHvA8Z)

[3 Glick M, Williams DM, Kleinman DV, Vujicic M, Watt RG, Weyant RJ. A new definition for oral health developed by the FDI World Dental Federation opens the door to a universal definition of oral health. *Br Dent J* 2016; **221**: 792–793.](https://www.zotero.org/google-docs/?mHvA8Z)

[4 Baiju R, Peter E, Varghese N, Sivaram R. Oral health and quality of life: current concepts. *J Clin Diagn Res JCDR* 2017; **11**: ZE21.](https://www.zotero.org/google-docs/?mHvA8Z)

[5 Sischo L, Broder HL. Oral Health-related Quality of Life: What, Why, How, and Future Implications. *J Dent Res* 2011; **90**: 1264–1270.](https://www.zotero.org/google-docs/?mHvA8Z)

[6 Alrawiai S, Asimakopoulou K, Scambler S. Patient‐Centred Care in Dentistry: Definitions and Models‐Commentary. *Eur J Dent Educ* 2021; **25**: 637–640.](https://www.zotero.org/google-docs/?mHvA8Z)

[7 Leggett H, Duijster D, Douglas GVA *et al.* Toward More Patient-Centered and Prevention-Oriented Oral Health Care: The ADVOCATE Project. *JDR Clin Transl Res* 2017; **2**: 5–9.](https://www.zotero.org/google-docs/?mHvA8Z)

[8 Lee H, Chalmers NI, Brow A *et al.* Person-centered care model in dentistry. *BMC Oral Health* 2018; **18**: 1–7.](https://www.zotero.org/google-docs/?mHvA8Z)

[9 Mills I, Frost J, Kay E, Moles D. Person-centred care in dentistry-the patients’ perspective. *Br Dent J* 2015; **218**: 407–413.](https://www.zotero.org/google-docs/?mHvA8Z)

[10 Scambler S, Asimakopoulou K. A model of patient-centred care – turning good care into patient-centred care. *Br Dent J* 2014; **217**: 225–228.](https://www.zotero.org/google-docs/?mHvA8Z)

[11 Apelian N, Vergnes J, Hovey R, Bedos C. How can we provide person-centred dental care? *Br Dent J* 2017; **223**: 419–424.](https://www.zotero.org/google-docs/?mHvA8Z)

[12 Håkansson Eklund J, Holmström IK, Kumlin T *et al.* Same same or different? A review of reviews of person-centred and patient-centred care. *Patient Educ Couns* 2019; : 3–11.](https://www.zotero.org/google-docs/?mHvA8Z)

[13 Glick M, Williams DM, Ben Yahya I *et al.* Vision 2030: Delivering Optimal Oral Health for All. Geneva: FDI World Dental Federation, 2021.](https://www.zotero.org/google-docs/?mHvA8Z)

[14 World Health Organization (WHO). Oral Health Achieving better oral health as part of the universal health coverage and noncommunicable disease agendas towards 2030. Report by the Director-General (EB148/8) 148th Session of the Executive Board, Provisional Agenda Item 6. 2021.](https://www.zotero.org/google-docs/?mHvA8Z)

[15 World Health Organization (WHO). Oral health Executive board resolution EB148/R1. 2021.](https://www.zotero.org/google-docs/?mHvA8Z)

[16 Apelian N, Vergnes J-N, Bedos C. Is the dental profession ready for person-centred care? *Br Dent J* 2020; **229**: 133–137.](https://www.zotero.org/google-docs/?mHvA8Z)

[17 Mills I, Frost J, Moles DR, Kay E. Patient-centred care in general dental practice: sound sense or soundbite? *Br Dent J* 2013; **215**: 81–85.](https://www.zotero.org/google-docs/?mHvA8Z)

[18 Hebblethwaite S. ‘ I Think That It Could Work But...’: Tensions Between the Theory and Practice of Person-Centred and Relationship-Centred Care. *Ther Recreation J* 2013; **47**: 13.](https://www.zotero.org/google-docs/?mHvA8Z)

[19 Kane P, Murtagh F, Ryan K *et al.* The gap between policy and practice: a systematic review of patient-centred care interventions in chronic heart failure. *Heart Fail Rev* 2015; **20**: 673–687.](https://www.zotero.org/google-docs/?mHvA8Z)

[20 Hawkes N. Seeing things from the patients’ view: what will it take? *Bmj* 2015; **350**.](https://www.zotero.org/google-docs/?mHvA8Z)

[21 Haque A. *How should root filled posterior teeth be restored? A systematic review and survey to general dental practitioners*. 2020.https://livrepository.liverpool.ac.uk/3090007/1/201195779\_February2020.pdf.](https://www.zotero.org/google-docs/?mHvA8Z)

[22 Stewart M, Brown JB, Weston W, McWhinney IR, McWilliam CL, Freeman T. *Patient-centered medicine: transforming the clinical method*. CRC press, 2013.](https://www.zotero.org/google-docs/?mHvA8Z)

[23 Holmes RD, Steele JG, Donaldson C, Exley C. Learning from contract change in primary care dentistry: a qualitative study of stakeholders in the north of England. *Health Policy* 2015; **119**: 1218–1225.](https://www.zotero.org/google-docs/?mHvA8Z)

[24 Garcia RI, Sohn W. The paradigm shift to prevention and its relationship to dental education. *J Dent Educ* 2012; **76**: 36–45.](https://www.zotero.org/google-docs/?mHvA8Z)

[25 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**: 380–387.](https://www.zotero.org/google-docs/?mHvA8Z)

[26 Public Health England. Inequalities in oral health in England: summary. 2021https://www.gov.uk/government/publications/inequalities-in-oral-health-in-england/inequalities-in-oral-health-in-england-summary (accessed 17 Jun2021).](https://www.zotero.org/google-docs/?mHvA8Z)

[27 Tiwari T, Baker S, Albino J. Reducing oral health disparities: social, environmental and cultural factors. *Front Public Health* 2017; **5**: 298.](https://www.zotero.org/google-docs/?mHvA8Z)

[28 Petticrew M, Tugwell P, Welch V *et al.* Better evidence about wicked issues in tackling health inequities. *J Public Health* 2009; **31**: 453–456.](https://www.zotero.org/google-docs/?mHvA8Z)

[29 Beard JR, Officer AM, Cassels AK. The World Report on Ageing and Health. *The Gerontologist* 2016; **56**: S163–S166.](https://www.zotero.org/google-docs/?mHvA8Z)

[30 The Faculty of Dental Surgery of The Royal College of Surgeons of England. Improving older people’s oral health. 2017.](https://www.zotero.org/google-docs/?mHvA8Z)

[31 NHS Information Centre. Adult Dental Health Survey. 2009https://digital.nhs.uk/data-and-information/publications/statistical/adult-dental-health-survey/adult-dental-health-survey-2009-first-release (accessed 17 Jun2021).](https://www.zotero.org/google-docs/?mHvA8Z)

[32 Hellyer PH. The older dental patient – who cares? *Br Dent J* 2011; **211**: 109–111.](https://www.zotero.org/google-docs/?mHvA8Z)

[33 Wu Y, Wang F, Fan S, Chow JK-F. Robotics in dental implantology. *Oral Maxillofac Surg Clin* 2019; **31**: 513–518.](https://www.zotero.org/google-docs/?mHvA8Z)

[34 Susic I, Travar M, Susic M. The application of CAD/CAM technology in Dentistry. IOP Publishing, 2017, p 012020.](https://www.zotero.org/google-docs/?mHvA8Z)

[35 Estai M, Kanagasingam Y, Tennant M, Bunt S. A systematic review of the research evidence for the benefits of teledentistry. *J Telemed Telecare* 2018; **24**: 147–156.](https://www.zotero.org/google-docs/?mHvA8Z)

[36 Carlgren L, Rauth I, Elmquist M. Framing Design Thinking: The Concept in Idea and Enactment. *Creat Innov Manag* 2016; **25**: 38–57.](https://www.zotero.org/google-docs/?mHvA8Z)

[37 Langley J, Wolstenholme D, Cooke J. ‘Collective making’ as knowledge mobilisation: the contribution of participatory design in the co-creation of knowledge in healthcare. *BMC Health Serv Res* 2018; **18**: 1–10.](https://www.zotero.org/google-docs/?mHvA8Z)

[38 Design Council. Design perspectives: design skills. 2020.https://www.designcouncil.org.uk/sites/default/files/asset/document/Design%20Perspectives-%20Design%20Skills.pdf.](https://www.zotero.org/google-docs/?mHvA8Z)

[39 Buchanan R. Wicked Problems in Design Thinking. *Des Issues* 1992; **8**: 5.](https://www.zotero.org/google-docs/?mHvA8Z)

[40 O’Sullivan C, Nickpour F. 50 Years of Inclusive Design for Childhood Mobility; Insights from an Illustrative Mapping Review. In: in Boess S Cheung, M and Cain, R (eds) (ed). . Held Online, 2020 doi:https://doi.org/10.21606/drs.2020.275.](https://www.zotero.org/google-docs/?mHvA8Z)

[41 BSI Standards Publication. BS EN ISO 9241-210:2019 Ergonomics of human-system interaction. Human-centred design for interactive systems. 2019.](https://www.zotero.org/google-docs/?mHvA8Z)

[42 Giacomin J. What Is Human Centred Design? *Des J* 2014; **17**: 606–623.](https://www.zotero.org/google-docs/?mHvA8Z)

[43 Zhang T, Dong H. Human-Centred Design: An Emergent Conceptual Model. London, 2009http://bura.brunel.ac.uk/handle/2438/3472.](https://www.zotero.org/google-docs/?mHvA8Z)

[44 Steen M. Tensions in human-centred design. *CoDesign* 2011; **7**: 45–60.](https://www.zotero.org/google-docs/?mHvA8Z)

[45 Jordan PW. Human factors for pleasure seekers. In: *Design and the social sciences*. CRC Press, 2002, pp 26–40.](https://www.zotero.org/google-docs/?mHvA8Z)

[46 Altiparmakogullari Y, Cifter M, Cifter AS. A Multidisciplinary inspection of Dental Photography: What Do Dentist Think and What Can Designer Do? *Des J* 2017; **20**: S1989–S1997.](https://www.zotero.org/google-docs/?mHvA8Z)

[47 British Standards Institute. BS 7000-6:2005: Design management systems - Managing Inclusive Design - Guide. 2005.](https://www.zotero.org/google-docs/?mHvA8Z)

[48 John Clarkson P, Coleman R. History of Inclusive Design in the UK. *Appl Ergon* 2015; **46**: 235–247.](https://www.zotero.org/google-docs/?mHvA8Z)

[49 Lim Y, Giacomin J, Nickpour F. What Is Psychosocially Inclusive Design? A Definition with Constructs. *Des J* 2020; : 1–24.](https://www.zotero.org/google-docs/?mHvA8Z)

[50 Nickpour F, Dong H. Designing for Diversity: Inclusive Design as a catalyst for change? 2018.](https://www.zotero.org/google-docs/?mHvA8Z)

[51 DOGA. Jordan toothbrush packaging. https://doga.no/en/tools/inclusive-design/cases/jordan-toothbrush-packaging/ (accessed 19 Nov2021).](https://www.zotero.org/google-docs/?mHvA8Z)

[52 Campbell D, Stockman K, Burns D. Design and Systems Thinking for Healthcare Practitioners. In: *Design Thinking in Higher Education*. Springer, 2020, pp 91–125.](https://www.zotero.org/google-docs/?mHvA8Z)

[53 Chamberlain P Wolstenholme, D, Dexter, M, Seals, E. The State of the Art of Design in Health: An expert-led review of the extent of the art of design theory and practice in health and social care. 2015.](https://www.zotero.org/google-docs/?mHvA8Z)

[54 Komashie A, Ward J, Bashford T *et al.* Systems approach to health service design, delivery and improvement: a systematic review and meta-analysis. *BMJ Open* 2021; **11**: e037667.](https://www.zotero.org/google-docs/?mHvA8Z)

[55 Tsekleves E, Cooper R. Emerging Trends and the Way Forward in Design in Healthcare: An Expert’s Perspective. *Des J* 2017; **20**: S2258–S2272.](https://www.zotero.org/google-docs/?mHvA8Z)

[56 Väänänen T. Design is the strategy. NHS Digit. 2020.https://digital.nhs.uk/blog/design-matters/2020/design-is-the-strategy (accessed 5 Oct2021).](https://www.zotero.org/google-docs/?mHvA8Z)

[57 Baker SR. No simple solutions, no single ingredient: systems orientated approaches for addressing wicked problems in population oral health. *Commun Dent Health* 2019; **36**: 3.](https://www.zotero.org/google-docs/?mHvA8Z)

[58 Thomas W, Hujala A, Laulainen S, McMurray R. *The management of wicked problems in health and social care*. Routledge, 2018.](https://www.zotero.org/google-docs/?mHvA8Z)

[59 Irwin T. The emerging transition design approach. *Cuad Cent Estud En Diseño Comun Ens* 2019; : 147–179.](https://www.zotero.org/google-docs/?mHvA8Z)

[60 What is Human-Centered Design? Interact. Des. Found. https://www.interaction-design.org/literature/topics/human-centered-design (accessed 27 Apr2022).](https://www.zotero.org/google-docs/?mHvA8Z)

[61 Brocklehurst PR, Baker SR, Langley J. Context and the evidence-based paradigm: The potential for participatory research and systems thinking in oral health. *Community Dent Oral Epidemiol* 2020. doi:10.1111/cdoe.12570.](https://www.zotero.org/google-docs/?mHvA8Z)

[62 Geddis-Regan A, Exley C, Taylor G. Navigating the Dual Role of Clinician-Researcher in Qualitative Dental Research. *JDR Clin Transl Res* 2022; **7**: 215–217.](https://www.zotero.org/google-docs/?mHvA8Z)

[63 Robinson TA. Getting it all together: the fragmentation of the disciplines and the unity of knowledge. *Headwaters* 2008; **25**: 102–114.](https://www.zotero.org/google-docs/?mHvA8Z)

[64 Lievesley M, Wassall R. Designing across organisational boundaries-Community Dentistry Services. Newcastle University, 2015.](https://www.zotero.org/google-docs/?mHvA8Z)

[65 Health and Care Bill - Parliamentary Bills - UK Parliament. https://bills.parliament.uk/bills/3022 (accessed 5 Nov2021).](https://www.zotero.org/google-docs/?mHvA8Z)

[66 NHS. The NHS long term plan. 2019.https://www.longtermplan.nhs.uk/.](https://www.zotero.org/google-docs/?mHvA8Z)

[67 Guribye F, Gjøsæter T. Tangible Interaction in the Dentist Office. ACM, 2018 doi:10.1145/3173225.3173287.](https://www.zotero.org/google-docs/?mHvA8Z)

[68 Brocklehurst PR, Langley J, Baker SR, McKenna G, Smith C, Wassall R. Promoting co-production in the generation and use of research evidence to improve service provision in special care dentistry. *Br Dent J* 2019; **227**: 15–18.](https://www.zotero.org/google-docs/?mHvA8Z)

[69 FDI Whole Mouth Health. Lab4Living Des. Health Well- Sheff. Hallam Univ. https://lab4living.org.uk/projects/whole-mouth-health/ (accessed 13 Sep2021).](https://www.zotero.org/google-docs/?mHvA8Z)

[70 Design Specific. https://www.designspecific.co.uk/ (accessed 3 Dec2020).](https://www.zotero.org/google-docs/?mHvA8Z)

[71 Menzies R, Herron D, Scott L, Freeman R, Waller A. Involving clinical staff in the design of a support tool to improve dental communication for patients with Intellectual Disabilities. 2013 doi:10.1145/2513383.2513407.](https://www.zotero.org/google-docs/?mHvA8Z)

[72 Coventry University HDTI. Teggy. https://www.coventry.ac.uk/business/our-services/health-design-technology-institute/health-design-technology-institute-case-study-menu/teggy/ (accessed 20 Dec3AD).](https://www.zotero.org/google-docs/?mHvA8Z)

[73 Hong A, Baker L, Prieto Curiel R *et al.* Reconciling big data and thick data to advance the new urban science and smart city governance. *J Urban Aff* 2022; : 1–25.](https://www.zotero.org/google-docs/?mHvA8Z)

[74 Freeman R, Doughty J, Macdonald ME, Muirhead V. Inclusion oral health: Advancing a theoretical framework for policy, research and practice. *Community Dent Oral Epidemiol* 2020; **48**: 1–6.](https://www.zotero.org/google-docs/?mHvA8Z)

[75 Elaine Muirhead V, Milner A, Freeman R, Doughty J, Macdonald ME. What is intersectionality and why is it important in oral health research? *Community Dent Oral Epidemiol* 2020; **48**: 464–470.](https://www.zotero.org/google-docs/?mHvA8Z)

[76 Digital inclusion for health and social care. NHS Digit. https://digital.nhs.uk/about-nhs-digital/our-work/digital-inclusion (accessed 10 Dec2021).](https://www.zotero.org/google-docs/?mHvA8Z)

[77 Petrie H, Wakefield M. Remote Moderated and Unmoderated Evaluation by Users with Visual Disabilities of an Online Registration and Authentication System for Health Services. 2020, pp 38–43.](https://www.zotero.org/google-docs/?mHvA8Z)

[78 Kirk Hamilton D. Evidence-Based Practice: Four Levels Revisited. 2020.](https://www.zotero.org/google-docs/?mHvA8Z)