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Integrating health screening for non-communicable diseases into dental services: what do we know?

Janine Doughty[1], Jessica F. Large[2], Amanda J. Daley[2], Zehra Yonel[3]

[1]School of Dentistry, University of Liverpool, Liverpool, UK; [2]Centre for Lifestyle Medicine & Behaviour, School of Sport, Exercise and Health Sciences, National Centre for Sport and Exercise Medicine, Loughborough University, Loughborough, UK; [3]Periodontology Research Group, School of Dentistry, College of Medical & Dental Sciences, Institute of Clinical Sciences, University of Birmingham, Birmingham, UK

This narrative review describes the impetus for health screening for non-communicable diseases in dental settings and highlights important considerations for evaluating such interventions. Real world cases are presented that showcase health screening interventions implemented in the UK. Non-communicable diseases including diabetes and cardiovascular disease are a global public health challenge. They are largely preventable by implementing lifestyle changes such as healthy eating and participation in physical activity, regular health screening for disease prevention, and/or early initiation of treatment. Hypertension case finding and control is one of the key five areas of focus for adult health, and oral health and diabetes are two of five key clinical areas for children and young people where efforts should be focused to intervene, improve outcomes and reduce inequalities. Links between oral and chronic diseases have been discussed in recent years. Therefore, screening for diabetes and cardiovascular disease has become of greater relevance to the dental profession. There is emerging evidence indicating that screening for the risk factors of cardiovascular diseases and diabetes in dental settings shows promise for improving health outcomes and may offer a cost-effective preventive approach for the detection of diabetes. Real-world services implementing health screening in dental settings have highlighted possibilities for the future and highlight the potential for the role of the dental team in detecting chronic diseases.

Keywords*: dental public health, clinical outcomes, Screening*

Introduction

Globally, the epidemic of non-communicable chronic diseases (NCDs) is one of the greatest threats to public health (World Health Organisation, 2019). NCDs, including diabetes and cardiovascular disease, are largely preventable by implementing lifestyle changes such as healthy eating and physical activity, regular health screening for disease prevention, and/or early initiation of treatment. Therefore, health screening forms a critical part of the public health response to chronic disease management in the population by detecting disease at an early or asymptomatic stage, with the aim of improving health outcomes and reducing associated health care costs.

In the United Kingdom (UK), the number of children and adults living with chronic diseases, such as diabetes and cardiovascular disease, is increasing (Ng *et al*., 2024) and preventing chronic diseases at all stages of life is important for reducing related morbidity and mortality. For example, age at diagnosis of type II diabetes (T2DM) predicts survival and cardiovascular risks and has implications for determining the timing and intensity of risk factor interventions for clinical decision making. Preventing/delaying T2DM onset in younger individuals is key to improving long term health outcomes (Sattar *et al*., 2019). In England, almost three-quarters of people aged under 40 years who are diagnosed with T2DM are also living with obesity (NHS England, 2023). Overall, in England, 63.8% adults and 37.7% of 10–11-year-old children are living with overweight or obesity which can adversely impact their health and wellbeing (Baker, 2023).

Key screening outcomes for the risk factors associated with chronic disease include blood glucose and/or HbA1c, cholesterol, triglycerides, blood pressure, and assessment of height and weight for the calculation of body mass index and height to waist ratio. Screening for these outcomes also typically forms part of the National Health Service (NHS) Health Check offered by general practices to assess cardiovascular health and overall wellbeing of patients aged ≥40 years (Tanner *et al*., 2022).

Oral diseases such as dental caries and periodontal disease are also associated with NCDs (Herrera *et al*., 2023; Doughty *et al*., 2023; Public Health England, 2019; Holm *et al*., 2016; Daley, 2022; Taylor, Manz and Borgnakke, 2004; Sanz *et al*., 2018). In 2023, Doughty et al. published a call to action to recognise the potential that dental professionals have to be involved in screening for chronic disease following the NHS Health Check approach (Doughty *et al*., 2023). However, despite increasing evidence demonstrating the opportunities for health screening in dental settings and the relationship between oral and general health, limited real-world health screening and engagement of the wider dental profession has taken place.

To date, researchers have explored the potential for health screening to be offered to patients seen in dental settings to identify conditions such as obesity, diabetes, atrial fibrillation, hypercholesterolaemia, hypertension, metabolic syndrome, HIV and HPV (Doughty *et al*., 2023; Obaid Hassan *et al*., 2023; Conway *et al*., 2016; Suarez-Durall *et al*., 2019; Doke *et al*., 2021). This narrative review presents the rationale for health screening

Correspondence to: Dr. Janine Doughty. Email: janineyd@liverpool.ac.uk

to be offered to patients in primary and secondary care dental settings and highlights key evidence evaluating such interventions in dental settings. In addition to the discussion, real world cases are presented that showcase health screening interventions implemented in the UK.

Rationale for health screening in dental settings

1. Accessing an untapped patient population

Each year, NHS dental professionals in England provide care for 18.1 million adults and 6.4 million children (NHS Digital., 2023), each of whom presents a potential opportunity for receiving health screening and the provision of brief lifestyle advice. A key advantage of using dental settings to screen and then risk assess patients for non-communicable disease is that different populations attend different healthcare settings (Strauss *et al*., 2010). Approximately 12% of people who attend for dental examinations biannually will not have seen a GMP within the past year and almost half (48%) have never had a health check up with a GMP (Yonel *et al*., 2018). This presents an opportunity to access a broader patient population who may not have signs and symptoms of chronic disease, are at an earlier stage in the disease course and may not have recently attended their general medical practitioner (GMP) or accessed health screening elsewhere. Additionally, success of the NHS Health Check programme has been modest; with only about half (52.6%) of those invited attending (Patel *et al*., 2020). Therefore, the remainder of those invited may benefit from receiving health screening in alternative settings, such as in dental settings.

2. The oral systemic association

Oral diseases, including periodontitis and dental caries, are associated with poorer blood glucose control, the development and control of hypertension, hypercholesteremia and increased risk of myocardial infarction and stroke (Herrera, *et al*., 2023; Song, *et al.*, 2020; Guo *et al.*, 2023; Shahi *et al*., 2022). Additionally, high sugar and fat diets that predispose individuals to chronic disease are also associated with the development and severity of oral disease. Associations between oral disease and chronic diseases highlight the value of the dental profession in screening patients and understanding and attending to common risk factors of both oral diseases and chronic diseases. (Sheiham and Watt, 2000).

3. Policy agenda

Collaboration across healthcare services to support the public with optimising their health and help reduce health inequalities in the population is a key priority for the NHS as showcased in NHS England's national approach CORE20PLUS5 (NHS England, 2021; Public Health England, NHS England and Health Education England, 2016). The approach aims to inform action to reduce healthcare inequalities at both a national and system level. Hypertension case finding and control is one of the key five areas of focus for adult health, and oral health and diabetes are two of five key clinical areas for children and young people where efforts should be focused to intervene, improve outcomes and reduce inequalities. The European Federation of Periodontology and NHS Commissioning Standards for Dental Care for People with diabetes recommend collaboration between family doctors and dental teams/oral healthcare professionals to facilitate the early detection of periodontitis and the early detection of diabetes or cardiovascular disease across all dental settings. Furthermore, education of the relevance of NCDs and associated risk factors is required, as well as the development of integrated pathways to facilitate early detection and management of non-communicable diseases in dental settings (Herrera *et al*., 2023; Large, Rogers and Stevens, 2020; NHS England and NHS Improvement, 2019). To support dental teams in this more holistic approach, a consensus is required from regulatory bodies and indemnity providers to reassure the dental profession that they are performing within their scope of practice (Doughty *et al*., 2023).

4. Making Every Contact Count

Prevention throughout the life course is crucial to improving the health of the population. For example, four out of five children with obesity will continue to live with obesity into adulthood (Simmonds *et al*., 2016; Ng *et al*., 2024), adversely impacting their health and opportunities in later life. During dental appointments, oral health and dietary preventative advice are typically offered to patients. Healthcare professionals are encouraged to Make Every Contact Count (MECC), by using opportune moments within patient consultations to provide brief interventions to support healthy lifestyle changes (Public Health England, NHS England and Health Education England, 2016). The implementation of health screening could signpost to general medical practice for follow up care, including definitive testing, diagnosis and management. Further, targeted advice could be provided for people with out-of-range health screening results and standard preventative advice for those with negative screening outcomes. For example, dental teams could offer dietary advice that benefits both oral and general health as outlined by Delivering Better Oral Health and the Scottish Dental Clinical Effectiveness Programme (Scottish Dental Clinical Effectiveness Programme, 2018; Department of Health and Social Care, 2021).

Dental teams are willing to engage in health screening as part of their professional duty to support patients in improving their health (Clark, *et al*.,2018; Wright and Casamassimo, 2017; Large *et al*., 2022; Henderson, 2015; Wijey *et al.*, 2019; Large *et al*., 2024; Greenberg *et al*., 2010). Indeed, some dental settings already offer body mass index (BMI) screening, cholesterol screening and / or diabetes screening; we have presented three such examples below from primary and secondary care dental services (Doughty *et al*., 2023; Clark, *et al*., 2018; Large *et al.*, 2022; Wijey *et al.*, 2019; Large *et al*., 2024; Dixon *et al*., 2019).

Dental teams already support oral and general health including oral cancer screening during routine appointments (Gajendra *et al*., 2023; General Dental Council, 2019; Public Health England, 2014). Smoking is a well evidenced risk factor for cancer, cardiovascular and respiratory disease and periodontal disease (Public Health England, 2014; Amaral *et al*., 2023; Gajendra, McIntosh and Ghosh, 2023). Trained dental teams are successful

in promoting smoking cessation (Amaral *et al*., 2023; Gajendra, McIntosh and Ghosh, 2023; Omaña-Cepeda *et al*., 2016). Overweight/obesity, high cholesterol and high blood glucose are other important risk factors that predispose to many of the same chronic diseases (Herrera *et al*., 2023; Doughty *et al*., 2023). Therefore, dental teams could deliver brief interventions similar to those for other health risks, including BMI, cholesterol and diabetes, and signposting or referral for preventative or interventive care as required (Doughty *et al*., 2023).

Effectiveness of health screening in dental settings

There are multiple factors that should be assessed to evaluate the effectiveness of health screening in dental settings, dependent upon the health condition and the outcome of interest. Those factors include:

- **The condition**: The ability of an intervention to improve disease outcomes as a result of early intervention. For example, reduced complications from diabetes as a result of early detection and initiation of diet modification or medication.
- **The test:** The accuracy of the screening test (sensitivity and specificity) to detect the condition of interest in the population under study. For example, Case 1 in this paper presents a two-step diabetes risk-assessment in dental settings. A quick, non-invasive questionnaire (which has low specificity) identifies those at potential risk who may be followed up with a point-of care HbA1c test.
- **The treatment:** The availability of an effective treatment is a necessary part of a screening programme. For example, early initiation of statins for patients with high cholesterol to reduce the risk of cardiovascular disease.
- **The programme**: The benefits and harms and cost-effectiveness of the intervention. For example, an evaluation of an overweight/obesity intervention may focus on the acceptability of the intervention to the patient and dental professional population. Key markers of success may include the proportion of patients willing to engage with the intervention. The health economic impact of the programme determines whether the cost-savings from improved health outweigh its costs.
- **The implementation criteria**: The availability of facilities, staffing, training for screening for and treating health conditions.

The following sections discuss evaluations of health screening for non-communicable chronic disease in dental settings with a focus on the identification of risk factors for chronic disease, improvements in health outcomes, acceptability and cost-effectiveness of programmes.

1. Identifying risk factors for chronic disease in dental patients

Health screening in dental settings has reported similar proportions of patients with positive screening for cardiovascular disease and diabetes in comparison with the wider population (Doughty *et al.*, 2023; Holm *et al*., 2016). For example, studies conducted in Nigeria, UK and Denmark have reported that between 1.7% and 24% of dental patients have blood glucose results indicating non-diabetic hyperglycaemia and T2DM (Doughty *et al*., 2023; Holm *et al.*, 2016; Opeodu and Adeyemi, 2013; Z. Yonel *et al*., 2020). Studies have reported a high sensitivity (0.91) but low specificity (0.19) of identifying T2DM and pre-diabetes in dental settings when screening using a one-step risk-questionnaire. Thus, those risk-questionnaires identify positive cases, but create a high rate of false positives. The challenge with this is causing psychological harm/worry to healthy patients and generating unnecessary onward referrals for further investigations. Nonetheless, studies report higher prevalence of undiagnosed diabetes in patient populations presenting with periodontal disease, indicating the unique opportunity for dental teams to identify populations living with undiagnosed disease (Holm *et al*., 2016). European studies have reported that more than half of patients screened in dental settings were living with overweight or obesity (54% – 58.2%) (Holm *et al*., 2016; Doughty *et al*., 2023).

2. Improved health outcomes from health screening in dental settings.

There is emerging evidence of improved health outcomes following dental screening for cardiovascular diseases and diabetes. A randomised controlled trial enrolled orthodontic clinics in Mexico and Southern California with their dental teams providing brief exercise and diet advice during dental visits to improve diet, physical activity and BMI amongst children aged 8-16 years (Hovell *et al*., 2018). Less 'junk food' (French fries, chips & sweets) was consumed by the intervention group and there was a reduction in BMI amongst male participants at 12- and 18-month follow-up. Orthodontists could deliver preventative lifestyle advice to children and adolescents following BMI screening, benefit health and add to a population cumulative impact if all areas of healthcare adopted such interactions.

In Santiago, Spain a follow up study (n=154) identified more than a quarter of participants (29%) screened in dental settings had high blood pressure. Of these, 33 people were referred, of whom 19 attended for follow up with their family doctor (Fernández-Feijoo *et al*., 2010). After that assessment 11 patients received non-pharmacological treatment, 6 had pharmacological treatment and no treatment was indicated for two. In the case of periodontal disease, there is scant evidence of diabetic health improvements as a direct result of health screening in dental settings. However, blood glucose or HbA1c screening has an additional benefit in that it provides the dental team with information to tailor oral health treatment plans (Simpson *et al*., 2022).

3. Acceptability of health screening in dental settings

Despite supportive policy, and well evidenced connections between oral and systemic health that encourages health professionals, including dental teams, to make every contact that they have with patients to count, routine health screening remains uncommon across the dental profession. Key barriers include lack of time, an absence of clear pathways of remuneration, fear of offending patients and potentially damaging clinician-patient relationships and weight stigma (Large *et al.*, 2024;

Henderson, 2015; Curran *et al*., 2010; da Silva Gomes *et al.*, 2016; Malik *et al*., 2023, 2021; Gibson Miller *et al.*, 2020). Additionally, dental professionals are reportedly less willing to perform finger prick chair side screening tests when compared with oral fluid (Greenberg *et al*., 2010). However, high levels of public support for health screening and positive feedback from families engaging with dental team led health screening interventions are reported (Large *et al.*, 2022; Wijey *et al.*, 2019; Large *et al*., 2024; Taveras *et al*., 2015; Sansare *et al*., 2015; Guo *et al*., 2018; Greenberg *et al.*, 2012). Patients are willing for dental professionals to screen for high blood pressure and diabetes (55–90%), discuss results immediately (79–89%) and make a financial contribution ($20) (50-67%) (Greenberg *et al*., 2012). One recent systematic review of dental teams' and public views on weight management in dental settings, reported that 83% of the public were supportive of weight screening and 85% supportive of weight discussions by dental teams (Large *et al*.,2024).

4. Cost-effectiveness of health screening in dental settings

Identification of people with dysglycaemia in dental settings to receive prediabetic weight loss programmes has been identified as a cost-effective intervention in the United States (Neidell *et al.*, 2017). In Australia, studies of cost-effectiveness of diabetes screening in dental settings have estimated that between eight and 34 cases of T2DM could be avoided per 10,000 patients screened if the intervention were implemented by between 10% and 40% of dental practices (Gao *et al*., 2022). The costs of screening appear to be lower when tests are combined, for example, performing blood pressure and blood glucose screening simultaneously (Engström *et al*., 2013).

Case studies

This section presents three case studies that focus on, 1) diabetes and hypertension screening in primary dental care 2) an NHS health check in general dental practice and 3) weight screening in a hospital paediatric dentistry department. These case studies exemplify different approaches and outcomes successfully implemented within routine dentistry in the UK.

*1: Targeted risk-based detection of non-communicable diseases (*Yonel *et al.,* 2020*)*

An exploratory study in a dental practice determined whether this setting could successfully integrate screening for NCDs. Most (60%) patients offered the screening accepted it. Screening used validated questionnaires and point-of-care testing for five conditions associated with periodontitis (T2DM and chronic obstructive pulmonary disease with questionnaires, cardiovascular disease by recording blood pressure and atrial fibrillation and chronic kidney disease and vitamin D insufficiency via a finger-stick blood spot test). A recruitment target of 50 patients was reached in eight days. Of the 45 participants without a known diabetes diagnosis (type-1 or type 2), 47% were considered high risk for non-diabetic hyperglycaemia or T2DM. Those defined as high risk were offered a finger-prick HbA1c test. The point-of-care test was used as a reference standard to determine performance of the questionnaire in the study population, of these 16% were considered high-risk for diabetes (non-diabetic hyperglycaemia range) and a further 4% were within the diabetes range (HbA1c ≥6.5% (48mmol/mol)).

One third (34%) of patients were living with overweight based on BMI recorded within the practice and 28% more were living with obesity. Of the patients who did not believe themselves to have cardiovascular disease or hypertension, 44% had high systolic readings (> 140 mmHg) and 13% had diastolic readings > 100 mmHg.

*2: NHS health checks in general dental practice, Welsh border and Cheshire East, England (*Doughty *et al.,* 2023*).*

Two general dental practices in Cheshire East (Cheshire) and the Welsh border (Border) region implemented a five-point health screening service for their patients as part of a service evaluation. At the Cheshire practice screening took place between 31 August 2020 and 8 November 2021, and in the border practice 2 between 1 February 2021 and 31 January 2023. The suite of tests included measuring blood pressure, blood glucose, cholesterol and triglycerides, BMI and height to waist ratio by dental therapists for private membership patients (Cheshire) or by dental nurses for NHS patients (Border). Overall, 515 patients were screened across the two practices. In the Cheshire practice 871 patients attended during the evaluation of whom 58 (6.5%) were screened. In the Border practice, 11200 patients attended, of whom 458 (4.1%) were screened. The programme identified 79.9% of screened patients as having above healthy range blood pressure (33.2% with high blood pressure of 149-159 / 90-99 or higher), 16.7% with hypercholesteraemia, 3.3% with high blood glucose, 58.2% with high BMI (17.9% of whom are living with obesity) and 65.9% with high height to waist ratio measurements.

The proportions of patients with raised biomarkers predisposing to cardiovascular disease and/or diabetes were similar to population prevalence statistics for hypertension, impaired glucose regulation, hypercholesteraemia and elevated BMI (Moody *et al*., 2016; Bilitou *et al*., 2022; Kivimäki *et al*., 2022). This case study demonstrates that health screening can be delivered within general dental practice environments; however, self-selected uptake of the service may be low and therefore fail to reach the majority of the patient population

*3: Routine BMI screening in the Paediatric Dentistry Department, Edinburgh Dental Institute, Scotland (*Large *et al.,* 2022*).*

To determine the feasibility and acceptability of routine BMI screening, the paediatric dentistry team at the Edinburgh Dental Institute introduced optional BMI screening for all new paediatric patient appointments. Training about measuring BMI, holding sensitive discussions and referrals was provided by the local weight management team. A departmental standard operating procedure and protocol guided the team and standardised the approach. As part of the new patient dental appointment, children were identified as being above, below or a healthy weight using the NHS BMI calculator (NHS, 2023) and referral offered, as appropriate, to the local child weight management programme ('Get Going')

or their GMP. 'Get Going' is part of NHS Lothian's Child Healthy Weight Service that supports children and families with healthy lifestyle changes. The multidisciplinary team comprises dieticians, psychologists, exercise specialists, community leisure partners and health coaches with experience in nutrition, behavioural change and physical activity. The free programme is based in community and local leisure facilities, lasts 8-9 weeks, with a 6-month follow-up, and is available to children and young people aged 5-18 years with a BMI centile >91st.

From November 2019–July 2021, 825 children had their BMI recorded by the dental team (dental nurse/dentist), of whom 18.1% were above a healthy weight (>91st BMI centile) and 28.2% of the families offered it accepted referral. Moreover, service evaluations demonstrated high levels of support from dental staff, children and families (Large *et al*., 2022). Over 75% of staff found it easy to measure height and weight, that they had received adequate training and that they would like to see the project extended to other departments. Dental nurses and dentists felt that clinic time was not severely impacted as most children were a healthy weight. Moreover, 81.6% of children reported being happy to have their height/weight measured and 98% of parents/carers understood why their child's BMI was taken and did not have any concerns.

Overall, this evaluation demonstrates that BMI assessment, discussion and referral can be incorporated into paediatric dentistry new patient clinics with potentially little impact on clinical time and with high acceptance from children and families. BMI screening supports clinical decisions, such as local anaesthetic and medication prescribing, but also promotes a holistic approach to patient care as reflected in the feedback from staff and families. Nationally, 33% of children in Scotland aged 2-15 years were at risk of overweight/obesity in 2022 (18% for obesity) highlighting that the need for support on a population level is greater than reflected in this specific relatively small sample (Obesity Action Scotland, 2023). Whether the approach to screening and intervention would work in primary dental care settings is not known.

Opportunities for the future

There is growing evidence demonstrating the clinical benefit and cost-effectiveness of dental teams screening for NCDs. Recent National Institute for Health and Care Excellence (2022) guidelines highlight the risk of periodontitis amongst those living with diabetes and a recent commissioning standard highlights the role of medical colleagues signposting those newly diagnosed with diabetes to dental professionals (NHS England and NHS Improvement, 2019; National Institute for Health and Care Excellence, 2022). Thus, there seems to be growing understanding amongst medical and dental colleagues about the associations between oral and systemic health (Sanz *et al*., 2018; Herrera *et al*., 2023). This shared understanding gives opportunities for collaboration between dental and medical colleagues, to develop care-pathways to deliver holistic, patient centred approaches to care and to develop new funding streams for screening. There are also more research opportunities to understand the design, implementation and translation of new interventions and screening tests into routine dental care. Provided that the validity of screening is sufficient and patients are willing to engage, the benefits include early-identification and prevention of disease, reduced morbidity and negative sequalae of NCDs and reduced burden on primary medical care. This may benefit individuals improving their quality of life and potentially save NHS costs.

Summary

This narrative review on the value of screening for chronic health conditions suggests that dental settings may be an acceptable and effective way to identify those at risk of chronic disease. The associations between oral and systemic conditions make the participation of the dental profession in health screening more compelling. However, local and system barriers have prevented health screening from becoming routine practice in UK dental settings. At present, these barriers appear insurmountable despite supportive health policy and stymy the translation of research into real world practice. However, small scale initiatives in primary and secondary care in both adults and young people, demonstrate the potential to screen for cardiovascular disease and diabetes among dental patients. The acceptability of health screening in dental settings is high and offers the opportunity to improve health outcomes and reduce health care costs from the treatment of NCDs.

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