

# Oral health promotion in acute hospital setting: a quality improvement programme

Grazia Antonacci <sup>1,2</sup>, Laraib Ahmed,<sup>3</sup> Laura Lennox,<sup>1</sup> Samuel Rigby,<sup>3</sup> Sophie Coronini-Cronberg <sup>1,4</sup>

**To cite:** Antonacci G, Ahmed L, Lennox L, *et al.* Oral health promotion in acute hospital setting: a quality improvement programme. *BMJ Open Quality* 2023;12:e002166. doi:10.1136/bmjopen-2022-002166

► Additional supplemental material is published online only. To view, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2022-002166>).

Received 24 October 2022  
Accepted 2 April 2023



© Author(s) (or their employer(s)) 2023. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

<sup>1</sup>Department of Primary Care and Public Health, National Institute for Health and Care Research (NIHR) Applied Research Collaboration (ARC) Northwest London, Imperial College London, London, UK

<sup>2</sup>Imperial College Business School, Centre for Health Economics & Policy Innovation, Imperial College London, London, UK

<sup>3</sup>Chelsea and Westminster Hospital NHS Foundation Trust, London, UK

<sup>4</sup>Office of the Medical Director, Chelsea and Westminster Hospital NHS Foundation Trust, London, UK

## Correspondence to

Dr Grazia Antonacci;  
[g.antonacci@imperial.ac.uk](mailto:g.antonacci@imperial.ac.uk)

## ABSTRACT

Tooth extraction is the most common hospital procedure for children aged 6–10 years in England. Tooth decay is almost entirely preventable and is inequitably distributed across the population: it can cause pain, infection, school absences and undermine overall health status. An oral health programme (OHP) was delivered in a hospital setting, comprising: (1) health promotion activities; (2) targeted supervised toothbrushing (STB) and (3) staff training. Outcomes were measured using three key performance indicators (KPI1: percentage of children/families seeing promotional material; KPI2: number of children receiving STB; KPI3: number of staff trained) and relevant qualitative indicators. Data were collected between November 2019 and August 2021 using surveys and data from the online booking platform. OHP delivery was impacted by COVID-19, with interventions interrupted, reduced, eliminated or delivered differently (eg, in-person training moved online). Despite these challenges, progress against all KPIs was made. 93 posters were deployed across the hospital site, along with animated video 41% (233/565) of families recalled seeing OHP materials across the hospital site (KPI1). 737 children received STB (KPI2), averaging 35 children/month during the active project. Following STB, 96% participants stated they learnt something, and 94% committed to behaviour change. Finally, 73 staff members (KPI3) received oral health training. All people providing feedback (32/32) reported learning something new from the training session, with 84% (27/32) reporting that they would do things differently in the future. Results highlight the importance of flexibility and resilience when delivering QI projects under challenging conditions or unforeseen circumstances. While results suggest that hospital-based OHP is potentially an effective and equitable way to improve patient, family and staff knowledge of good oral health practices, future work is needed to understand if and how patients and staff put into practice the desired behaviour change and what impact this may have on oral health outcomes.

## PROBLEM

Dental decay remains a significant, global public health issue, affecting up to 90% of particularly young children, with disadvantaged populations at particular risk.<sup>1–7</sup> Paediatric dental disease affects children's ability to eat, speak and socialise, impairing school

## WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ Tooth extraction is the most common hospital procedure for children aged 6–10 years in England.
- ⇒ Tooth decay is almost entirely preventable and is inequitably distributed across the population.
- ⇒ Oral health education and promotion can be effective in improving oral health literacy and stimulating positive behaviour change, particularly when based on the Health Belief Model and when involving both parents/carers and children.

## WHAT THIS STUDY ADDS

- ⇒ The implementation of an Oral Health Programme (OHP) in a 'non-traditional' health promotion and prevention setting, is potentially an effective and equitable way to improve knowledge of good oral health practices and encourage positive behaviour change.
- ⇒ The use of patient demographic data throughout the intervention allowed for enhanced services and supported the monitoring of health inequalities.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ Health promotion programmes deploying a targeted universalism approach in a hospital setting could potentially be an effective approach to equitable population health improvement.
- ⇒ Key OHP components and overall learning could be applied to other National Health Service hospitals.
- ⇒ Future work should include rigorous 'down stream' evaluations to demonstrate long-term impact, for example, future dental decay rates in those receiving supervised toothbrushing.

readiness and creating high levels of health system demand.<sup>8–10</sup> In 2019, tooth extraction for dental decay was the most common hospital procedure for children aged 6–10 years old in England,<sup>11</sup> though the distribution of paediatric dental disease is inequitable.<sup>9–11</sup> Dental decay prevalence is almost double among Asian or Asian British children (36.9%) compared with those of white British ethnicity (20.6%), the group with the lowest prevalence.<sup>8</sup> Dental disease is also more common in more deprived areas: in

2016–2017, over one-third (36.3%) of 5years old from the most deprived areas in England suffered from active tooth decay, compared with 12.5% in the least deprived areas.<sup>8</sup>

Although oral health is improving in England,<sup>9,10</sup> dental care provision remains a significant challenge. Nine in 10 National Health Service (NHS) dental practices are not accepting new adult patients, and eight in 10 are not taking on children.<sup>12</sup> Even in London where access was best, three-quarters of practices are not open to new (adult) patients.<sup>12</sup>

In London over a quarter of 5years old (27%) have experienced tooth decay.<sup>10</sup> The hospital setting has been identified as a potential setting to complement current OH promotion activities traditionally delivered in community settings (eg, schools), as it provides a unique opportunity to share learning with children and their families simultaneously.

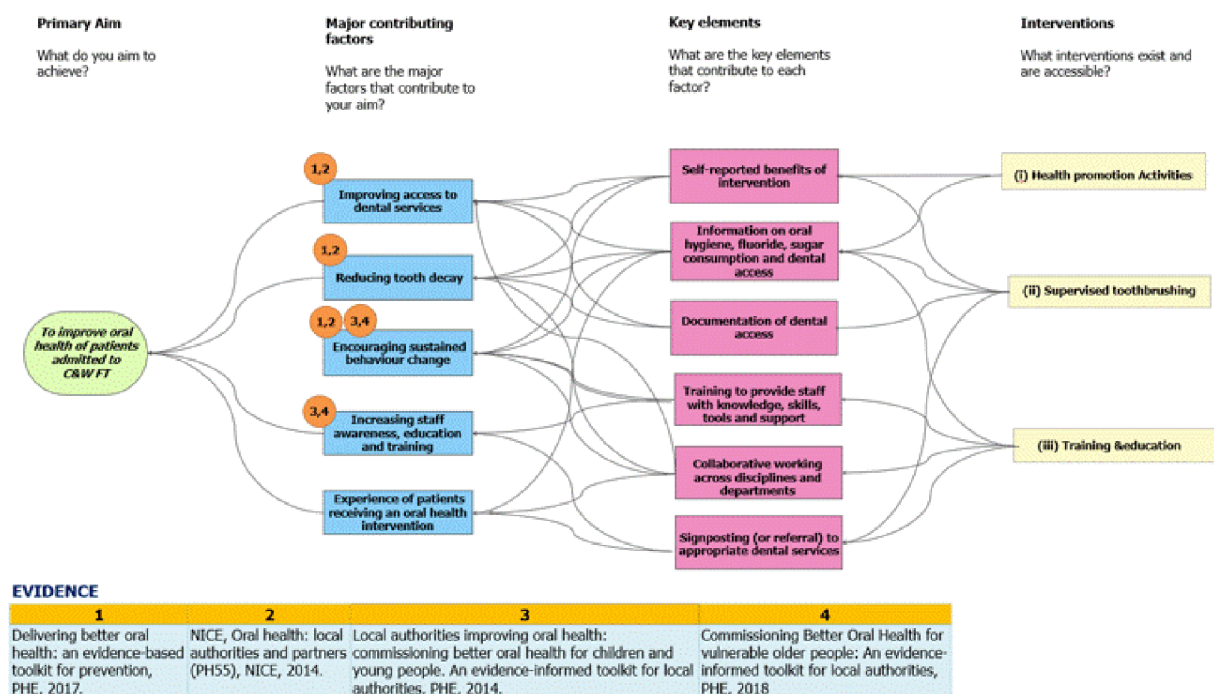
To respond to this local health need, a 2-year (September 2019–September 2021) oral health improvement and disease prevention programme (Oral Health Programme, OHP) was jointly developed and funded by the Public Health Department for the Royal Borough of Kensington and Chelsea (RBKC), the City of Westminster, Public Health England (PHE) (London), and Chelsea and Westminster Hospital NHS Foundation Trust (CWFT).

In 2014/2015, one-third (33.4%) of children aged 5years old living in RBKC had visible dental decay, significantly higher than the national average (24.8%).<sup>13</sup> Chelsea and Westminster Hospital (CWH) is located in RBKC. It is one of two constituent hospitals that comprise CWFT and offers a paediatric dental extraction surgery service. CWFT

serves an ethnically diverse local population, with 40% identifying as being of a non-white British background and in 2019 cared for more than 80 000 children.<sup>14,15</sup> In 2016–2017, 1555 children underwent dental extractions at CWH of which 85% had multiple extractions.<sup>16</sup> This site was chosen for programme delivery on the basis that it has a significant paediatric service offering, including the paediatric dental extraction centre for NW London, and that it is located in RBKC.<sup>17,18</sup>

The aim of the programme was to equitably improve the oral health improvement messaging of paediatric patients admitted to CWH through three intervention components (figure 1):

- Health promotion activities (HPA): display of videos and posters and distribution of bedside information packs across paediatric settings (objective: 75% of children/families reporting seeing oral health messaging at the Trust).
- 'Supervised toothbrushing' (STB): one-to-one sessions delivered to paediatric inpatients and their carers (objective: increase of the number of children receiving STB, 75% of children/families identifying something they had learnt; 75% of children/families committing to an oral health behaviour change; signposting 100% children who were not regularly seeing a dentist).
- Staff training: 30 min session on paediatric oral health delivered to maternity and paediatric staff (objective: increase of the number of staff trained; 75% of attending staff claiming to have learnt something; 75% of attending staff committing to positive change).



**Figure 1** Action effect diagram for the oral health programme. CWFT, Chelsea and Westminster Hospital NHS Foundation Trust; PHE, Public Health England. NICE, National Institute for Health and Care Excellence.

## BACKGROUND

Tooth decay is largely preventable, particularly if two key risk factors are addressed: high volumes/frequency of sugar consumption and low frequency/quality of oral hygiene practice.<sup>19 20</sup> At the time of programme development PHE recommended multisectoral working, including health and education services, to support preventive activity and 'provide the best start in life and the foundations of good health into adulthood'.<sup>21</sup> PHE's ambition was to see children growing up free from tooth decay, by supporting families to 'make the healthy choice the easy choice to improve diets and reduce rates of childhood obesity', with 'less sugar, calories and salt in the food eaten every day'.<sup>22-24</sup> To deliver on these ambitions, PHE advocated the use of the Making Every Contact Count (MECC) approach,<sup>25</sup> a method to facilitate behaviour change that seeks to use the millions of interactions healthcare staff have with patients and their families to encourage positive behaviour change. The MECC approach uses 'brief' and 'very brief' (range: under a minute to a couple of minutes) discussions that arise in interactions to address health improvement.

Common methods to reduce oral health risk factors, which can be delivered within an MECC approach, include education and promotion activities.<sup>26</sup> A systematic review<sup>27</sup> found oral health education and promotion can be effective in improving oral health literacy and stimulating positive behaviour change, particularly when based on the Health Belief Model<sup>28 29</sup> and when involving both parents/carers and children.

Successful examples include an OHP (comprising STB, opportunistic oral health promotion, fluoride toothpaste, toothbrush provision), targeting children aged under 5 years old in deprived areas of Glasgow which demonstrated a consistent pattern of improvement in the dental health indices within the intervention areas.<sup>30</sup> However, evidence also supports a cautionary approach as these interventions can, in certain forms, also exacerbate dental health inequalities.<sup>31</sup>

## MEASUREMENT

A baseline questionnaire was conducted between 16 November 2019 and 26 November 2019 involving 101 children and their parents/carers attending CWH. Baseline results showed 61% of children were from ethnic minority groups and 52% lived in the most deprived areas (Indices of Multiple Deprivation—IMD quintiles 1 and 2).<sup>32</sup> The majority of respondents reported not seeing any health messaging information in the hospital relating to brushing teeth, healthier eating or physical activity (55% not seeing posters, videos or leaflets and 66% not getting advice or information). Moreover, 22% of children reported eating sugary foods, 9% drinking sugary drinks and 18% having both every day.

OHP project interventions started at different dates. STB started on 18th November 2019, promotional material displays began on 16 December 2019 and staff training

on 22 December 2019. While measurement outcomes were considered, given the available time, resources and feasibility, process measures were used (figure 1). Where mechanisms of action of the intervention are well established, process measures allow the success of QI project to be understood by reflecting the way systems and processes work to deliver the desired outcomes.<sup>33 34</sup> Intervention performance was, therefore, evaluated using process metrics. For each of the three intervention components, one quantitative key performance indicator (KPI), alongside other quantitative and qualitative indicators needed to monitor diverse aspects of the intervention were identified (figure 2).

Data were collected between November 2019 and August 2021. HPA and STB data were collected through a 'bedside survey' (online supplemental file) delivered by an oral health coordinator (OHC) to all patients/families after the delivery of STB. Questions related to HPA were added to the survey from September 2020. Training data were collected through an online booking platform and an online staff feedback survey (online supplemental file). Participant numbers alongside role, grade and departments were collected as well as feedback on learning.

Where appropriate, statistical process control (SPC) charts were used to explore the

data and potential impacts of the change interventions (figure 3).<sup>35</sup> NHS Excel template for XmR charts and P-charts were used.<sup>36</sup> Other data have been analysed using summary statistics and qualitative analysis. A balancing metric (BM) was used to take into account the time dedicated by the OHP staff to programme delivery.

## DESIGN

The intervention was developed and overseen by an OHP team involving representatives from the RBKC public health department, PHE and CWFT, who provided quality assurance of the programme through quarterly governance and review meetings. During these meetings, CWFT staff presented OHP monitoring data, which served as a basis to discuss progress and issues. OHP delivery and monitoring was delivered by CWFT staff, which included an OHC, a Public Health Consultant (CPH), and a Public Health or clinical Fellow. The CPH had overall programme oversight. This team forged a relationship with the dental team to ensure that the information provided to patients was streamlined. Programme evaluation was supported by the National Institute for Health Research Applied Research Collaboration for North-West London. During the intervention design stage, the team developed an Action Effect Diagram to illustrate the underpinning programme theory (figure 1).<sup>37</sup> The design of the intervention was informed by the available evidence, existing PHE guidelines, and structured around the Health Belief and COM-B models (suggesting that capability -C, opportunity -O and motivation -M are



Interventions	Indicators and other data monitored	Data source	Objective	Results summary
(i) Health promotional material	KPI 1 Proportion of children/ families that reported seeing promotional material at the Trust	Bedside survey		KPI 1 Mean: 41%; KPI 1 Mean increased from 33% to 63% over the last 12 months; KPI 1 Median: 44 %; Total People surveyed: 565; Total People reporting seeing promotional material: 233.
	KPI 2 Number of children receiving supervised toothbrushing (STB)	Bedside survey	≥ 75%	KPI 2 Mean: 11.5/week, KPI 1 improved after the start of PDSA 7a and after PDSA 7b. KPI 2 Median: 12; Total Children receiving STB: 737.
	Proportion of children/families who identified something they had learned during the STB session	Bedside survey	≥ 75%	96% (708/737)
(ii) Supervised toothbrushing	Proportion of children/families committing to an oral health behaviour change	Bedside survey	≥ 75%	91% (674/737)
	Number of children who were not regularly seeing a dentist that have been signposted	Bedside survey	100%	100% (173/173)
	Frequency of toothbrushing	Bedside survey	Improvement compared to baseline data	76% of the children reporting they brushed their teeth less than 2 times per day (174/229) said that they would start brushing twice daily.
	Frequency of sugar intake	Bedside survey	Improvement compared to baseline data	54% of the children reporting they were drinking sugary drinks >3 times/week (140/257) said that they would reduce sugar in their diet. 69% of the children reporting they were having sugary foods >3 times/weeks (218/317) said that they would reduce sugar in their diet.
	Demographic data of children seen for supervised toothbrushing (ethnicity and socio-economic status)	Bedside survey	N/A	43% of children lived in postcodes with the highest deprivation (IDACI Quintiles 1&2). Ethnicity: Asian/Asian British: 18%, Black/Black British:14%, Mixed:12%, Any other: 13%, White British/Irish: 25%, White other: 17%, Prefer not to say: 1%. 57% belonging to a minority ethnic group vs 39% of CWFT catchment.
	Themes of learning and commitment to change	Bedside survey	N/A	Learning: Brushing:34%, Sugar:29%, Fluoride:20%, Dentist: 11%, Other:5%, Nothing:1%. Commitment to change: Brushing: 46%, Sugar:30%, Dentist:12%, Fluoride:7%, Other:4%, Nothing:1%.
	Number of children that were given fluoride containing	Bedside survey	N/A	280
(iii) Staff training	KPI 3 Number of people attending the training session.	Online booking platform		Total number of people trained: 73. KPI 3- spike in the week following the start of PDSA6 and then suspended during the Covid 2nd wave.
	Proportion of attending staff claiming to have learned something	Online staff feedback survey	≥ 75%	100% of respondents (32/32).
	Proportion of attending staff committing to positive change in professional and personal practice	Online staff feedback survey	≥ 75%	84% of respondents (27/32).
	Themes of learning and commitment to change	Online staff feedback survey	N/A	Themes of learning. For their patients- Brushing: 23%, Sugar:23%, Dentist:18%, General oral care:18%, Toothpaste/fluoride:10%, Offering special OH advice for specific groups of patients:10%, Other:10%. For themselves/their family- Sugar:35%, Brushing:29%, Dentist:12%, Toothpaste/fluoride:9%, General oral care:9%, Other:6%. Commitment to change. For their patients- Offering special OH advice for specific groups of patients:26%, Signposting:23%, Brushing:19%, Dentist:16%, Sugar:6%, Other:6%, Nothing:3%. For themselves/their family- Brushing: 38%, Sugar:31%, Dentist:10%, Other:10%, General oral care:7%, Toothpaste/Fluoride:4%.
	Role, grade and department of attendants	Online booking platform	N/A	Nurse (29%), Doctor/ Consultant (22%), Maternity nurse (19%), Student nurse (16%), Dietetics (10%), Other (4%).

(\*) It was not possible to set out a proportional target as it was not feasible to calculate the denominator given the need to account for specific patient eligibility criteria

(\*\*) It was not possible to set a specific target as it was not feasible to calculate the denominator of all staff due to high staff turnover

**Figure 2** Indicators and other data monitored, and summary of results. KPI, key performance indicators; OH, oral health; PDSA, Plan-Do-Study-Act. IDACI, Income deprivation affecting children index.

essential for any behaviour -B to change), with consideration of MECC principles.<sup>18 25 28 29 38 39</sup>

The three components of the programme are described below.

### Health promotion activities

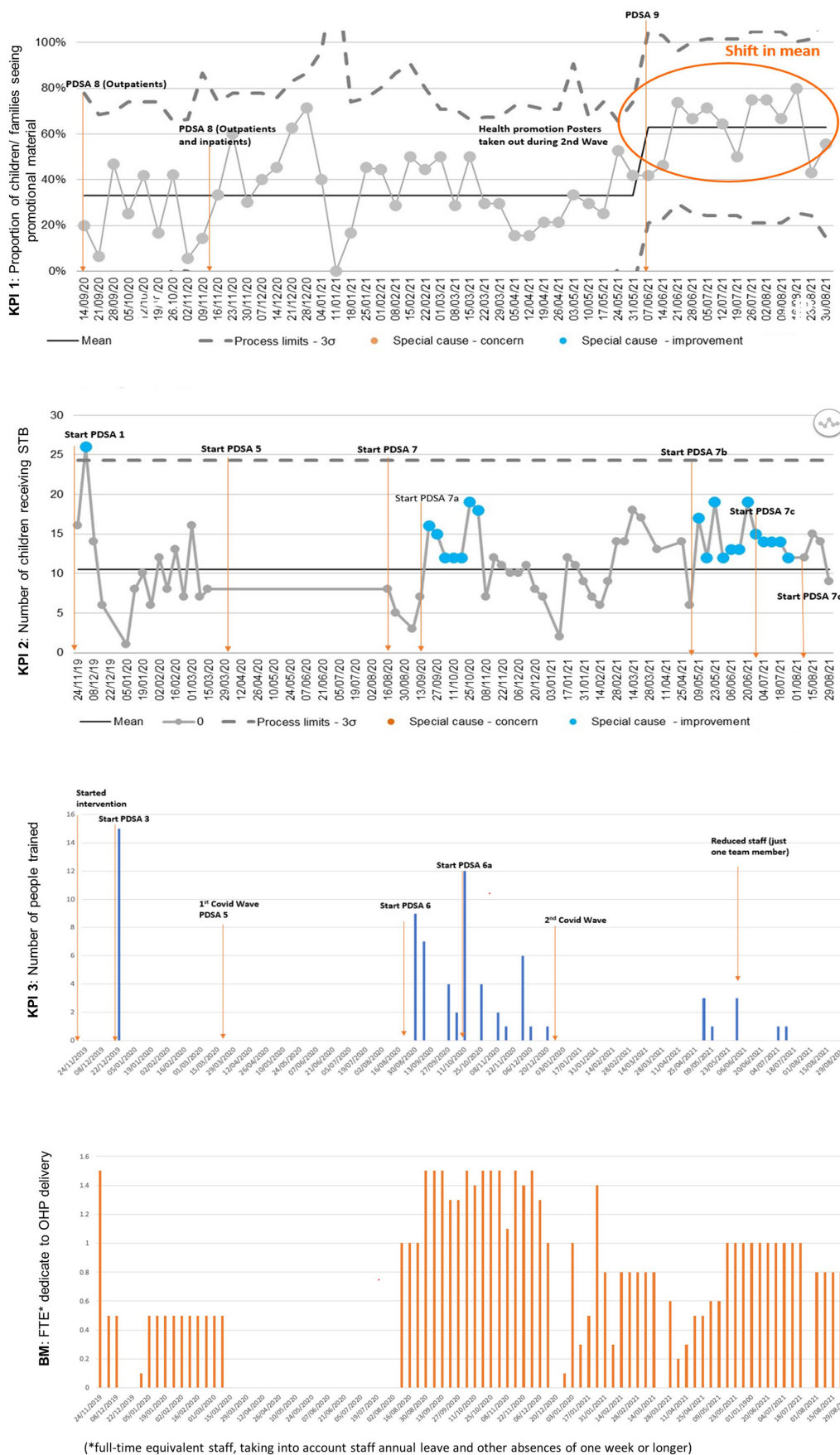
Evidence-based health promotion materials, in the form of videos, posters and bedside information packs, were strategically distributed across paediatric and maternity settings in the hospital. Based on the PHE's 'Change for Life' resources,<sup>40</sup> materials contained information on dental decay epidemiology (to influence perceived susceptibility), information on how to reduce risk of dental decay (to increase the perception of benefits of positive oral health behaviours), and cues for behaviour change, such as recommendations (to reduce consumption of sugary food and drinks).

### Supervised toothbrushing

STB is a brief intervention informed by motivational interviewing (MI) techniques,<sup>41–43</sup> where motivation is a state of preparedness for change rather than an individual personality trait.<sup>44</sup> The primary goal is to facilitate behaviour change by assisting patients to explore and resolve their ambivalence regarding the behaviour change.<sup>45</sup> The purpose of STB was to explore opportunities with children and parents that could self-direct behaviour change, rather than telling them what to do. STB involved: discussing current oral health practices; providing evidence-based information and advice on oral health and safe fluoride use; inviting commitment to positive behaviour change;

overcoming access barriers to behaviour change through provision of oral hygiene materials (eg, toothpaste, toothbrush) to those in need. In addition, patients/carers were signposted to community dental services, where appropriate. STB was delivered by the OHC, who underwent training to be able to accurately deliver the intervention, including signposting to STB framework<sup>46</sup> and e-learning module, for the purpose of quality assurance.

Only where clinically appropriate, STB was opportunistically offered on an individual paediatric in-patient basis. For example, children with eating disorders, gastro issues or an unsafe swallow were not given sugar advice. Face-to-face interaction at the bedside enabled personalised advice, message provision, signposting and facilitated access to paediatric inpatients (<18 years) regardless of the admission reason. The intervention was adapted according to the children's age and health status. For example, school-aged children were given advice on brushing frequency, regular dentist visits, using fluoridated toothpaste and sugar consumption, while parents of children under 1 year were additionally given advice about weaning and the appropriate use of milk bottles. An effort was made to involve children of all ages as much as possible in the STB, however, for children under 7 years old discussion and feedback was always supported by parents. Prior to the COVID-19 pandemic, STB was supplemented by the supervision of patients' toothbrushing on the wards. However, given the risk of aerosol generation, this was switched to a demonstration of good toothbrushing technique on a plastic model mouth.



**Figure 3** KPIs and balancing metric (BM) over time. SPC charts have been used for KPI1 (P-Chart) and KPI2 (XmR chart). KPIs, key performance indicators; PDSA, Plan-Do-Study-Act; SPC, statistical process control; STB, supervised toothbrushing. FTE, Full time equivalent.

## Staff training

Following PHE recommendations,<sup>18</sup> staff in a variety of roles across maternity and paediatric departments at CWFT were invited to attend a 30 min oral health teaching session. Training was designed to promote staff awareness of oral health to improve patient care. Underpinned by the Health Belief Model,<sup>28 29</sup> the teaching aimed to increase staff: understanding of dental disease vulnerability among their patients'; perception of the value of reducing dental disease risk factors; self-efficacy related to caring for patients' dental health.<sup>28</sup> Initial training was delivered by qualified dentist and Public Health Clinical Fellow, along with the OHP coordinator and was based on PHE 'Change for Life' messaging.<sup>40</sup> On account of COVID-19, training moved virtual, live sessions and covered: the burden of disease attributable to dental decay; an overview of the risk factors for dental decay; recommendations for reducing risk of dental decay; positive actions front-line healthcare staff can take to promote positive oral health messages. During the session, staff were shown how to refer patients to dental services and where to find freely available resources to distribute to patients and their families.

## STRATEGY

To improve oral health understanding among paediatric patients and their families, a targeted universalism approach encompassing three interventions was implemented. These were tested and refined by completing a number of formal and informal Plan-Do-Study-Act (PDSA) cycles throughout the programme (online supplemental file).

PDSA cycles 1–4 outline the introduction of the three interventions within the Trust. During this process, learning was collected on intervention refinement (PDSA 1, 3, 6), data issues (PDSA cycle 2/2a and 4), delivery challenges (PDSA 6, 7a–d), and stakeholder preferences (PDSAs 5–7b, c).

The first wave of COVID-19 saw the programme suspended for 5 months (March–August 2020), during which: there was no STB; posters and visual messaging, etc were removed from the wards and public areas due to mandated infection prevention and control measures; no discharge packs were distributed. Staff training was necessarily suspended. KPIs were not collected during this time; however, some staff feedback was gathered (PDSA 5). PDSA cycles 6–9 detail the reintroduction of interventions and capture the changes made to accommodate new restrictions and ongoing learning. For example, the adaptation from in-person staff training to online training (PDSA 6) and the reduced delivery of STB from four intended children's wards to a single 'Covid Safe' children's ward (PDSA 7).

Throughout the project, PDSA cycles and KPI measures were monitored concurrently to investigate changes in the measures and introduce actions and improvements as needed (see the Results section). While many changes

were successful, others were not retained. For example, a new system for identifying eligible patients for STB was trialled but subsequently abandoned as it resulted in fewer patients being identified (PDSA 7c).

## RESULTS

More details about the Results section are presented in online supplemental file and summarised in [figure 2](#).

### Health promotion activities

During the project period, 93 posters were deployed across the hospital site (emergency department (ED), paediatric, maternity), along with animated videos (ED, outpatients). Overall, 41% (233/565) of families recalled seeing OHP materials across the hospital site (KPI1), though those identifying as Asian or Asian British ethnicity were least likely to report this (29.3%) compared with those of white or white British ethnicity (46.0%). The target of 75% for KPI1 was not met. However, the analysis of data over time shows an improvement in KPI1, which increased up to an average of 63% over the last 12 weeks of the programme period.

SPC chart ([figure 3](#)) shows how KPI1 increased after posters were displayed in inpatient wards (PDSA 8), but numbers dropped again on account of COVID-19 wave II when many posters were removed from wards again. Then from the start of June 2021, a shift of the KPI1 mean from 33% to 63% is observed along with reduction in process variability. This shift in the process mean corresponds to the start of PDSA 9, when 40 new posters were added to the wards.

### Supervised toothbrushing

737 children (0–5 years: 50%; 6–10: years 21%, 11–15 years: 25%; 16–18 years: 3%) received STB (KPI2), averaging 11.5 children/week. When considering the diffusion of messaging to siblings (n=946) OHP an estimated 1683 children were reached.

The delivery of STB was heavily influenced by access to wards due to the pandemic and staff time dedicated to the OHP delivery (BM). From September 2020, there was an improvement in the process due to the increase of FTE staff available from 1 to 1.5. In September, KPI2 increased when the bedside proforma was updated to include information prompts for children under 12 months (PDSA 7a) to facilitate the routine delivery of STB to this age group. KPI2 then dropped further between 20 December 2020 and end of February due to holidays, reduction in ward activity and staff sickness. The process improved again in May 2021 when a new schedule for STB was devised (PDSA 7b). KPI2 slightly decreased when a 'dot system' to identify patients suitable for STB was introduced in the ward (PDSA 7c) and then raised again as they went back to manual identification of patients (PDSA 7d).

After the onset of the pandemic, supervision of patients demonstrating brushing their own teeth was suspended to minimise COVID-19 infection risk. A total of 280 children were provided with toothpaste containing fluoride.



Targets concerning the impact of STB on patient and parent/carer knowledge of dental health were met. Ninety-six per cent of children/families (708/737) stated that they learnt something during bedside sessions. The most common theme of learning reported by children/families was around toothbrushing frequency/technique (34%), followed by diet and nutrition (29%). 91% (674/737) of children/families committed to a positive oral health behaviour change, in particular regarding toothbrushing (46%) and diet (30%).

Relating to dental care access, all (100%) of children reporting not regularly seeing a dentist (n=173) were signposted to dental services.

Of the 229/737 children reporting they brushed their teeth less than 2 times per day, 76% (174/229) said that they would start brushing twice daily. Of the 257/737 children stating that they were drinking sugary drinks more than 3 times per week, 54% (140/257) said that they would reduce sugar in their diet. Of 317/737 children stating that they were having sugary foods more than 3 times per week, 69% (218/317) said that they would reduce sugar in their diet.

Of the children receiving STB, 43% lived in postcodes associated with the highest deprivation (quintiles 1 and 2) and 57% identified as belonging to a minority ethnic group, compared with 40% seen in the CWFT catchment population.<sup>47</sup> Those identifying as 'black or mixed ethnicity' were more likely to receive oral hygiene products, compared with those of white ethnicity (57% vs 42%).

### Staff training

From November 2019 to August 2021, 73 staff members (KPI3), including foundation doctors to consultants, nurses, midwives, Allied Health Professionals, received training. Figure 3 shows that before the COVID-19 second wave, only one training session was offered. The number of training sessions increased after the COVID-19 first wave as training resumed with online courses offered every day (PDSA 6). In October 2020, there was an increase in the number of attendees due to the fact that the training booking system process was refined, and training sessions were CPD accredited and advertised within the Trust newsletter (PDSA 6a). Attendance data show that after this change the sessions were attended by a more targeted group of clinicians. Staff training was suspended again during the COVID-19 second wave and lower numbers were registered due to reduced staff availability (1 WTE, rather than 1.5) in the period 31 August 2020–3 January 2021 (BM). Targets about learning and commitment to positive change were fully reached. All respondents (32/32) reported learning something new, particularly in terms of their own personal/family's care. The main reported areas of learning for their patient versus their own care were around: diet (23% vs 35%) and toothbrushing practice (23% vs 29%). 84% (27/32) of staff reported that they would do things differently, predominantly regarding offering targeted OH advice

for specific patient groups, such as for children with additional needs (eg, unsafe swallow, autism) (26%), signposting (23%) and brushing (19%), while for themselves and their family around brushing (38%) and sugar intake (31%).

### Data completeness

It was not possible to achieve 100% data completeness. Missing data included: postcode data (to assign small area deprivation measure in form of IMD) for 4% (33/737) patients; OH behaviour data for 23% (168/737) of patients; lessons learnt or behaviour commitments for 4% (26/737) and 8% (56/737) of patients respectively.

For KPIs (figure 3), data gaps were mainly observed during periods of staff absence or enhanced infection control limits. KPI1 data absence, noted in early programme phases, was attributable to late addition of questions to the bedside survey (on 7 September 2020).

Conscious of potential bias due to data completeness, all analyses have been performed with omission of missing data as in this study measurement was used to monitor progress and not to provide definitive statements on the intervention effectiveness.

### LESSONS AND LIMITATIONS

The OHP delivery was significantly impacted by the COVID-19 pandemic. Some interventions were interrupted, reduced or eliminated, while others were delivered differently. This revealed the flexibility of programme delivery in order to adapt to unforeseen and uncontrollable circumstances.

The application of three different interventions to OH prevention and promotion increased programme resilience. Strengths of the programme included its foundation in evidence and behavioural theory and its delivery in an acute hospital setting where access to groups at higher risk of poor oral health outcomes was facilitated. Moreover, the use of MI techniques allowed health practitioners to customise their intervention to the patient's level of readiness for change. This technique also has the potential to increase patient and practitioner satisfaction while promoting health behaviour change.<sup>48</sup> With MI, patients are more likely to feel heard and understood by their health practitioner.<sup>48</sup> Finally, collecting data on the patient demographic characteristics helped paint a holistic picture of the population reached by this programme, which was used to enhance services and identify inequalities which can directly be addressed by the hospital staff.

A number of programme weaknesses need to be considered. First, the dependence on primarily a single member of staff for frontline service delivery: even with increased resource, opportunities for children to receive OHP were missed due to staff unavailability, including but not limited to weekends. In May 2022, oral health assessment become part of the mandatory admission pack completed for each admission to CWH. This reinforces

the rationale for OHP and supports its ongoing delivery and sustainability. Increasing staff receiving training is also a key step towards sustaining knowledge and scaling the programme in the future. Having a wide and diverse staff base to deliver messaging would decrease the risk of having single members of staff delivering the intervention. Future work is needed to explore the potential for programme sustainability including potential improvements and adaptations to ensure long-term benefits from this initiative.

Second, is the use of proxy measurement to assess patient/family and clinician behaviour change. Although all respondents to the post-training survey indicated that they learnt something new for their patients and most clinicians (84%) and patients (91%) committed to a positive behavioural change, the actual change in behaviour could not be measured. Instead, self-reported behavioural intention was used as a proxy for realised behaviour change. This is, however, considered a valid proxy measure, with studies in different clinical settings reporting a statistically significant correlation between intended and actual behaviour change among both clinicians and patients.<sup>49–51</sup> Further, using self-reported point-in-time measures is relatively quick, cost-effective and easy compared with observing actual behaviour over time and is shown to be particularly suitable when the design of the change intervention is evidence based.<sup>52 53</sup>

Third is the inability to assess longer-term outcome measures. This was due to challenges associated with patient follow-up after discharge, resource scarcity and delays associated with ethical approval. As a consequence, it was not possible to examine whether staff, children and their families put in practice the desired behaviour change or whether signposted children ultimately attended a dentist appointment, or what the outcome of this visit was. This also prevented the determination of which programme components were most/least effective in producing the long-term desired behaviour change.

Finally, no suitable, validated surveys were readily available, and resource constraints did not allow to conduct the validation process. The questionnaire used within this study may serve as a helpful baseline for future validation efforts as the programme scales up.

Despite these limitations, the approach enabled an evaluation of the three strands of an evidenced targeted-universalism approach by monitoring process and BM. These were used to assess and modify the interventions to continually improve design and delivery to maximise potential patient outcomes. Other limitations are related to missing data as described above and to the difficulty to monitor some data which would have helped to build more robust indicators.

If this programme was to be enhanced or rolled out further, actions to enable measurement of impact should be taken, for example, by securing funding for a longer-term cohort study. Future evaluation could be strengthened by obtaining necessary ethical approval to enable data collection of specific outcome measures and to

explore the experience of the OHP patients following discharge, including actions taken by participants following the intervention. This would enable a better understanding of the long-term effectiveness of the OHP and support service adaptation to improve the experience. Specific measures related to the uptake of dental services could also provide further insight into the broad impact of this work. In terms of resourcing, the mechanisms that allow for more flexibility in service delivery could also be anticipated. For example, the intervention could be designed to promptly switch from face-to-face to online delivery or to allow for flexible staffing. Moreover, activity on emergency admission wards could be prioritised to improve service equity, given higher emergency service use by those living in more deprived areas and in ethnic minority groups.<sup>54</sup> Finally, more attention would be paid to the design and distribution of health promotion material to increase accessibility to ethnic minority groups.

Challenges with poor paediatric oral health and inequity of access to dental services are not limited to the CWFT catchment area, but are seen across the country and internationally.<sup>1–7 13</sup> Key programme components and learning from this improvement project can be applied and adapted to other NHS hospitals and worldwide as the evidence base underpinning the programme has relevance in many settings. For example, while most hospitals in the UK are not paediatric and maternity specialist centres, many hospitals do function within acute trusts and the vast majority will have some form of paediatric ward/service where oral health promotion can be delivered.

## CONCLUSION

Implementation of just the STB component of the OHP programme from September 2019 to August 2021 in a ‘non-traditional’ health promotion and prevention setting directly reached 737 children (1683 if taking siblings into account) and their families, 43% of which lived in areas associated with high deprivation. Moreover, the programme allowed to reach children that wouldn’t be reached by school programmes (50% of children seen for STB were under 5 years old). Results suggest that a hospital-based opportunistic OHP is potentially an effective and equitable way to improve patient, family and staff knowledge of good oral health practices and encourage participants to consider positive behaviour change. This approach allowed for proactive messaging to be offered to all children and carers attending the hospital, including those who are there for health conditions other than tooth decay.

However, the programme has also demonstrated the constraints posed by the hospital environment on disease prevention or HPA, including competing service pressures, staffing issues and external shocks (eg, COVID-19). Another challenge is related to limited mechanisms to allow for follow-up of individual patients to assess



down-stream impact. Future programmes should consider the need for flexible and resilient health systems along with rigorous evaluations to support more robust in-hospital oral health promotion services, for example, impact of the OHP on dental decay rates.

This programme has initially demonstrated that how a paediatric hospital-based OHP can be accessed in a broadly equitably way, suggesting its value as a form of targeted universalism. In turn, this could help reduce pressure on the NHS and other health systems worldwide through targeted and evidenced prevention approaches, though would require the resources for longitudinal follow-up study to confirm findings. A third year of funding was awarded in 2021 to continue OHP delivery at CWH for a further year, and data from this programme continue to be collected for future evaluation. There are also plans to rollout OHP to other hospital sites in the region, as well as services including maternity and older adults.

**Twitter** Grazia Antonacci @graziantonacci and Laura Lennox @lauralennox3

**Acknowledgements** We acknowledge the Public Health Department for the Royal Borough of Kensington and Chelsea, the City of Westminster, Public Health England (London), and Chelsea and Westminster Hospital NHS Foundation Trust in funding and co-developing the Oral Health Programme.

**Contributors** Conceptualisation: SC-C; methodology: SC-C, SR, GA and LL; data curation: GA, LA; formal analysis: GA and SR; validation: LL; investigation: LA; writing—original draft: GA, SR, LL and SC-C; writing—review and editing: GA, SR, LL, LA and SC-C; visualisation: GA; Supervision: SC-C. All authors approved the final submitted manuscript; Guarantor: SC-C.

**Funding** The collaborative oral health programme bought together: Chelsea and Westminster Hospital NHS Foundation Trust (CWFT), the Bi-borough Department of Public Health - Westminster City Council (WCC), Royal Borough of Kensington and Chelsea (RBKC), and Public Health England (London), and was commissioned by the Bi-borough Department of Public Health. This evaluation is independent research supported by the National Institute for Health and Care Research (NIHR) Applied Research Collaboration (ARC) Northwest London. The views expressed in this publication are those of the author(s) and not necessarily those of the NHS, the NIHR, the Department of Health and Social Care, WCC; RBKC, Public Health England (London), or CWFT. No award/grant number.

**Competing interests** None declared.

**Patient and public involvement** Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

**Patient consent for publication** Not applicable.

**Ethics approval** This study involves human participants but ethics approval was not required as it was a service evaluation of a quality improvement project, and no patient identifiable data were included in the analyses.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** Data are available on reasonable request.

**Supplemental material** This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

**Open access** This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is

properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

## ORCID iDs

Grazia Antonacci <http://orcid.org/0000-0001-7742-8003>

Sophie Coronini-Cronberg <http://orcid.org/0000-0002-7932-8388>

## REFERENCES

- 1 Urquhart O, Tampi MP, Pilcher L, *et al*. Nonrestorative treatments for caries: systematic review and network meta-analysis. *J Dent Res* 2019;98:14–26.
- 2 George A, Sousa MS, Kong AC, *et al*. Effectiveness of preventive dental programs offered to mothers by non-dental professionals to control early childhood dental caries: a review. *BMC Oral Health* 2019;19.
- 3 Petersen PE. Sociobehavioural risk factors in dental caries—international perspectives. *Commun Dent Oral Epidemiol* 2005;33:274–9. 10.1111/j.1600-0528.2005.00235.x Available: <http://www.blackwell-synergy.com/toc/com/33/4>
- 4 Dülgergil Ç, Dalli M, Hamidi M, *et al*. Early childhood caries update: a review of causes, diagnoses, and treatments. *J Nat Sc Biol Med* 2013;4:29.
- 5 Kumarihamy SL, Subasinghe LD, Jayasekara P, *et al*. The prevalence of early childhood caries in 1-2 yrs olds in a semi-urban area of Sri Lanka. *BMC Res Notes* 2011;4:336.
- 6 Prowse S, Schroth RJ, Wilson A, *et al*. Diversity considerations for promoting early childhood oral health: a pilot study. *Int J Dent* 2014;2014:175084.
- 7 Smith L, Blinkhorn A, Moir R, *et al*. An assessment of dental caries among young Aboriginal children in New South Wales, Australia: a cross-sectional study. *BMC Public Health* 2015;15:1314.
- 8 PHE. Chapter 4: health of children in the early years. PHE; 2018. Available: <https://www.gov.uk/government/publications/health-profile-for-england-2018/chapter-4-health-of-children-in-the-early-years/oral-health>
- 9 PHE. Launch of the children's oral health improvement programme board. 2016. Available: <https://www.gov.uk/government/news/launch-of-the-childrens-oral-health-improvement-programme-board> [Accessed 10 Oct 2019].
- 10 PHE. Oral health survey of 5 -year-old children 2019. 2020. Available: <https://www.gov.uk/government/statistics/oral-health-survey-of-5-year-old-children-2019> [Accessed 9 Oct 2022].
- 11 PHE. Child oral health: applying all our health. 2022. Available: <https://www.gov.uk/government/publications/child-oral-health-applying-all-our-health/child-oral-health-applying-all-our-health> [Accessed 9 Oct 2022].
- 12 BBC. Full extent of NHS dentistry shortage revealed by far-reaching BBC research. Available: <https://www.bbc.co.uk/news/health-62253893> [Accessed 8 Aug 2022].
- 13 PHE. Child and maternal health. 2021. Available: <https://fingertips.phe.org.uk/profile/child-health-profiles/data#page/0/gid/1938133223/pat/6/par/E12000007/ati/302/are/E09000018/yr/1/cid/4/tbm/1/page-options/car-do-0> [Accessed 31 May 2022].
- 14 Chelsea and Westminster Hospital NHS Foundation Trust. Children's services. 2019. Available: <https://www.chelwest.nhs.uk/services/childrens-services> [Accessed 15 Oct 2019].
- 15 Chelsea and Westminster Hospital NHS Foundation Trust. A picture of health. profile of our trusts's local population. 2020. Available: <https://www.chelwest.nhs.uk/about-us/links/Full-Report-A-Picture-of-Health-Sep-2020.pdf> [Accessed 31 May 2022].
- 16 Hospital Episode Statistics (HES), Getting it Right First Time - CWFT Hospital Dentistry Review. London: NHS Improvement, 2017.
- 17 National Institute for Health and Care Excellence (NICE), "Oral health promotion in the community. Quality standard [QS139]". 2016. Available: <https://www.nice.org.uk/guidance/qs139> [Accessed 31 May 2022].
- 18 PHE. Local authorities improving oral health: commissioning better oral health for children and young people. An evidence-informed toolkit for local authorities. 2014. Available: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/321503/CBOHMaindocumentJUNE2014.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/321503/CBOHMaindocumentJUNE2014.pdf) [Accessed 31 May 2022].
- 19 PHE. Health matters: child dental health. 2017. Available: <https://www.gov.uk/government/publications/health-matters-child-dental-health/health-matters-child-dental-health> [Accessed 21 Oct 2019].
- 20 Harris R, Nicoll AD, Adair PM, *et al*. Risk factors for dental caries in young children: a systematic review of the literature. *Community Dent Health* 2004;21(1 Suppl):71–85.

- 21 NHS. The NHS long term plan. 2019. Available: <https://www.longtermplan.nhs.uk/publication/nhs-long-term-plan> [Accessed 10 Oct 2019].
- 22 PHE, “. Launch of the children’s oral health improvement programme board. 2016. Available: <https://www.gov.uk/government/news/launch-of-the-childrens-oral-health-improvement-programme-board> [Accessed 10 Oct 2019].
- 23 Department for Education, “Relationships Education, Relationships and Sex Education (RSE) and Health Education. London: Department for Education, 2019.
- 24 PHE. Phe strategy 2020 to 2025. 2019. Available: <https://www.gov.uk/government/publications/phe-strategy-2020-to-2025> [Accessed 10 Oct 2019].
- 25 Health Education. Making every contact count. Available: <https://www.makingeverycontactcount.co.uk> [Accessed 28 Jan 2020].
- 26 PHE. Improving the oral health of children: cost effective commissioning. 2016. Available: <https://www.gov.uk/government/publications/improving-the-oral-health-of-children-cost-effective-commissioning> [Accessed 7 Mar 2020].
- 27 Ghaffari M, Rakhshanderou S, Ramezankhani A, *et al.* Are educating and promoting interventions effective in oral health?: a systematic review. *Int J Dent Hyg* 2018;16:48–58.
- 28 Champion VL, Skinner CS. The health belief model health behavior and health education: theory, research, and practice. 2008;4:45–65.
- 29 Janz NK, Becker MH. The health belief model: a decade later. *Health Educ Q* 1984;11:1–47.
- 30 Blair Y, Macpherson L, McCall D, *et al.* Dental health of 5-year-olds following community-based oral health promotion in Glasgow, UK. *Int J Paediatr Dent* 2006;16:388–98.
- 31 Shen A, Bernabé E, Sabbah W. Systematic review of intervention studies aiming at reducing inequality in dental caries among children. *Int J Environ Res Public Health* 2021;18:1300.
- 32 Ministry of Housing, Communities & Local Government. English indices of deprivation 2015. 2015. Available: <https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015> [Accessed 20 Jan 2020].
- 33 NHS Institute for Innovation and Improvement. The how-to guide for measurement for improvement. 2008. Available: <https://www.england.nhs.uk/improvement-hub/wp-content/uploads/sites/44/2017/11/How-to-Guide-for-Measurement-for-Improvement.pdf> [Accessed 20 Jan 2023].
- 34 Agency for Healthcare Research and Quality,. Types of health care quality measures. 2015. Available: <https://www.ahrq.gov/talkingquality/measures/types.html> [Accessed 20 Jan 2023].
- 35 Mohammed MA. Using statistical process control to improve the quality of health care. *Quality and Safety in Health Care* 2004;13:243–5.
- 36 NHS English. Statistical process control tool. Available: <https://www.england.nhs.uk/statistical-process-control-tool> [Accessed 8 Aug 2022].
- 37 Reed JE, McNicholas C, Woodcock T, *et al.* Designing quality improvement initiatives: the action effect method, a structured approach to identifying and articulating programme theory. *BMJ Qual Saf* 2014;23:1040–8.
- 38 Michie S, van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implement Sci* 2011;6:42.
- 39 de Normanville C, Payne K, Ion V. Making every contact count: the prevention and lifestyle behaviour change competence framework. *The International Journal of Health, Wellness, and Society* 2011;1:227–38. 10.18848/2156-8960/CGP/v01i02/41163 Available: <https://cgscholar.com/bookstore/works/the-international-journal-of-health-wellness-and-society-vol-1-issue-2-2011>
- 40 PHE. Change4Life. 2021. Available: <https://campaignresources.phe.gov.uk/resources/campaigns/17-change4life/resources> [Accessed 31 May 2022].
- 41 Pine CM, Adair PM, Burnside G, *et al.* Dental recur randomized trial to prevent caries recurrence in children. *J Dent Res* 2020;99:168–74.
- 42 Emmons KM, Rollnick S. Motivational interviewing in health care settings. *Opportunities and Limitations Am J Prev Med* 2001:68–74.
- 43 Freudenthal JJ, Bowen DM. Motivational interviewing to decrease parental risk-related behaviors for early childhood caries. *J Dent Hyg* 2010;84:29–34.
- 44 Miller WR. Motivational interviewing with problem drinkers. *Behav Psychother* 1983;11:147–72.
- 45 Rollnick SR, Miller WR. What is motivational interviewing? *Behav Cogn Psychother* 1995;23:325–34.
- 46 PHE, “. Improving oral health: a toolkit to support commissioning of supervised toothbrushing programmes in early years and school settings. Available: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/574835/PHE\\_supervised\\_toothbrushing\\_toolkit.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/574835/PHE_supervised_toothbrushing_toolkit.pdf) [Accessed 20 Jan 2020].
- 47 NHS. Core20PLUS5 – an approach to reducing health inequalities for children and young people". [ online ]. available: NHS England » core20plus5 – an approach to reducing health inequalities for children and young people. n.d.
- 48 Britt E, Hudson SM, Blampied NM. Motivational interviewing in health settings: a review. *Patient Educ Couns* 2004;53:147–55.
- 49 Godin G, Kok G. The theory of planned behavior: a review of its applications to health-related behaviors. *Am J Health Promot* 1996;11:87–98.
- 50 Armitage CJ, Conner M. Efficacy of the theory of planned behaviour: a meta-analytic review. *Br J Soc Psychol* 2001;40(Pt 4):471–99.
- 51 Eccles MP, Hrisos S, Francis J, *et al.* Do self- reported intentions predict clinicians’ behaviour: a systematic review. *Implement Sci* 2006;1:28.
- 52 Eccles M, Grimshaw J, Walker A, *et al.* Changing the behavior of healthcare professionals: the use of theory in promoting the uptake of research findings. *J Clin Epidemiol* 2005;58:107–12.
- 53 Improved Clinical Effectiveness through Behavioural Research Group (ICEBeRG). Designing theoretically-informed implementation interventions. *Implement Sci* 2006;1:4.
- 54 Warner M, Burn S, Stoye G, *et al.* Socioeconomic deprivation and ethnicity inequalities in disruption to NHS hospital admissions during the COVID-19 pandemic: a national observational study. *BMJ Qual Saf* 2022;31:590–8. 10.1136/bmjqs-2021-013942 Available: <https://qualitysafety.bmj.com/content/early/2021/11/24/bmjqs-2021-013942>