NHS Education for Scotland

Scottish Dental Clinical Effectiveness Programme

Prevention and Management of Dental Caries in Children

Guidance Update Methodology

April 2025

Scottish Dental Clinical Effectiveness Programme

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Contents

1 Overview of the SDCEP guidance update process

Prevention and Management of Dental Caries in Children was first published in 2011 and was fully updated 2018 following SDCEP's NICE-accredited guidance development process. The methodology was documented in the SDCEP Prevention and Management of Dental Caries in Children Guidance Development Methodology (2018). In line with SDCEP's standard five-year guidance review period, a scheduled review of the guidance topic commenced in Spring 2023 and was conducted as follows:

- A scoping survey was conducted to inform the potential development of an update to the SDCEP Prevention and Management of Dental Caries in Children - second edition guidance. A summary report of this survey is provided in Appendix 1.
- A Guidance Development Group (GDG) was convened (see Appendix 2).
- Feedback on the guidance was sought from GDG members and some GDG members provided more-detailed feedback on certain sections of the guidance.
- A surveillance review was carried out to assess whether there were any developments in the topic or changes in the evidence base that would impact on the guidance recommendations and inform any updating required. The surveillance review incorporated stakeholder feedback from the scoping survey and GDG. A report of the surveillance review is provided in Appendix 3. The surveillance review concluded that while a full update of the guidance was not required, there was a need to update certain aspects of the guidance, indicating that a more focused approach was suitable.
- Based on the surveillance review, evidence relating to selected aspects of the guidance was summarised as discussion points (see Section 2).
- The surveillance review report and evidence summaries were shared with the GDG, which subsequently met to debate the discussion points and agree amendments to those aspects of the guidance identified as in need of updating. This is documented in Appendix 4.
- The guidance content was updated based on the decisions of the GDG.
- Targeted external peer review of the draft updated guidance was carried out in October 2024 (see Section 3). All peer reviewer comments were considered, and the guidance amended accordingly prior to publication.

2 Discussion points

A list of discussion points was developed based on areas for potential updating that were identified through surveys of practitioners and previous GDG members, by the surveillance review and a review of the second edition of the guidance by several current GDG members. For each discussion point, one of these alternative approaches was adopted as noted in Table 1.

- **Considered judgement** – this approach applied when it seemed likely that a key recommendation might change, or a new key recommendation might be required. Details

of the considered judgement approach is provided in the SDCEP Prevention and Management of Dental Caries in Children Guidance Development Methodology (2018).

- **Evidence summary** – this approach was used when there was a change in evidence from that previously cited or the emergence of new evidence which might impact on the clinical advice points but not a key recommendation.
- **Updated text proposed** – this approach was used when it appeared clear what change to the guidance text was required. This mainly related to contextual information or terminology.

Table 1. Discussion points

Discussion point	Approach
DP1 Promoting UNCRC	Updated text proposed for Introduction and Providing additional support
DP2 Promoting realistic dentistry	Updated text proposed for Introduction
DP3 Promoting sustainability	Updated text proposed for Introduction
DP4 Caries detection devices and systems	Evidence summary (see Appendix 4.1)
DP5 Obesity as a caries risk factor	Evidence summary (see Appendix 4.2)
DP6 Caries risk assessment tools	Evidence summary (see Appendix 4.3)
DP7 Vital pulp therapies in permanent teeth	Considered judgement (see Appendix 4.4)
DP8 Sugar-free medicine	Evidence summary (see Appendix 4.5)
DP9 Fissure sealant application based on age and risk	Evidence summary (see Appendix 4.6)
DP10 Fluoride varnish application based on age and risk	Evidence summary (see Appendix 4.7)
DP11 Efficacy of fluoride varnish vs fissure sealants	Considered judgement (see Appendix 4.8)
DP12 Use of silver diamine fluoride for caries prevention & treatment	Considered judgement (see Appendix 4.9)
DP13 Types of lesion suitable for no caries removal and fissure seal	Evidence summary (see Appendix 4.10)
DP14 Resin infiltration for white spot lesions	Evidence summary (see Appendix 4.11)
DP15 Selective or stepwise caries removal in permanent teeth	Evidence summary (see Appendix 4.12)
DP16 Age for first permanent molars of poor prognosis	Updated text proposed for First permanent molars of poor prognosis to align with RCSE guideline

Discussion point	Approach
DP17 First permanent molars extraction & balancing	Updated text proposed for First permanent molars of poor prognosis to align with RCSE guideline
DP18 Molar incisor hypomineralisation	Evidence summary (see Appendix 4.13)
DP19 Remineralisation	Evidence summary (see Appendix 4.14)
DP20 Use of pre-formed metal crowns on FPMs of poor prognosis	Evidence summary (see Appendix 4.15)
DP21 Use of atraumatic restorative technique	Evidence summary (see Appendix 4.16)
DP22 Local anaesthesia	Updated text proposed for Local anaesthesia citing sources of further information
DP23 Providing additional support	Updated text proposed for Providing additional support to reflect current child protection guidelines, citing and aligning with UNCRC

Appendix 4 provides details of considered judgments and evidence summaries for discussion points as indicated in Table 1.

3 Peer review

Topic experts were invited to contribute to targeted external peer review in October 2024, by providing feedback on the draft updated guidance, with a focus on the significant changes. They were also asked to provide any other relevant feedback. The 11 peer reviewers (see Appendix 5) who provided feedback represented a range of relevant dental expertise and experience. Some of the peer reviewers also had knowledge of guidance methodology. The peer reviewers were asked to declare any interests.

All peer reviewer comments were considered, and the guidance amended accordingly prior to publication.

4 Conflicts of interest

All contributors to SDCEP, including members of the GDG and external peer reviewers, are required to complete an SDCEP Declaration of Interests form to disclose relevant interests including financial conflicts of interest, such as receipt of fees for consulting with industry, and intellectual conflicts of interest, such as publication of original data bearing directly on a recommendation. These forms are held by SDCEP, updated yearly and details are available on request. At the beginning of each group meeting during guidance development, participants are asked to confirm whether there are any changes to their Declaration of Interests.

Declared interests which could have potentially constituted a conflict of interest were considered by the SDCEP Programme Development Team (PDT) and the GDG chairs to decide whether and how the extent of the individual's participation in the guidance development should be limited (e.g. exclusion from certain decisions or stages, or complete withdrawal).

Further information on SDCEP's approach to conflicts of interest is available in the SDCEP Guidance Development Process Manual (version 3.0, May 2024).

Summary of disclosures

All of the GDG members, peer reviewers and members of the SDCEP PDT completed and returned the Declaration of Interests form.

Paid and unpaid professional roles relating to the provision of dental care for children or education were not considered to be a conflict of interests. Several group members and peer reviewers declared membership of committees or societies related to their healthcare roles, but this was also considered unlikely to lead to a conflict of interest.

None of the SDCEP PDT members had any interests likely to constitute a conflict with regards to the updating of the guidance.

Nine of the 20 GDG members and five of the 11 peer reviewers declared one or more financial interests relevant to the guidance topic which could potentially cause, or be perceived to cause, conflicts of interest:

1. One co-chair declared non-commercial grant funding for research related to the guidance topic.
2. One co-chair declared a consultancy fee from a commercial company in relation to oral hygiene products.
3. Two GDG members declared consultancy or lecture fees from commercial companies in relation to oral hygiene products.
4. A GDG member and a peer reviewer declared financial support for conference attendance.
5. A GDG member declared receipt of payment for participation in non-commercially funded research studies relating to caries management approaches.
6. Two GDG members and two peer reviewers declared research grants that include funding from commercial companies that produce oral hygiene products or dental restorative materials.
7. One peer reviewer providing feedback on behalf of a professional society declared that the society has corporate membership for commercial companies that produce dental products.
8. Two GDG members and a peer reviewer declared non-commercial grant funding for research related to the guidance topic.

Consideration of potential to cause conflict(s) of interest:

1. & 8. The guidance recommendations are unlikely to lead to financial benefit or loss in relation to non-commercially funded research grants, therefore not considered a conflict of interest.

2. & 3. While potentially direct financial interests, the second edition of the guidance does not make recommendations about specific brands of oral hygiene products and the third edition is not expected to either. Therefore, unlikely to lead to a conflict of interest.

4. Financial support to attend a conference, which is not over and above funding to support reasonable travel, accommodation and attendance costs, is not considered a conflict of interest.

5. Participation in ongoing, non-commercially funded research trials on caries management approaches is not considered a conflict of interest.

6. The second edition of the guidance does not make recommendations about specific brands of oral hygiene products or dental restorative materials and the third edition is not expected to either. Therefore, the guidance recommendations are unlikely to have a specific financial impact for the commercial funders and so receipt of research grants with commercial funding is unlikely to lead to a conflict of interest.

7. The second edition of the guidance does not make recommendations about specific brands of dental products and the third edition is not expected to either. Therefore, the guidance recommendations are unlikely to have a specific financial impact for the corporate members of the professional society and so the corporate membership is judged unlikely to lead to a conflict of interest.

Decision on the management of the potential conflict(s) of interest:

As the declared interests 1, 4, 5 & 8 were not considered to cause conflicts of interest, it was agreed that no specific action was required. Declared interests 2, 3, 6 &7 were judged unlikely to cause a conflict of interest but were kept under review during the guidance updating. In the event that recommendation of any specific oral hygiene products or dental materials was under consideration by the GDG, the participation of the individual in those decisions would have been reconsidered. All GDG members were notified that if at any point in the guidance development they felt that their impartiality could be affected, then they should raise this within a meeting and/or contact SDCEP or the group chair to advise of this.

5 Equality impact assessment for this guidance

The possibility of inequalities associated specifically with the Prevention and Management of Dental Caries in Children guidance was considered at various stages during development of the second edition. Potential issues were identified through discussions with guidance development group members, practitioners and patients and from feedback from the external consultation and

peer review, as summarised in the SDCEP Prevention and Management of Dental Caries in Children Guidance Development Methodology (2018).

Potential inequalities were again considered throughout the guidance updating for the third edition, with input from GDG members and peer reviewers. While no issues likely to lead to direct or indirect discrimination or disadvantaging of any specific group were identified, some additions were made to the guidance to further promote inclusivity. Further details of the points noted and specific actions taken are recorded in an EQIA checklist which is available on request.

6 Sustainability considerations for this guidance

While the potential environmental impact of the recommendations and clinical advice was noted during the updating of the guidance, this did not directly inform the considered judgement process. The GDG is conscious that prevention of oral diseases is one of the most powerful means of reducing the environmental impact of oral healthcare. A section communicating this and other sustainability messages is included within the guidance introduction.

7 Future updating

A review of the context of this guidance (e.g. regulations, legislation, trends in working practices, evidence) will take place five years after publication and, if this has changed significantly, the guidance will be updated accordingly.

Appendix 1 Scoping Survey Report

Prevention and Management of Dental Caries in Children

Translation Research in a Dental Setting (TRiaDS): Scoping Survey

A scoping survey was conducted in February – April 2023 to inform the potential development of an update to the SDCEP Prevention and Management of Dental Caries in Children guidance.

Aims of the survey

The survey aimed to:

- explore how the 2018 edition of the guidance was being used in practice;
- identify barriers to implementing the guidance;
- establish whether there was any new evidence or relevant developments;
- capture views of guidance users regarding content and layout.

Method

- Sample and recruitment:
  - Dental practitioners in the General Dental Service (GDS), undergraduate dental students in Scotland, the Scottish Vocational Dental Practitioners, the Childsmile team and members of the British Society of Paediatric Dentistry (BSPD) were contacted by email via the NES Portal and local networks.
- Data collection:
  - Online survey hosted on Questback, which included questions related to:
    - current usage and knowledge of the guidance;
    - barriers to implementing the guidance re: clinical assessment, caries prevention and caries management;
    - new evidence or relevant developments re: clinical assessment, caries prevention and caries management;
    - content and layout re: clinical assessment, caries prevention and caries management;
    - demographics: age, gender, role, geography, work setting.
- Data analysis:
  - Descriptive statistics and thematic analysis were used to analyse the data.

Results

- Sixty-three participants:
  - 74% female, 23% male, 3% prefer not to say.
  - 64% Scotland, 23% England, 9% Wales, 4% other, 0 Northern Ireland.
  - 34% GDS, 28% Public Dental Service (PDS), 26% Hospital Dental Service, 8% Community Dental Service, 3% undergraduate.
  - Age: 45% 26-35, 39% 36-50, 16% over 50.

  - 31% associate dentist, 23% PDS dentist, 12% hospital registrar, 12% other, 8% principal dentist, 7% consultant, 3% undergraduate, 3% dental core trainee.
  - 97% reported they were aware of the guidance.
- The majority of participants reported they used the guidance "often" or "always" for assessment and planning (77%), prevention (77%) and caries management (79%).
- Barriers: time, remuneration, NHS pressures, patient and parental engagement and cooperation, access to dental services.
- New evidence or relevant developments: silver diamine fluoride, updated guidance on Molar Incisor Hypomineralisation and the management first permanent molars of poor prognosis, Minimally Invasive Dentistry, dental erosion, the BSPD's position statement on obesity.
- Content and layout: generally positive – clear and visual, good use of images and colour. Negative comments about length of the guidance – too wordy, not always relevant.

Conclusions

This study:

- identified areas of new evidence and clinical developments;
- provided insight into practitioners' use and views of the current guidance;
- provided a framework for a surveillance study prior to a guidance update.

Appendix 2 The Guidance Development Group

A Guidance Development Group (GDG) comprising individuals from a range of relevant branches of the dental profession was convened for the focused update of this guidance.

Name	Role
Chris Deery (Co-chair)	Professor of Paediatric Dentistry, University of Sheffield
Nicola Innes (Co-chair)	Professor of Paediatric Dentistry; Honorary Consultant in Paediatric Dentistry; Head of School of Dentistry & Interim Head of School of Healthcare Sciences, University of Cardiff
Lorraine Arnot	General Dental Practitioner, Montrose, Dental Adviser, NHS Education for Scotland
Paul Ashley	Professor of Paediatric Dentistry, Academic Lead Paediatric Dentistry, UCL Eastman Dental Institute
Avijit Banerjee	Professor of Cariology & Operative Dentistry / Hon Consultant, Restorative Dentistry, Faculty of Dentistry, Oral & Craniofacial Sciences, King's College London; Guy's & St. Thomas' Hospitals Trust, London, UK
Brett Duane	Associate Professor in Dental Public Health, Trinity College, Dublin
Alex Keightley	Consultant in Paediatric Dentistry, NHS Lothian
Nicole Kettles	General Dental Practitioner, Kirriemuir
Peter King	Childsmile Programme Manager
Maxine Lee	BSc Programme Lead, Dundee Dental Hospital and School
Helen Lodge	Dental Nurse, Bicester, Oxfordshire
Heather Lundbeck	Clinical Lecturer in Paediatric Dentistry, Cardiff University
Zoe Marshman	Professor/Honorary Consultant of Dental Public Health, University of Sheffield; Academic Director of the Oral and Dental Directorate of Sheffield Teaching Hospitals NHS Foundation Trust

Catherine McCann	Honorary Consultant and Clinical Lecturer in Paediatric Dentistry, Dundee Dental Hospital and School
Jayne Owen	Speciality Doctor in Paediatric Dentistry, University Hospitals Bristol
Christine Park	Senior Clinical lecturer/ Honorary Consultant in Paediatric Dentistry, Glasgow Dental Hospital & School
Laurie Powell	General Dental Practitioner, Bicester, Oxfordshire
Gillian Richardson	Consultant in Paediatric Dentistry NHS Greater Glasgow & Clyde; Honorary Clinical Senior Lecturer, University of Glasgow
Miranda Steeples	President British Society of Dental Hygiene and Therapy
Greig Taylor	NIHR Clinical Lecturer/Specialist in Paediatric Dentistry, School of Dental Sciences, Newcastle University

Members of the GDG for the development of the second edition of the guidance, which included two patient representatives, are listed in SDCEP Prevention and Management of Dental Caries in Children Guidance Development Methodology (2018).

Appendix 3 Surveillance Review Report

Prevention and Management of Dental Caries in Children

Dental Clinical Guidance

Surveillance Review Report - November 2023*

Surveillance Review Report Contents

* The version of the report presented in this appendix includes minor updates to clarify how the surveillance review informed the development of the guidance update.

A3.1 Guidance review summary and updating proposals

A surveillance review of the second edition of SDCEP's Prevention and Management of Dental Caries in Children (PMDCC2) guidance was carried out, taking into consideration recent evidence, guidelines, other relevant developments relating to the topic, and stakeholder feedback.

The surveillance review indicates that key parts of the PMDCC2 guidance reflect current recommended practice but a number of aspects were identified which should be updated or considered for inclusion as new additions to the guidance.

Based on the surveillance review findings, it is recommended that a guidance development group is convened to:

- Consider the evidence about obesity as a risk factor for caries, and the performance of caries risk assessment tools.
- Consider the differences between the recommendations in Public Health England's Delivering Better Oral Health and PMDCC2 for the provision of fluoride varnish and sealants and the good practice point covering the administration of sugar free medicine, with a view to updating these in the guidance.
- Review the evidence on the efficacy of sealants versus varnish with a view to updating the PMDCC2 guidance.
- Review the evidence around the use of silver diamine fluoride with a view to including this intervention in the guidance.
- The PMDCC2 guidance and the identified evidence appear to be consistent for the management of caries in primary and permanent teeth but this should be subject to clinical verification.
- Review the dental techniques in the PMDCC2 guidance to ensure they remain best practice.
- Consider the evidence and resources for managing dental anxiety to ensure the relevant PMDCC2 section reflects best up-to-date practice.
- Update the additional support section to take account of revised child protection guidelines and the emergence of new policies about children's rights.
- Consider sustainability in relation to the prevention and treatment of caries in children with a view to including advice on this.
- Review the Molar Incisor Hypomineralisation guideline with a view to deciding whether to include additional advice on its treatment in the respective section in the guidance.
- Review the evidence relating to the detection of caries by means of devices and systems other than radiographic imaging, to consider whether to include information on these in the guidance.

Overall, the surveillance review found that a full review of the guidance is not required. The recommendations above suggest that the PMDCC2 guidance requires minor updating of contextual information throughout, the inclusion of additional information and the partial updating of selected recommendations.

A3.2 Background

The second edition of the SDCEP Prevention and Management of Dental Caries in Children guidance (referred to as PMDCC2 guidance throughout) was published in 2018. In line with SDCEP's standard five-year guidance review period a scheduled review of the guidance topic commenced in Spring 2023. A surveillance review was carried out to assess whether there were any developments in the area or changes in the evidence base that would impact on the guidance recommendations and inform any updating.

A3.3 Surveillance review methods

The following steps were carried out by SDCEP to assess whether the recommendations and other content in the guidance remain up to date.

- Guidelines used previously as sources were checked for updated versions.
- New guidelines relevant to the topic were sought by checking websites and publications of known guideline providers and relevant professional bodies including:
    - Scottish Intercollegiate Guideline Network (SIGN)
    - National Institute for Health and Care Excellence (NICE)
    - Public Health England (PHE)
    - Guidelines International Network (GIN) International Guideline Library
    - ECRI Guidelines Trust
    - American Dental Association (ADA)
    - British Society of Paediatric Dentistry (BSPD)
    - American Academy of Pediatric Dentistry (AAPD)
    - European Association of Paediatric Dentistry (EAPD)
- Updated and new guidelines were assessed for any changes or new recommendations that might impact on the guidance.
- A search of the Cochrane Database of Systematic Reviews and Epistemonikos, from 2018 to July 2023, for new systematic reviews (SRs) relevant to caries in children and meeting the inclusion criteria used previously for the PMDCC2 guidance was carried out.
- The conclusions of Cochrane reviews were checked to assess the impact on the guidance recommendations. Additional SRs were selected for inclusion for aspects of the topic for which new/updated guidelines or Cochrane reviews were absent, or the SRs were able to directly supplement identified evidence.
- Information on other developments relevant to the topic was sought from stakeholders and feedback on PMDCC2 was also considered. The stakeholder views were obtained through respective surveys of practitioners and Guidance Development Group (GDG) members (see Section A3.5).
- The websites of the following organisations were reviewed for potentially relevant sources of information such as consensus statements and policy statements:

- International Association of Paediatric Dentistry (IAPD)
- European Organization for Caries Research (ORCA)
- College of General Dentistry
- World Dental Federation (FDI)
- World Health Organisation (WHO)

This surveillance review sought updated and new evidence from the beginning of 2018 given the potential for evidence to be published in the time period between the completion of the searches for the second edition of the guidance in October 2017 and its final publication in May 2018.

A3.4 Surveillance review findings and assessment

This surveillance report is structured around the clinical questions and recommendations from the second edition of the guidance and covers: risk assessment; prevention (including infant feeding, toothbrushing, toothpaste, dietary advice, application of fluoride varnish, mouthrinse, sealants and recall intervals); management of caries in primary and permanent teeth; pulp therapy; behavioural management; providing additional support. In addition, the report presents other issues which emerged from stakeholder feedback.

A3.4.1 Caries risk assessment

The PMDCC2 guidance, in advising the need to carry out a risk assessment, discusses the known risk factors associated with child caries and the potential to use caries risk assessment (CRA) tools. This review identified a guideline,[1] an umbrella review of SRs[2] and a SR[3] which examined risk factors associated with caries.

The Delivering Better Oral Health (DBOH)[1] guideline recognises that the risk of caries is multi-factorial in nature and is linked with social and economic circumstances and ethnicity. The prevalence of dental caries is higher in some ethnic groups and deprivation is also recognised as a determining factor. Higher risks for children include those presenting with tooth decay, children who have had dental caries in their primary dentition and first permanent molars and those who have been admitted to hospital for removal of their teeth, as well as certain children who are medically compromised or have a disability. In addition, there may be specific risks for children with hypomineralised teeth. Modifiable risk factors for caries are also noted, in particular diet, consuming too much cariogenic sugar and medicines containing sugars.

The umbrella review[2] included 15 studies and identified potential risk factors for early childhood caries as enamel defects, high levels of mutans streptococci, the presence of dentinal caries, increased consumption of soda, daily intake of sugary snacks and obesity. This reinforced the findings of the SR[3] which identified the two strongest risk factors associated with early childhood caries in high- or upper-middle-income countries as the presence of enamel defects and high levels of mutans streptococci. Significant secondary risk factors in the high-income country

category were the presence of dentinal caries, frequent consumption of sweetened foods, poor oral hygiene, and the presence of visible plaque.

Obesity as a risk factor

The identification of obesity as a risk factor[2] was based on two SRs[4,5] which concluded that younger children (<6 years old) who were overweight/obese have a greater risk/prevalence of caries.

The first SR[4] tested the association of caries and bodyweight in preschool children by only including studies which contained both underweight and overweight groups. A qualitative analysis of 33 studies was inconsistent, with 11 studies indicating that underweight children have more caries, 11 studies finding a nonsignificant difference in caries experience between overweight and underweight children, and nine studies indicating that overweight/obese children have more caries. This may be because of a range of confounding factors including age, socio-economic status, culture and race. Twelve studies were included in a meta-analysis. Three studies that used the decayed, missing and filled surfaces (dmfs) index did not find any differences in early childhood caries (ECC) prevalence between overweight and underweight children with the evidence being rated as low quality. Nine studies that used the decayed, missing, and filled teeth (dmft) index found that overweight/obese children are at a significantly greater risk statistically of having ECC ($P<0.01$). This was based on moderate quality evidence and led the authors to conclude that overweight and obese preschool children are at greater risk of having early childhood caries.

The second SR[5] evaluated whether children aged 6 years and younger with overweight and/or obesity have higher dental caries experience compared with children with normal weight and to identify the common risk factors associated with both conditions. Nine studies were included in the review: five cohort studies and four case-control studies. Six studies reported a significantly higher caries experience amongst children with overweight and/or obesity, one study reported a higher caries experience, but it was not statistically significant, whereas two studies found no significant difference in the caries experience of children with overweight and/or obesity. The pooled estimates drawn from case-control studies (n=4) indicate that children with high BMI scores are more likely to experience dental caries compared with children with normal weight (OR = 2.15, 95% CI, 1.04-4.43). Low levels of parental income and education were commonly associated with both overweight/obesity and dental caries in young children. The authors concluded that children with overweight and obesity have a higher dental caries experience compared with children with normal weight with the proviso that the quality of evidence varied considerably.

Subsequently, a recent umbrella review has been identified which aimed to evaluate and summarise evidence from SRs on the association between dental caries and nutritional status in children and adolescents.[6] The review identified 19 SRs of which: seven found an association between obesity/overweight and dental caries; one, an association between underweight and dental caries; and eleven, no associations. However, 17 of the included SRs were assessed as showing high risk of bias and critically low methodological quality.

Stakeholder feedback identified the BSPD position statement on obesity and dental health.[7] The statement recognises that obesity is a multi-factorial disorder with risk factors including environmental and genetic factors. The position statement calls for further co-ordinated, multi-agency approaches to the management of obesity and dental decay, to include supporting dietary changes that are age appropriate, affordable, culturally sensitive and consistent with healthy eating advice and clearer food labelling. This approach supports close liaison with dieticians and networks established in weight management programmes to facilitate appropriate referral and also to raise awareness of established common risk factors.

Caries Risk Assessment tools

The PMDCC2 guidance notes that although several tools for caries risk assessment exist, there is no consensus on which is most effective. DBOH[1] observes that CRA tools are based on extensive research but can be complex and time consuming to use.

Four SRs investigated the performance of CRA tools.[8-11] There is evidence for the effective performance of some individual tools.[8,9] There is a lack of information to determine the levels of evidence underpinning the reliability and validity of tools.[10] The general conclusion across reviews is that there is a lack of evidence to firmly establish if the tools are effective in determining patients' actual caries risk or in predicting their probability of developing new carious lesions.[8,9,11]

One SR[11] reviewed evidence to evaluate whether five standardized CRA models are able to evaluate the risk according to the actual caries status and/or the future caries increment. A quality assessment reduced 1,392 identified studies to 32 for review and in all but one, Cariogram was used both as the sole model or in conjunction with other models. All the studies on children (n = 16) and adults (n = 12) found a statistically significant association between the risk levels and the actual caries status and/or the future caries increment. Nineteen papers, all using Cariogram except one, were classified as being of good quality. Three of four papers comprising children and adults found a positive association. For seven of the included papers, Cariogram sensibility and specificity were calculated; sensibility ranged from low (41.0) to fairly low (75.0), while specificity was higher, ranging from 65.8 to 88.0. Wide 95% confidence intervals for both parameters were found, indicating that the reliability of the model differed in different caries risk levels. The authors concluded that the validity of standardized CRA models is limited and Cariogram, which was tested in few studies of good quality, does not provide sufficient evidence to affirm that it is effective in caries assessment and prediction.

A second SR[10] reviewed the strength of evidence which underpins eight CRA tools for children aged six years or under. The review established that across all CRA tools there was a lack of information to determine the levels of evidence for the measurement properties of reliability and construct validity. Tools that were assessed as having strong evidence for content validity, identified the relevant risk factors for caries in the population being studied, before developing and testing their respective CRA tools. In this respect, the National University of Singapore CRA tool reported the most information to inform the assessment of its measurement properties and as a

result this tool attained a higher quality rating than other CRA tools. The authors concluded that evidence to inform the selection of CRA tools for children is mostly yet to be established.

A third SR[9] identified seven CRA tools but restricted their analysis of performance to Cariogram due to a lack of high quality studies for other tools and concluded that the average predictive performance of both full and reduced Cariogram seems to be acceptable.

The fourth SR[8] was updated and included true prospective trials validating baseline risk categories over at least a 12-month period. This led to the review of two software tools and three manual checklists. The National University of Singapore model displayed a good accuracy in two studies, while the accuracy of Cariogram ranged from poor to good in various populations. The manual checklists were only validated in one study each and displayed limited to poor accuracy. The authors concluded that there was a lack of prospective trials validating existing CRA tools in preschool children and the available evidence could not determine whether their use leads to better oral care. However, the authors recommended the use of CRA tools as their desirable effects are most likely to outweigh their undesirable effects.

Assessment: A review of caries risk factors confirms they are generally consistent with those included in the PMDCC2 guidance. Obesity is emerging as a potential risk factor and may warrant consideration for inclusion in the updated guidance. There is some evidence pointing to effective operation of individual risk assessment tools, although collectively their performance remains to be proved.

Recommendation: Consider the evidence around obesity as a risk factor for caries, and the performance of caries risk assessment tools.

A3.4.2 Caries prevention

Recommendations for caries prevention in children in the second edition of the guidance were primarily based on evidence from the SIGN guideline 138 Dental Interventions to Prevent Caries in Children.[12] As this guideline has not been subsequently updated, the recommendations and advice for prevention of caries in PMDCC2 guidance have been mapped against those in DBOH.[1] Additional evidence in the form of new or updated SRs was identified for oral health education,[13] interdental cleaning aids[14] and toothpaste.[15]

DBOH includes recommendations and good practice points for the prevention of caries in children by age (0 to 3 years, 3 to 6 years, 7 to 18 years) and risk level (all children, children giving concern because of dental caries risk). The recommendations cover infant feeding, toothbrushing, toothpaste, dietary advice, application of varnish, mouthrinse, sealants and recall intervals. These recommendations and good practice points in these areas were mapped against those in the PMDCC2 guidance and largely matched them in content and strength with three differences identified.

DBOH strongly recommends the application of resin sealant to permanent teeth on eruption for children from 7 years and young people up to 18 years giving concern because of dental caries risk

whereas PMDCC2's strong recommendation is to place fissure sealants on permanent molars as early as possible after eruption for all children.

A minor difference was the application of fluoride varnish, with DBOH recommending its application to children aged three years and over and the respective PMDCC2 guidance endorsing its application to children two years old and over.

The other variation between the two sources relate to sugar fee medicine. DBOH states that it is good practice for children up to 6 years to use sugar-free versions of medicines if possible. Similarly for children up to 18 years old giving concern because of dental caries risk, where the child is prescribed medication frequently or long term, dentists should liaise with the medical practitioner to request that it is sugar free. PMDCC2 guidance provides no advice on sugar free medicine but indirectly makes reference to this in the assessment section with the question "does the child take regular sugar-containing medication?".

Oral health advice

A SR[13] was undertaken to inform the WHO Ending childhood dental caries manual.[16] The review found moderate-quality evidence which showed a benefit for children of caregivers who received oral health education, resulting in a reduced risk of early childhood caries as compared with those of caregivers who had never received oral health education (odds ratio, 0.39; 95% CI, 0.19 to 0.79; P= 0.009).

Toothbrushing

The PMDCC2 guidance noted that evidence for the use of floss in addition to toothbrushing is insufficient to support its use. A subsequent new SR[14] evaluated the effectiveness of interdental cleaning devices used at home, in addition to toothbrushing, compared with toothbrushing alone, for preventing and controlling periodontal diseases, caries and plaque. The review of 35 RCTs (no included studies were conducted with children or adolescents) concluded that additional use of floss or interdental brushes compared to toothbrushing alone may reduce gingivitis or plaque, or both, and interdental brushes may be more effective than floss. However, the evidence is low to very low-certainty, and the effect sizes observed may not be clinically important. In addition, the long-term significance of the findings is unclear as few of the studies evaluated pocket probing depth as a measure of periodontitis and none assessed interproximal caries.

Toothpaste

The PMDCC2 guidance noted that "high quality evidence from SRs indicates there is a dose-relationship between toothpaste fluoride concentration and level of caries reduction" based on a Cochrane review. This original review which included 75 studies was updated in 2019 with the addition of 21 studies.[15] The updated review confirmed the benefits of fluoride toothpaste in preventing caries and a dose-response effect was observed for decayed, missing, and filled surfaces (D(M)FS) in children and adolescents. However, the review noted that for many comparisons of

different concentrations the caries-preventive effects and confidence in these effect estimates are uncertain and could be challenged by further research.

Assessment: Current guidance and evidence identified across the range of preventive interventions is generally consistent with that already provided in PMDCC2 guidance. Differences were noted between DBOH and PMDCC2 in the application of varnish and sealants and the administration of sugar free medicine.

Recommendation: Consider the differences between DBOH and PMDCC2 recommendations for the provision of fluoride varnish and sealants and the good practice point covering the administration of sugar free medicine, with a view to updating these in the guidance.

A3.4.3 Fissure sealants

Evidence in the PMDCC2 guidance for the effectiveness of fissure sealants in permanent teeth was drawn from SIGN Guideline 138.[12] The guidance noted that both resin-based and glass ionomer sealants are effective in preventing caries (moderate and low to very low quality of evidence respectively).

Three more recent SRs were identified: a Cochrane review[17] and a SR[18] examining the efficacy of sealants in preventing caries in primary teeth; a Cochrane review[19] comparing sealants versus other interventions for non-cavitated or cavitated but not deep lesions.

The efficacy of sealants in preventing caries in primary teeth

A Cochrane review[17] evaluated the effects of sealants versus no sealants in three studies but could not pool the data due to differences such as age of participants and duration of follow-up. One study comparing fluoride-releasing sealants to no treatment groups showed insufficient evidence of a difference at 24 months follow-up (Becker Balagtas odds ratio (BB OR) 0.76, 95% CI 0.41 to 1.42; 1 study, 85 children, 255 tooth surfaces). Two studies comparing glass ionomer based sealants came to differing conclusions: one study found insufficient evidence of a difference at follow-up between 12 and 30 months (OR 0.97, 95% CI 0.63 to 1.49; 449 children); another with 12-month follow-up found a large, beneficial effect of sealants (OR 0.03, 95% CI 0.01 to 0.15; 107 children). The evidence was rated as low. The review also compared different sealant materials (6 studies) but did not pool the data due to study differences. The incidence of development of new caries lesions was typically low across the different sealant types evaluated and the certainty of the evidence was assessed to be low or very low for the outcome of caries incidence. The review concluded the relative effectiveness of different types of sealants in preventing caries on the occlusal surfaces of primary teeth has yet to be established and that this evidence gap should be addressed through robust RCTs.

The SR[18] evaluated the evidence on the effectiveness of different sealants in prevention and arrest of the pit and fissure occlusal caries in primary molars of children. This review identified no significant difference in the overall caries incidence and progression when evaluated over 24 months between (1) resin-based sealant (RBS) and glass ionomer sealants (GIS) or resin-

modified GIS; (2) conventional and newly developed RBS; (3) autopolymerized and light-polymerized RBS; (4) RBS with topical fluoride application and topical fluoride alone; and (5) RBS with topical fluoride application and resin infiltration with topical fluoride application. The pooled estimates of the mean retention rates of RBS and GIS on primary molars over an 18-months period were 85.94% and 23.18%, respectively. The certainty in the evidence of each outcome was determined as low or very low mainly because of high risk of overall bias and imprecision. In line with the Cochrane review (Ramamurthy 2022) the authors concluded that there are currently insufficient well-controlled RCTs to determine whether sealants are beneficial in preventing or arresting non-cavitated occlusal caries in the primary molars.

Sealing using sealants versus other interventions for non-cavitated or cavitated but not deep lesions in primary and permanent teeth

The Cochrane review[19] found there was insufficient evidence of a difference between sealing with sealants and conventional restoration (CR) (OR 5.00, 95% CI 0.51 to 49.27; 1 study, 41 teeth, permanent teeth, cavitated), sealing versus selective excavation (SE) (OR 3.11, 95% CI 0.11 to 85.52; 2 studies, 82 primary teeth, cavitated) or sealing versus no treatment (OR 0.05, 95% CI 0.00 to 2.71; 2 studies, 103 permanent teeth, non-cavitated). All studies were assessed as very low-certainty evidence. The review determined that the uncertainty of the evidence meant that no conclusion could be made about whether sealing with sealants is better, worse or the same as conventional treatment, SE or no treatment.

In relation to dental techniques, stakeholder feedback identified a need to be more specific about the use of bond under fissure sealant, particularly if sealing over caries.

Assessment: Recent evidence about sealants is uncertain, with the identified reviews unable to add conclusive new evidence to that which already exists on their effectiveness and to the comparison of different materials. The better retention rates of RBS noted in PMDCC2 guidance is confirmed. Given this, it is suggested that no change to the PMDCC2 guidance is required in relation to the use of different sealant materials for the prevention or arrest of caries.

Note: subsequent feedback highlighted the need to reconsider the use of sealants/infiltration for the management of caries in permanent teeth.

A3.4.4 Topical fluorides

Two aspects of fluoride interventions were reviewed, firstly the effectiveness of fluoride varnish versus sealants and secondly the application of silver diamine fluoride (SDF).

Fluoride varnish versus sealants

The PMDCC2 guidance noted evidence that fluoride varnish (FV) is not as effective as fissure sealants (FS) in reducing decay in occlusal surfaces based on a Cochrane review.[20] The relative effectiveness of FV versus FS is addressed in an updated Cochrane review[21] and two SRs.[22,23]

The update of the Cochrane review[21] agreed that applying FV or resin-based FS to first permanent molars helps prevent occlusal caries, but it was not possible to reach reliable conclusions about which one is better to apply. The available studies do not suggest either intervention is superior and this evidence was assessed as having very low certainty. The updated Cochrane review found very low-certainty evidence that placing resin-based FS as well as applying FV works better than applying fluoride. This led to the conclusion that available data are insufficient to reach conclusions about whether it is better to apply FS or FV on occlusal surfaces of permanent molars, and so either intervention, or both, can be used.

Two SRs[22,23] agree with the updated Cochrane review's[21] finding of no difference between the relative effectiveness of FS and FV. The first SR's[22] meta-analysis showed that there was no statistical difference on caries incidence or occlusal DMFS increment between the FS group and FV group at 2 to 3 years' follow-up. The authors concluded that biannual applications of FV or FS may be equally effective on caries prevention for first primary molars (FPMs) giving clinicians a choice between the two techniques. The second SR's[23] meta-analysis found no significant difference between FS and FV in caries prevention efficacy of FPMs at 2 years' follow-up with the authors suggesting the use of FV since it is more affordable and easier to apply.

In addition, stakeholder feedback noted that evidence around application of FV for younger children is more equivocal and this is an area that would warrant further discussion.

Silver Diamine Fluoride (SDF)

The use of SDF is not included in the PMDCC2 guidance. The increasing use of SDF was highlighted by several stakeholders describing it as established and mainstream paediatric dental practice in the UK. The use of SDF is endorsed internationally in guidelines,[24-26] consensus statements[27] and policy documents.[28] Additional evidence was drawn from a SR undertaken for the US Preventive Services Task Force.[29]

The AAPD[30] notes evidence from 22 clinical trials which have evaluated and confirmed the efficacy of SDF on caries arrest and/or prevention. Although clinical trials have inherent bias because of the staining (i.e. the difference between control and treated teeth is obvious to the researcher), studies (n=17) consistently conclude that SDF is more effective for arresting dentinal caries than fluoride varnish. SDF reportedly also has approximately two to three times more fluoride retained than delivered by sodium fluoride, stannous fluoride, or acidulated phosphate fluoride (APF) commonly found in foams, gels, and varnishes. Additionally, SDF has not been shown to reduce adhesion of resin or glass ionomer restorative materials. SDF is safe when used in adults and children in accordance with dosing and application criteria and does not appear to negatively impact oral health-related quality of life in young children.

A SR[29] found limited evidence from two RCTs for the application of SDF in children and none for those under 5 years of age. A RCT[31] of first graders (n=704) in six Philippines primary schools compared one application of SDF (administered by school nurses) or atraumatic restorative treatment (ART) sealants (administered by dentists). Children in two other schools served as no

treatment controls. The study protocol required schools to provide daily school-based tooth brushing with fluoride toothpaste but this was not complied with by three schools. Therefore, analyses were stratified according to school compliance with tooth brushing. There were no statistically significant differences between SDF versus controls in caries increment in children in the brushing schools (hazard ratio [HR] 1.16, 95% CI, 0.51 to 2.63) or non-brushing schools (HR 0.71, 95% CI 0.45 to 1.11), though estimates were imprecise. Staining and other harms were not reported. A second RCT[32] of 6 year old children (n=452) found the application of 38 percent SDF every 6 months associated with fewer new decayed surfaces in primary teeth and first permanent molars versus no SDF at 36 months (0.29 vs. 1.43 and 0.37 vs. 1.06, respectively). The applicability of this trial to prevention is uncertain however as SDF was used for caries arrest in deciduous teeth and baseline caries status in first permanent molars was unclear.

It is noted that an upcoming Cochrane review is due to be published which will add to the body of evidence on SDF.

Assessment: The review indicates two areas of divergence between new evidence and SDCEP guidance on the application of FV. Firstly, the PMDCC2 guidance notes the superiority of sealants over varnish in reducing decay in occlusal surfaces. Evidence from an updated SR and two recent SRs found no difference in efficacy between sealants and varnish. Secondly PMDCC2 guidance does not address the use of SDF which is now in use in the UK and is endorsed internationally.

Recommendation: Review the evidence on the efficacy of sealants versus varnish and SDF with a view to updating the PMDCC2 guidance.

A3.4.5 Management of caries in primary teeth

PMDCC2 recommendations for the management of primary teeth include choosing the least invasive feasible caries management strategy and preservation of tooth structure. The surveillance review identified two guidelines[26,33] and a replacement Cochrane review[19] on the treatment and management of caries in primary teeth. The evidence considers treatment approaches and restorative materials.

The ADA[33] presented seven recommendations for primary teeth: two on carious tissue removal (CTR) approaches specific to lesion depth and five on direct restorative materials specific to tooth location and surfaces involved. The recommendation for the treatment of moderate caries lesions on vital primary teeth requiring a restoration is the use of selective carious tissue removal, nonselective carious tissue removal, or no carious tissue removal (i.e. sealing lesions with a preformed crown) (conditional recommendation, very low certainty). The recommendation for the treatment of advanced caries lesions on vital primary teeth requiring a restoration is prioritizing the use of selective carious tissue removal or no carious tissue removal (i.e. sealing with a preformed crown) over nonselective carious tissue removal or stepwise carious tissue removal (conditional recommendation, very low certainty).

The ADA guideline noted that in most clinical scenarios, evidence did not show important differences between CTR approaches and direct restorative materials to suggest whether one treatment option is superior to another. One key finding for advanced lesions was that more conservative CTR approaches were associated with fewer clinical failures. This was in the context of evidence of increased risk of experiencing outcomes such as pulp exposure when all carious tissues are removed.

EAPD[26] guidelines present evidence-based recommendations for treating deep carious lesions in primary teeth where good quality evidence was available or recommends good clinical practice where evidence was weak. Evidence was considered in three areas: conventional management, minimal invasive dentistry (MID) and restorative materials. In terms of MID, the guidance was based on an umbrella review[34] and recommends the application of 38% SDF and endorses the Hall Technique and Atraumatic Restorative Technique. In relation to management, the guidance notes that indirect pulp capping or selective and stepwise caries removal, and pulpotomy have high success rates and can be recommended as effective treatment modalities for the management of deep caries in primary teeth. The evidence on materials led to recommendations based on low - grade evidence and expert opinion due to the absence of well-designed RCTs in children. The EAPD guideline in endorsing MID notes the advantage that many of these techniques can be carried out without aerosol generation and there is some evidence of improved patient outcomes.

The replacement Cochrane review[19] compared the effectiveness of conventional restoration, selective excavation, stepwise carious tissue removal , sealing of carious lesions using sealant materials or preformed metal crowns , or non-restorative cavity control to treat carious lesions conventionally considered to require restorations in primary or permanent teeth with vital (sensitive) pulps. The review included 27 studies of which 16 evaluated primary teeth, 10 evaluated permanent teeth, and one evaluated both. Most studies showed high risk of bias and limited robustness, resulting in low- or very low-certainty evidence for most comparisons. The review concluded that compared with conventional restoration, the Hall Technique and selective carious tissue excavation have a lower risk of failure in the primary dentition. The evidence is very uncertain in comparing conventional restoration with stepwise removal for primary teeth.

Stakeholder feedback in relation to the management of dental caries in primary teeth identified the following aspects for review to ensure PMDCC2 guidance reflects best practice:

- conventional preformed metal crown on its own should not be recommended. The procedure should start with a Hall Crown with a need sometimes to do a mesial or distal slice. Layer on top of that in cases where cooperation is good (or guaranteed e.g. under general anaesthesia) and also consider some caries removal.
- there is little or no indication anymore for occlusal preparation methods
- the section on local anaesthetic should reference the relevant Cochrane review[35] and briefly consider articaine versus lidocaine.

Assessment: PMDCC2 recommendations for the management of caries in primary teeth include choosing the least invasive feasible caries management strategy and preservation of tooth structure. The identified guidelines and Cochrane review endorse a MID approach and support the view that less invasive approaches reduce the risk of clinical failures. As such, the PMDCC2 guidance and the additional identified evidence appear to be consistent but this should be confirmed by clinical verification. Subject to this verification it is likely that no change will be required to PMDCC2 in relation to the management of caries in primary teeth, other than perhaps to the details of some of the dental techniques.

Note: Subsequent discussions included the consideration of stepwise versus selective caries removal.

A3.4.6 Management of caries in permanent teeth

PMDCC2 recommendations for the management of permanent teeth include choosing the least invasive feasible caries management strategy and preservation of tooth structure and the health of the dental pulp. Two guidelines[33,36], a revised guideline[37] and a replacement Cochrane review[19] were identified for review.

The ADA[33] presented seven recommendations for permanent teeth: two on CTR approaches specific to lesion depth and five on direct restorative materials specific to tooth location and surfaces involved. The recommendation for the treatment of moderate caries on vital permanent teeth requiring a restoration is prioritizing the use of selective carious tissue removal over nonselective carious tissue removal (conditional recommendation, very low certainty). The recommendation for the treatment of advanced caries lesions on vital permanent teeth requiring a restoration is prioritizing the use of selective carious tissue removal over stepwise carious tissue removal or nonselective carious tissue removal (conditional recommendation, very low certainty).

As noted earlier in their recommendations on primary teeth, the ADA guideline highlights the prioritisation of more conservative CTR to treat advanced caries lesions on permanent teeth and points to evidence that more conservative CTR approaches were associated with fewer clinical failures.

The European Society of Endodontology (ESE)[36] position statement is in agreement with the PMDCC2 guidance in adopting selective caries removal and restoration with a selection of materials in teeth with reversible pulpitis to avoid pulp exposure. The position statement provides additional guidance to that of the PMDCC2 guidance in the treatment of carious pulp exposure, materials to be used in vital pulp therapy and follow-up actions for vital pulp therapy.

The Cochrane review[19] compared the effectiveness of conventional restoration (CR), selective excavation (SE), stepwise carious tissue removal (SW), and sealing of carious lesions with preformed metal crowns (HT) in permanent dentition. A variety of outcome measures were used in the included studies: loss of teeth due to extraction: necrosis of the pulp; root caries; dental filling

failure; irreversible pulpitis; carious exposure of pulp. The comparisons of treatment approach found that:

- the odds of failure were higher for CR than SW in permanent teeth (moderate-certainty evidence);
- the odds of failure may be higher for CR than SE in permanent teeth (very low-certainty evidence);
- the odds of failure were higher for SW than SE in permanent teeth (moderate-certainty evidence).

In addition, a network meta-analysis for deep lesions showed the probability of failure to be greatest for CR compared with SE, SW and HT. The review concludes that compared with conventional restoration, SE and SW have a lower risk of failure in the permanent dentition.

The revised guideline[37] on the assessment and management of first permanent molars is an update of the 2014 version which is referenced in PMDCC2. The focus of the update has moved from guidance on the various malocclusions to a broader approach covering principles and advising input from Orthodontics. The guidance advises assessment of wisdom tooth presence and assessment of the position of the Second Permanent Molar. Underpinning the guidance is the promotion of realistic dentistry principles to ensure that the patient and parents/carers are included in the decision-making process.

Stakeholder feedback in relation to the management of dental caries in permanent teeth identified the following aspects for review to ensure the PMDCC2 guidance reflects best practice:

- the possible inclusion of a section on vital pulpotomies including use of biodentine or equivalent;
- whether stepwise removal of caries should be removed in favour of selective caries removal.

Assessment: The identified guidelines and Cochrane review endorse the conservative PMDCC2 approach and support the view that less invasive approaches reduce the risk of clinical failures. The PMDCC2 guidance and the additional evidence identified appear to be consistent, but this should be confirmed by clinical verification. Subject to this verification it is likely that no change will be required to the PMDCC2 guidance in relation to the management of caries in permanent teeth other than perhaps to some dental techniques. The adoption of realistic dentistry principles in updated guidance on first permanent molars highlights the value of this approach.

Note: Subsequent discussions included the consideration of fissure sealants and resin infiltration as management options for permanent teeth, and stepwise versus selective caries removal.

A3.4.7 Pulp Therapy

The review identified a guideline,[36] an updated Cochrane review[38] and an umbrella review[39] covering pulp therapy techniques and medicaments.

PMDCC2 guidance on techniques recommends for pulpitis with reversible symptoms in primary teeth placing a crown using the Hall Technique or if an occlusal lesion, carry out selective caries removal, avoiding the pulp, and restore using composite, resin modified glass ionomer, compomer or glass ionomer. ESE guidance[36] agrees with this approach in recommending selective carious-tissue removal (one-stage or two stage stepwise technique) in teeth with reversible pulpitis, provided radiographic assessment indicates caries has progressed no deeper than the pulpal quarter with a zone of dentine separating the carious lesion from the pulp chamber. A hydraulic calcium silicate or a glass–ionomer cement should be placed over the deep dentine in both one- and two-stage procedures.

PMDCC2 guidance on medicaments is based on a Cochrane review which was updated with the inclusion of 40 new trials bringing the total to 87 trials.[38] For pulpotomy the updated review assessed three comparisons of medicaments as providing moderate-quality evidence. Compared with formocresol, mineral trioxide aggregate (MTA) reduced both clinical and radiological failures, with a statistically significant difference at 12 months for clinical failure and at 6, 12 and 24 months for radiological failure (12 trials, 740 participants). Compared with calcium hydroxide, MTA reduced both clinical and radiological failures, with statistically significant differences for clinical failure at 12 and 24 months. MTA also appeared to reduce radiological failure at 6, 12 and 24 months (four trials, 150 participants) (low-quality evidence). When comparing calcium hydroxide with formocresol, there was a statistically significant difference in favour of formocresol for clinical failure at six and 12 months and radiological failure at 6, 12 and 24 months (six trials (one with no failures), 332 participants). The Cochrane review concludes that after a pulpotomy, MTA seems to be the best material, in terms of biocompatibility and efficacy, to put into contact with the remaining root dental nerve. The evidence showed it to be less likely to fail than either calcium hydroxide or formocresol. This is in line with PMDCC2 guidance and an umbrella review[39] which reported the highest quality of evidence supporting the effective application of mineral trioxide aggregate and formocresol.

Pulpectomy and pulp capping

Pulpectomy and pulp capping were also evaluated in the updated Cochrane review[38] but are not a main focus of the PMDCC2 guidance so are not reviewed here. Similarly the PMDCC2 guidance does not cover the use of non-vital pulp therapies but an AAPD guideline[40] was identified for this approach.

Assessment: The review of evidence for pulpotomy techniques and medicaments indicates consistency with the PMDCC2 guidance, so unlikely that changes to the recommendations are required.

Note: subsequent feedback highlighted the need to consider the use of pulp therapies in permanent teeth for the guidance update.

A3.4.8 Dental anxiety

Stakeholders identified a resource based on cognitive behavioural therapy (CBT) principles aimed at reducing dental anxiety in children. 'Your teeth are in control' is a self-help guide with accompanying resources, for children aged 9-16 years, which is delivered by dental practitioners and dental care professionals.[41] The guide is suitable for children with mild to moderate dental anxiety who require a course of treatment but have no urgent dental treatment needs. An evaluation of the guide (n=48) revealed a statistically significant reduction in child self-reported dental anxiety and improvements in quality of life with 60% indicating they felt 'a lot less worried' about going to the dentist since using the guide. The guide was found to be acceptable to children, parents and dental professionals.

Assessment: The identification of a CBT resource highlights the potential for alternative approaches aimed at reducing dental anxiety to those detailed in the PMDCC2 guidance.

Recommendation: Consider the evidence and resources for managing dental anxiety to ensure the relevant PMDCC2 section reflects best up-to-date practice.

A3.4.9 Child protection

Child Protection Guidance for Health Professionals (2013) which informed the PMDCC2 guidance was replaced and incorporated into the Scottish Government's (SG) National Guidance for Child Protection in Scotland[42] which was subsequently updated in 2023. The updated SG guidance integrates child protection within the Getting it right for every child (GIRFEC) framework[43] and wider strategic landscape, including incorporation of the United Nations Convention on the Rights of the Child (UNCRC)[44] and The Promise (to care experienced people).[45] The incorporation of guidance for health professionals lays down responsibilities for all practitioners and specifically dental care practitioners who will often come into contact with vulnerable children and are in a position to identify possible child abuse or neglect from routine examinations, or presentation of injuries or poor oral hygiene.

Stakeholders identified the *Was not Brought* (WNB) toolkit[46] as a safeguarding resource for inclusion. WNB recognises that dental neglect and missed appointments are the most common reasons for dentists to make child protection referrals and takes a different approach to did not attend (DNA). WNB operates through four progressive stages of escalating action depending on the response from parents/carers. The aim of this approach is to get dental professionals to: think about the situation from the child's perspective; identify any impact on the child's wellbeing; plan what support would help the child to receive the dental care they need; consider whether they need to share safeguarding information with other health or social care professionals.

Additional guidance in this area was identified from PHE *Safeguarding in general dental practice*[47] which includes information on roles and responsibilities and confidentiality, consent and information sharing.

Getting it Right for Every Child

A refreshed GIRFEC policy statement was published in 2022.[43] Changes in this included a focus on children's rights as an underpinning principle of GIRFEC, ensuring policy and practice protects, respects and fulfils the rights of all children and young people. The statement also aligns to key policy areas, for example The Promise and a continued commitment to eradicate child poverty.

Other policy initiatives to be considered

Initiatives incorporated into GIRFEC and child protection guidance were identified by stakeholders as being worthy of inclusion in their own right. Specifically these are the Rights of a Child[44] and The Promise.[45]

The United Nations Convention on the Rights of the Child (UNCRC)[44] states that adults should know about children's rights and gives children a voice so they are listened to. Specifically, the convention states that children have a right to information that they can understand, especially information for their health and wellbeing (Article 17). The principles of the Rights of a Child underpin the recent BSPD initiative Rights from the Start[48] which aims to raise awareness in dentistry of the rights that must be upheld for the youngest in society. In practice this means providing information children can really understand, listening to their views and supporting them to make decisions. In the context of shared decision making in health, NICE guidance[49] was identified by stakeholders and includes recommendations on putting it into practice, things to think about before a discussion, during a discussion and after or between discussions. The guidance is helpful in setting out principles but does not specifically address the implementation of shared decision making with children.

The Promise[45] resulted from an independent review into Scotland's care system and recognises the rights of the child as laid down in the UNCRC. The Promise was implemented through the publication of Plan 21-24 which sets out 25 actions which Scotland must take by 2024. The plan recognises that every child that is 'in care' in Scotland will have access to intensive support that ensures their educational and health needs are fully met. Local Authorities and Health Boards will take active responsibility towards care experienced children and young people, whatever their setting of care, so they have what they need to thrive.

The implementation of The Promise highlights the need identified by stakeholders to review PMDCC2 guidance for correct terminology, in this instance replacing 'looked after' with 'care experienced'.

Assessment: This review indicates that revised guidance and new policies have been introduced in the areas of child protection and children's rights.

Recommendation: Updating is required to take account of revised child protection guidelines and the emergence of new policies about children's rights.

A3.4.10 Aspects highlighted via Stakeholder Feedback

Stakeholder feedback was obtained through respective surveys of practitioners and Guidance Development Group members from the previous update of the guidance (see Section A3.5). The following issues were highlighted.

A3.4.11 Sustainability

A recurring development identified by stakeholders for inclusion in updated guidance is sustainability. There has been an increased focus on sustainability in the period since the publication of the PMDCC2 guidance in 2018 and stakeholders highlighted this as an omission to be addressed. In this respect a number of potential angles could be explored in updating the guidance. Firstly, the guidance should recognise the key principle of prevention as an approach in delivering sustainable dental care. Secondly, the guidance should consider and include evidence on the environmental impact and sustainability of interventions, products, processes and systems wherever possible. Thirdly, guidance should address the legislative requirements to reduce the carbon footprint. Finally, each specific recommendation should be accompanied by environmental comment if appropriate.

This surveillance review of new and updated guidance indicates that references to sustainability considerations are largely absent in these documents.

Assessment: Stakeholders have identified sustainability as an omission in the PMDCC2 guidance.

Recommendation: Consider sustainability in relation to the prevention and treatment of caries in children with a view to including advice on this.

A3.4.12 Molar Incisor Hypomineralisation (MIH)

The PMDCC2 guidance provides advice on the assessment and treatment of MIH. Stakeholders noted EAPD guidance[50] for children presenting with MIH, which is an update of a 2010 guideline which is not referenced in the current edition of the PMDCC2 guidance. The EAPD recommendations were mapped against PMDCC2 advice points and match broadly in the areas of applying fissure sealants, glass ionomer cement (GIC) restorations and preformed metal crowns in the treatment of MIH in molars.

In addition, EAPD guidance makes strong recommendations based on moderate certainty evidence for the invasive use of composite resin restorations as a restorative option in mild/severe cases (based on 8 studies) and that the use of self-etch, total etch or deproteinisation with sodium hypochlorite is unlikely to make a difference to the retention rate of a composite restoration (based on 3 studies). A further conditional recommendation based on moderate certainty evidence is that laboratory manufactured restorations using an invasive approach can be used as a restorative option in severe cases. Evidence for recommendations about MIH in molars is typically taken from a small number of studies (ranging from 2 to 8 studies).

Evidence for the treatment of MIH in incisors is less certain with recommendations for the use of resin infiltration (conditional recommendation, low certainty evidence from 3 studies) and microabrasion (conditional recommendation, very low certainty evidence from 3 studies).

Conditional recommendations for remineralisation (based on 3 studies of moderate to very low evidence) and treatment of sensitivity (based on 4 studies of low evidence) indicate that topical products containing CPP-ACP (casein phosphopeptide-amorphous calcium phosphate) may be beneficial for MIH-affected teeth.

Assessment: An updated EAPD guideline includes a number of recommendations for the treatment of MIH in molars and incisors, hypersensitivity and remineralisation which may be useful for supplementing the advice given in the PMDCC2 guidance, albeit that a number of the recommendations are based on a small number of studies and very low or low certainty of evidence.

Recommendation: Review MIH guideline with a view to deciding whether to include additional advice on its treatment in the respective section in the guidance.

A3.4.13 Dental erosion and periodontal disease

Dental erosion and periodontal disease are not included in the PMDCC2 guidance and were identified by stakeholders as potential topics for inclusion.

Recent guidance from the Royal College of Surgeons of England[51] was identified covering the aetiology, diagnosis and preventative and restorative treatment of dental erosion. The guidance notes the need, when undertaking dietary counselling, to ensure patients understand the difference between erosion and caries as the public can confuse these terms and believe them to be synonymous pathologies. This is of particular relevance to artificially sweetened diet drinks, which patients may feel are a better alternative to full fat varieties owing to their low sugar, not realising that their highly acidic component will contribute to the erosive process.

The British Society of Periodontology and Implant Dentistry (BSP) and BSPD published updated guidance on periodontal disease in 2021.[52] The guidance covers the classification, assessment, diagnosis, prevention and treatment of periodontal disease. The guidance does not indicate any direct association between caries and periodontal disease. It is noted that in the prevention of periodontal disease, the mechanical removal of plaque and good oral hygiene, toothbrushing with a fluoride toothpaste and regular flossing also have benefits for caries prevention. Horizontal bitewing radiographs recommended for the detection of caries can also be very useful in assessing a young patient's periodontal condition.

Assessment: Dental erosion and periodontal disease were identified by stakeholders as potential topics to be added to the PMDCC2 guidance. A review of guidance did not suggest a direct association between either condition and dental caries. There is some crossover in the potential for bitewing radiographs to detect both caries and periodontal disease and benefits arising from the recommended preventative approaches for both of these conditions. These may be advice points

for potential inclusion in the PMDCC2 guidance but do not suggest the need to include dental erosion and periodontal disease as standalone topics.

A3.4.14 Detection of caries

A review of the Cochrane Database identified five reviews published from 2020 which examined a range of devices and systems for the detection and diagnosis of caries in children and adults. The reviews cover illumination tests,[53] fluorescence-based devices,[54] visual classification systems,[55] electrical conductance devices[56] and dental imaging methods.[57] A comparative evaluation of the diagnostic accuracy of these technologies was also conducted.[58] In relation to imaging methods, a stakeholder identified cone beam computed topography (CBCT) use and this is addressed below.

An evaluation of three types of illumination test concluded that optical coherence tomography (OCT) appears to show the most potential, with superior sensitivity to near-infrared (NIR) and fibre-optic technology, which incorporates more recently developed digital fibre optics (FOTI/DIFOTI) devices.[53] The certainty of evidence was rated as low. OCT is not currently available to the general dental practitioner. FOTI and NIR are more readily available and easy to use; however, they show limitations in their ability to detect enamel caries but may be considered successful in the identification of sound teeth.

Three types of fluorescence-based (FB) devices were evaluated.[54] Blue and green FB appeared to outperform red FB devices but this difference was not supported by the results of a formal statistical comparison. The certainty of evidence was rated as low. The review concluded that there is considerable variation in the performance of these FB devices that could not be explained by the different wavelengths of the devices assessed, participant, or study characteristics. This leads to a question of whether the utilisation of a fluorescence device provides sufficient benefits to justify the cost given that dental practices will be invested in radiographic detection. Despite the reasonably high sensitivity and specificity estimates, the authors do not envisage a scenario where a clinician would carry out a clinical examination without performing a thorough visual diagnosis, and with development, future fluorescence-based devices may support the clinician in confirming the status of uncertain or difficult to diagnose teeth.

The review of visual classification systems included 67 studies with the most frequently reported systems being the International Caries Detection and Assessment System (ICDAS) (36 studies) and Ekstrand-Ricketts-Kidd (ERK) (15 studies).[55] There was substantial variability in the results of the individual studies: sensitivities ranged from 0.16 to 1.00 and specificities from 0 to 1.00. For all visual classification systems, the estimated summary sensitivity and specificity point was 0.86 (95% CI 0.80 to 0.90) and 0.77 (95% CI 0.72 to 0.82) respectively, diagnostic odds ratio (DOR) 20.38 (95% CI 14.33 to 28.98). The certainty of the evidence was rated as low. The review concluded that whilst the confidence intervals for the summary points of the different visual classification systems indicated reasonable performance, they do not reflect the confidence that one can have in the accuracy of assessment using these systems due to the considerable unexplained heterogeneity

evident across the studies. The authors note that the substantial variation in results in the results, is perhaps unsurprising as the use of these classification systems involve interpretation by the user.

The review of electrical conductance devices (non-invasive devices that send an electrical current to the surface of the tooth) evaluated two tests: the electronic caries monitor (ECM) (four studies) and CarieScan Pro (three studies).[56] There was variability in the results of the individual studies, with sensitivities which ranged from 0.55 to 0.98 and specificities from 0 to 1.00. The review concluded that based on the very low certainty of the evidence and the low number of included studies there is little evidence to support the widespread introduction of electrical conductance devices as an adjunct to clinical examination in a clinical setting.

The review of dental imaging methods included 77 studies.[57] The most frequently reported imaging methods were analogue radiographs (51 studies), digital radiographs (40 studies) and CBCT (7 studies). There was substantial variability in the results of the individual studies, with sensitivities that ranged from 0 to 0.96 and specificities from 0 to 1.00. For all imaging methods the estimated summary sensitivity and specificity point was 0.47 (95% confidence interval (CI) 0.40 to 0.53) and 0.88 (95% CI 0.84 to 0.92), respectively.

Low-certainty evidence suggests that imaging for the detection or diagnosis of early caries may have poor sensitivity but acceptable specificity, resulting in a relatively high number of false-negative results with the potential for early disease to progress. There is uncertainty as to whether the accuracy of these radiographs, specifically the sensitivity, is sufficient to detect and inform the diagnosis of early caries for clinicians. This finding does not detract from the benefits of using radiographs as an adjunct to the conventional visual-tactile examination for detecting and diagnosing severe levels of disease.

A comparative analysis concluded that the diagnostic accuracy of the tests was similar, suggesting confidence in the robustness of the results. In terms of sensitivity, the comparative performance of the technologies was similar, with the exception of radiographic imaging, which exhibited the poorest performance; the summary estimates of specificity were similar across all technologies.[58] The certainty of evidence was rated as low. The review concluded that given the proportions of false-negative and false-positive results that were found, it may seem that there is little benefit in supplementing the visual or visual-tactile method of caries detection with the use of more novel technologies. However, as the majority of primary care practitioners typically do not use a comprehensive robust visual/visual-tactile classification system (e.g. ICDAS or ERK) for caries detection, there is a risk of failing to detect early lesions in routine clinical practice. In these circumstances, the use of these detection technologies may be beneficial. However, where a practitioner employs a robust and detailed visual/visual-tactile classification system examination for every patient, then the use of these technologies may confer little additional benefit.

CBCT use was evaluated in the imaging review[57] and it was concluded that, although there was more limited evidence available than for other imaging methods, it shows considerably more promise in being able to detect enamel level lesions but has limited applicability to a typical clinical

setting. The high levels of radiation linked to CBCT make it difficult to justify this as a course of action to detect early lesions, although any lesion detected as an incidental finding on a CBCT taken for another purpose should be reported. This reflects EAPD guidance[59] which notes that CBCT is not indicated for caries detection and diagnosis with bitewing radiographs being the method of first choice. CBCT follows strict indications and is limited to very few clinical situations where two-dimensional imaging modalities fall short in terms of diagnostic efficacy.

Assessment: A number of reviews have been published on caries detection in the last three years indicating this as an area of emerging interest. Overall, the reviews pose questions about the variable performance of devices in detecting caries and their benefit/added value given their cost and the fact that most practices will have already invested in a radiographic device. Some devices are not available (OCT) or have limited applicability (CBCT) to general practice and the value of others may be in supporting visual examinations. The evidence reviewed was rated as low or very low certainty.

Recommendation: The PMDCC2 guidance does not cover the detection of caries by means of devices and systems other than by radiographic imaging. The content of the guidance could be expanded to cover caries detection devices and systems, but evidence does not generally endorse their use in this role. Alternatively, the guidance could note the emerging interest in this area and its potential use in the future.

A3.5 Stakeholder surveys

Dental practitioner survey

A survey of primary care dental practitioners was conducted by SDCEP's partner programme, Translation Research in a Dental Setting (TRiaDS), (completed April 2023), with the following results (see Appendix 1 for further details):

- 63 respondents.
- Respondents reported positively on the layout of the current guidance describing it as 'clear' and 'easy to navigate'. The use of pictures, colour, tables, flow charts and repetition were also reported on favourably.
- Responses identified new evidence and clinical developments to be explored. These included the use of SDF, MIH guidelines, obesity as a risk factor, MID, CBCT use, pulpotomies, children's rights.
- The survey highlighted the need to review the terminology used in the guidance.

Guidance Development Group survey

A survey seeking feedback on the PMDCC2 guidance and information on relevant developments in the topic area was sent to members of the Guidance Development Group (GDG) in September 2023.

- Seven GDG members provided responses.
- Respondent's feedback was positive with them reporting colleagues and trainees finding the guidance useful. It was also noted that the guidance is referenced by other resources and publications.
- Responses identified new evidence and clinical developments to be explored. These included the use of SDF, several new guidelines on treating caries and the need to build sustainability considerations into recommendation and advice points wherever possible.
- Respondents identified a number of dental techniques in the guidance which they considered to have been superseded by new approaches.

Surveillance review references

1. Public Health England (PHE). Delivering Better Oral Health: an evidence-based toolkit for prevention. 2021; https://www.gov.uk/government/publications/delivering-better-oral-health-an-evidence-based-toolkit-for-prevention. Accessed 7 November 2023.
2. Thang Le VN, Kim JG, Yang YM, Lee DW. Risk Factors for Early Childhood Caries: An Umbrella Review. *Pediatric Dentistry.* 2021;43(3):176-194.
3. Kirthiga M, Murugan M, Saikia A, Kirubakaran R. Risk Factors for Early Childhood Caries: A Systematic Review and Meta-Analysis of Case Control and Cohort Studies. *Pediatric Dentistry.* 2019;41(2):95-112.
4. Angelopoulou MV, Beinlich M, Crain A. Early Childhood Caries and Weight Status: A Systematic Review and Meta-Analysis. *Pediatric Dentistry.* 2019;41(4):261-272.
5. Manohar N, Hayen A, Fahey P, Arora A. Obesity and dental caries in early childhood: A systematic review and meta-analyses. *Obesity Reviews.* 2020;21(3):e12960.
6. Fernandes TO, Carvalho PA, Abreu FV, et al. Association between nutritional status and children and adolescents' dental caries experiences: an overview of systematic reviews. *Journal of Applied Oral Science : revista FOB.* 2023;31:e20230138.
7. British Society of Paediatric Dentistry (BSPD). Obesity and Dental Decay in Children Position Statement. 2020; https://www.bspd.co.uk/Professionals/Resources/Position-Statements. Accessed 10 November 2023.
8. Jørgensen MR, Twetman S. A systematic review of risk assessment tools for early childhood caries: is there evidence? *European Archives of Paediatric Dentistry : official journal of the European Academy of Paediatric Dentistry.* 2019;21(2):179-184.
9. Su N, Lagerweij MD, van der Heijden G. Assessment of predictive performance of caries risk assessment models based on a systematic review and meta-analysis. *Journal of Dentistry.* 2021; 110:103664.
10. Christian B, Armstrong R, Calache H, Carpenter L, Gibbs L, Gussy M. A systematic review to assess the methodological quality of studies on measurement properties for caries risk assessment tools for young children. *International Journal of Paediatric Dentistry.* 2018;29(2):106-116.
11. Cagetti MG, Bontà G, Cocco F, Lingstrom P, Strohmenger L, Campus G. Are standardized caries risk assessment models effective in assessing actual caries status and future caries increment? A systematic review. *BMC Oral Health.* 2018;18(1):123.
12. Scottish Intercollegiate Guidelines Network (SIGN). Dental interventions to prevent caries in children. 2014; https://www.sign.ac.uk/our-guidelines/dental-interventions-to-prevent-caries-in-children/. Accessed 7 November 2023.
13. Moynihan P, Tanner LM, Holmes RD, et al. Systematic Review of Evidence Pertaining to Factors That Modify Risk of Early Childhood Caries. *JDR Clinical and Translational Research.* 2019;4(3):2380084418824262.

14. Worthington HV, MacDonald L, Poklepovic Pericic T, et al. Home use of interdental cleaning devices, in addition to toothbrushing, for preventing and controlling periodontal diseases and dental caries. *Cochrane Database of Systematic Reviews*. 2019; 4: CD012018.

15. Walsh T, Worthington HV, Glenny AM, Marinho VCC, Jeroncic A. Fluoride toothpastes of different concentrations for preventing dental caries. *Cochrane Database of Systematic Reviews*. 2019; 3: CD007868.

16. World Health Organisation. Ending childhood dental caries: WHO implementation manual. 2020; https://www.who.int/publications/i/item/ending-childhood-dental-caries-who-implementation-manual. Accessed 20 November 2023.

17. Ramamurthy P, Rath A, Sidhu P, et al. Sealants for preventing dental caries in primary teeth. *Cochrane Database of Systematic Reviews*. 2022; 2: CD012981.

18. Lam PPY, Sardana D, Ekambaram M, Lee GHM, Yiu CKY. Effectiveness of Pit and Fissure Sealants for Preventing and Arresting Occlusal Caries in Primary Molars: A Systematic Review and Meta-Analysis. *The Journal of Evidence-based Dental Practice*. 2020;20(2):101404.

19. Schwendicke F, Walsh T, Lamont T, et al. Interventions for treating cavitated or dentine carious lesions. *Cochrane Database of Systematic Reviews*. 2021; 7: CD013039.

20. Ahovuo-Saloranta A, Forss H, Walsh T, Nordblad A, Makela M, Worthington HV. Pit and fissure sealants for preventing dental decay in permanent teeth. *Cochrane Database of Systematic Reviews*. 2017;7: CD001830.

21. Kashbour W, Gupta P, Worthington HV, Boyers D. Pit and fissure sealants versus fluoride varnishes for preventing dental decay in the permanent teeth of children and adolescents. *Cochrane Database of Systematic Reviews*. 2020; 11: CD003067.

22. Li F, Jiang P, Yu F, et al. Comparison between Fissure Sealant and Fluoride Varnish on Caries Prevention for First Permanent Molars: a Systematic Review and Meta-analysis. *Scientific Reports*. 2020;10(1):2578.

23. Rashed T, Alkhalefa N, Adam A, AlKheraif A. Pit and Fissure Sealant versus Fluoride Varnish for the Prevention of Dental Caries in School Children: A Systematic Review and Meta-Analysis. *International Journal of Clinical Practice*. 2022;2022:8635254.

24. Crystal YO, Marghalani AA, Ureles SD, et al. Use of Silver Diamine Fluoride for Dental Caries Management in Children and Adolescents, Including Those with Special Health Care Needs. *Pediatric Dentistry*. 2017;39(5):135-145.

25. Slayton RL, Urquhart O, Araujo MWB, et al. Evidence-based clinical practice guideline on nonrestorative treatments for carious lesions: A report from the American Dental Association. *Journal of American Dental Association*. 2018;149(10):837-849 e819.

26. Duggal M, Gizani S, Albadri S, et al. Best clinical practice guidance for treating deep carious lesions in primary teeth: an EAPD policy document. *European Archive of Paediatric Dentistry*. 2022;23(5):659-666.

27. Splieth Christian H, Banerjee A, Bottenberg P, et al. How to Intervene in the Caries Process in Children: A Joint ORCA and EFCD Expert Delphi Consensus Statement. *Caries Research*. 2020;54(4):297-305.

28. International Association of Paediatric Dentistry (IAPD). IAPD Foundational Articles and Consensus Recommendations: Minimal Invasive Dentistry. 2022; https://iapdworld.org/wp-content/uploads/2022/08/2022_02_minimal-invasive-dentistry.pdf. Accessed 20 November 2023.

29. Chou R, Pappas M, Dana T, et al. U.S. Preventive Services Task Force Evidence Syntheses, formerly Systematic Evidence Reviews. Screening and Interventions to Prevent Dental Caries in Children Younger Than Age Five Years: A Systematic Review for the U.S. Preventive Services Task Force. Rockville (MD): Agency for Healthcare Research and Quality (US). 2021; https://www.ncbi.nlm.nih.gov/books/NBK575915/. Accessed 23 November 2023.

30. American Academy of Pediatric Dentistry (AAPD). Policy on the use of silver diamine fluoride for pediatric dental patients. 2023; https://www.aapd.org/research/oral-health-policies--recommendations/use-of-silver-diamine-fluoride-for-pediatric-dental-patients/. Accessed 15 November 2023.

31. Monse B, Heinrich-Weltzien R, Mulder J, Holmgren C, van Palenstein Helderman WH. Caries preventive efficacy of silver diammine fluoride (SDF) and ART sealants in a school-based daily fluoride toothbrushing program in the Philippines. *BMC Oral Health.* 2012;12:52.

32. Llodra JC, Rodriguez A, Ferrer B, Menardia V, Ramos T, Morato M. Efficacy of silver diamine fluoride for caries reduction in primary teeth and first permanent molars of schoolchildren: 36-month clinical trial. *Journal of Dental Research.* 2005;84(8):721-724.

33. Dhar V, Pilcher L, Fontana M, et al. Evidence-based clinical practice guideline on restorative treatments for caries lesions: A report from the American Dental Association. *Journal of American Dental Association.* 2023;154(7):551-566 e551.

34. BaniHani A, Santamaría RM, Hu S, Maden M, Albadri S. Minimal intervention dentistry for managing carious lesions into dentine in primary teeth: an umbrella review. *European Archives of Paediatric Dentistry : official journal of the European Academy of Paediatric Dentistry.* 2022; (5):667-693.

35. St George G, Morgan A, Meechan J, et al. Injectable local anaesthetic agents for dental anaesthesia. *Cochrane Database of Systematic Reviews.* 2018; 7: CD006487.

36. Duncan HF, Galler KM, et al. European Society of Endodontology position statement: Management of deep caries and the exposed pulp. *International Endodontic Journal.* 2019;52(7):923-934.

37. Noar J, Taylor G, Ashley P, Williams A, Harrison M, Cobourne M. A Guideline for the Extraction of First Permanent Molars in Children. 2023; https://www.rcseng.ac.uk/dental-faculties/fds/publications-guidelines/clinical-guidelines/. Accessed 20 November 2023.

38. Smaïl-Faugeron V, Glenny AM, Courson F, Durieux P, Muller-Bolla M, Fron Chabouis H. Pulp treatment for extensive decay in primary teeth. *Cochrane Database of Systematic Reviews.* 2018; 5: CD003220.

39. Gizani S, Seremidi K, Stratigaki E, Tong HJ, Duggal M, Kloukos D. Vital Pulp Therapy in Primary Teeth with Deep Caries: An Umbrella Review. *Pediatric Dentistry.* 2021;43(6):426-437.

40. Coll JA, Dhar V, Vargas K, et al. Use of Non-Vital Pulp Therapies in Primary Teeth. *Pediatric Dentistry.* 2020;42(5):337-349.

41. Marshman Z. 'Your teeth you are in control'. *BDJ Team.* 2017;4(1):17010.

42. Scottish Government. National Guidance for Child Protection in Scotland 2021. https://www.gov.scot/publications/national-guidance-child-protection-scotland-2021-updated-2023/. Accessed 7 November 2023.

43. Scottish Government. Getting it right for every child (GIRFEC): policy statement. 2022. https://www.gov.scot/policies/girfec/. Accessed 7 November 2023.

44. Office of the High Commissioner for Human Rights. United Nations Convention on the Rights of the Child. 1989; https://www.ohchr.org/en/instruments-mechanisms/instruments/convention-rights-child. Accessed 7 November 2023.

45. The Promise Scotland. The Promise. 2020; https://thepromise.scot/. Accessed 7 November 2023.

46. British Dental Association (BDA). Was not brought. A tool for safeguarding children who miss appointments. 2020; https://www.bda.org/advice/patient-care-and-safety/safeguarding-was-not-brought/. Accessed 7 November 2023.

47. Public Health England (PHE). Safeguarding in general dental practice: a toolkit for dental teams. 2019; https://www.gov.uk/government/publications/safeguarding-in-general-dental-practice. Accessed 7 November 2023.

48. British Society of Paediatric Dentistry (BSPD). Rights from the Start. 2023; https://www.bspd.co.uk/Rights-from-the-Start. Accessed 7 November 2023.

49. National Institute for Health and Care Excellence (NICE). Shared Decision Making NICE guidleline [NG197]. 2021; https://www.nice.org.uk/guidance/ng197. Accessed 7 November 2023.

50. Lygidakis NA, Garot E, Somani C, Taylor GD, Rouas P, Wong FSL. Best clinical practice guidance for clinicians dealing with children presenting with molar-incisor-hypomineralisation (MIH): an updated European Academy of Paediatric Dentistry policy document. *European Archives of Paediatric Dentistry.* 2022;23(1):3-21.

51. Royal College of Surgeons of England. Clinical guidelines for dental erosion. Diagnosis, prevention and management of dental erosion. 2021; https://www.rcseng.ac.uk/dental-faculties/fds/publications-guidelines/clinical-guidelines/. Accessed 23 November 2023.

52. British Society of Periodontology and Implant Dentistry (BSP) and British Society of Paediatric Dentistry. Guidelines for periodontal screening and management of children and adolescents under 18 years of age. 2021; https://www.bsperio.org.uk/assets/downloads/Updated_BSP_BSPD_Perio_Guidelines_for_the_Under_18s_2021_FINAL_270921_vc_PDF_version.pdf. Accessed 23 November 2023.

53. Macey R, Walsh T, Riley P, et al. Transillumination and optical coherence tomography for the detection and diagnosis of enamel caries. *Cochrane Database of Systematic Reviews.* 2021; 1: CD013855.

54. Macey R, Walsh T, Riley P, et al. Fluorescence devices for the detection of dental caries. *Cochrane Database of Systematic Reviews.* 2020; 12: CD013811.

55. Macey R, Walsh T, Riley P, et al. Visual or visual-tactile examination to detect and inform the diagnosis of enamel caries. *Cochrane Database of Systematic Reviews.* 2021; 6: CD014546.

56. Macey R, Walsh T, Riley P, et al. Electrical conductance for the detection of dental caries. *Cochrane Database of Systematic Reviews.* 2021; 3: CD014547.

57. Walsh T, Macey R, Riley P, et al. Imaging modalities to inform the detection and diagnosis of early caries. *Cochrane Database of Systematic Reviews.* 2021; 3: CD014545.

58. Walsh T, Macey R, Ricketts D, et al. Enamel Caries Detection and Diagnosis: An Analysis of Systematic Reviews. *Journal of Dental Research.* 2022;101(3):261-269.

59. Kuhnisch J, Anttonen V, Duggal MS, et al. Best clinical practice guidance for prescribing dental radiographs in children and adolescents: an EAPD policy document. *European Archives of Paediatric Dentistry.* 2020;21(4):375-386.

Appendix 4 – Discussion Points: Evidence Summaries and Considered Judgements

Aspects of the guidance identified as potentially requiring updating were discussed with the Guidance Development Group as detailed in the following Discussion Point (DP) tables (also see Section 2). DPs 1-3, 16, 17, 22 and 23 (Promoting UNCRC; Promoting realistic dentistry; Promoting sustainability; Age for first permanent molars of poor prognosis; First permanent molars extraction & balancing; Local anaesthesia; Providing additional support) were presented to the group as proposed updated text and are not included here.

A4.1 DP4 Caries Detection Devices and Systems

Should more information about caries detection devices and systems be included in updated PMDCC guidance?
Background Current PMDCC2 guidance does not cover the detection of caries by means of devices and systems other than by radiographic imaging. A review of the Cochrane Database identified five reviews published from 2020 which examined a range of devices and systems for the detection and diagnosis of caries in children and adults. The reviews cover illumination tests (Macey 2021), fluorescence-based devices (Macey 2020), visual classification systems (Macey 2021b), electrical conductance devices (Macey 2021c) and dental imaging methods (Walsh 2021). A comparative evaluation of the diagnostic accuracy of all these five these technologies was also conducted (Walsh 2022).
Assessment of Evidence The comparative analysis (Walsh 2022) concluded that the diagnostic accuracy of the tests was similar suggesting confidence in the robustness of the results. In terms of sensitivity, the comparative performance of the technologies was similar, with the exception of radiographic imaging, which exhibited the poorest performance; the summary estimates of specificity were similar across all technologies. The certainty of evidence was rated as low. The review concluded that given the proportions of false-negative and false-positive results that were found, there appears to be little benefit in supplementing the visual or visual-tactile method of caries detection with the use of more novel technologies. However, as typically, the majority of primary care practitioners do not use a comprehensive robust visual/visual-tactile classification system (e.g. ICDAS or ERK) for caries detection, there is a risk of failing to detect early lesions in routine clinical practice. In these circumstances, the use of these detection technologies may be

beneficial. However, where a practitioner employs a robust and detailed visual/visual-tactile classification system examination for every patient, then the use of these technologies may confer little additional benefit.

Proposal for updating PMDCC2

A number of reviews have been published on caries detection in the last three years indicating this as an area of emerging interest. The evidence reviewed was rated as low and very low certainty. Overall, the reviews pose questions about the variable performance of devices in detecting caries and their benefit/added value given their cost and the fact that most practices will have already invested in a radiographic device. Some devices are not available (optical coherence tomography) or have limited applicability (cone beam computed topography) to general practice and the value of others may be in supporting visual examinations.

Given that the evidence does not generally endorse the role of devices in caries detection it is proposed that the PMDCC2 guidance is not expanded to include these, subject to the agreement of the GDG.

Outcome

The GDG agreed that no specific detail is to be given on caries devices and systems but a general reference to them can be made. The need for systematic assessment and early detection will also be added.

The Clinical assessment section of the guidance was amended.

References

Macey R, Walsh T, Riley P, Hogan R, Glenny AM, Worthington HV, et al. Transillumination and optical coherence tomography for the detection and diagnosis of enamel caries. Cochrane Database of Systematic Reviews. 2021. CD013855.

Macey R, Walsh T, Riley P, Glenny AM, Worthington HV, Fee PA, et al. Fluorescence devices for the detection of dental caries. Cochrane Database of Systematic Reviews. 2020. CD013811.

Macey R, Walsh T, Riley P, Glenny AM, Worthington HV, O'Malley L, et al. Visual or visual-tactile examination to detect and inform the diagnosis of enamel caries. Cochrane Database of Systematic Reviews. 2021b. CD014546.

Macey R, Walsh T, Riley P, Glenny AM, Worthington HV, Clarkson JE, et al. Electrical conductance for the detection of dental caries. Cochrane Database of Systematic Reviews. 2021c. CD014547.

Walsh T, Macey R, Riley P, Glenny AM, Schwendicke F, Worthington HV, et al. Imaging modalities to inform the detection and diagnosis of early caries. Cochrane Database of Systematic Reviews. 2021. CD014545.

Walsh T, Macey R, Ricketts D, Carrasco Labra A, Worthington H, Sutton AJ, et al. Enamel Caries Detection and Diagnosis: An Analysis of Systematic Reviews. Journal of Dental Research. 2022;101(3):261-9. 34636266.

A4.2 DP5 Obesity as a caries risk factor

Should obesity be added as a caries risk factor in updated PMDCC guidance?

Background

The surveillance report recommends consideration of the evidence around the relationship between obesity and caries as a means of assessing whether it should be included as a risk factor in an updated version of the guidance.

PMDCC2 identifies a range of risk factors for childhood caries taken from SIGN 138 (2014). These include: clinical evidence of previous disease; dietary habits, especially frequency of sugary food and drink consumption; social history, especially socioeconomic status; use of fluoride; plaque control; saliva; medical history.

PMDCC2 makes no reference to obesity and therefore its inclusion would be as a new risk factor for childhood caries. The question directly related to risk factors in PMDCC2 is "what factors should be taken into account to inform an assessment of the risk of a child developing dental caries?".

Assessment of Evidence

An umbrella review on risk for caries identified obesity as being a potential risk factor for early childhood caries (Thang 2021). This was based on two SRs which concluded that younger children (<6 years old) who were overweight/obese have a greater risk/prevalence of caries (Angelopoulou 2019, Manohar 2020). No direct causal relationship has been established between obesity and caries but it is concluded that low levels of parental income and education were commonly associated for both overweight/obesity and dental caries in young children. (Manohar 2020).

Another umbrella review examined the association between dental caries and nutritional status in children and adolescents (Fernandes 2023). Nineteen SRs were included with seven SRs finding an association between obesity/overweight and dental caries; one, an association between underweight and dental caries; and eleven, no associations. However, 17 of the included SRs showed high risk of bias and critically low methodological quality.

A PHE (2019) report examined the relationship between dental caries and BMI and concluded that children with underweight or overweight and very overweight were more likely to have experienced dental caries than those of a healthy weight.

A BSPD (2020) position statement calls for further co-ordinated, multi-agency approaches to the management of obesity and dental decay, including supporting dietary changes and close liaison with dieticians and networks established in weight management programmes to facilitate appropriate referral and also to raise awareness of established common risk factors.

The evidence presented suggests there is an association between child caries and obesity, but this does not amount to a causal link.

Proposal for updating PMDCC2

Obesity could be added to the range of risk factors cited in PMDCC2 with an explanatory sentence noting that there is an association between caries and obesity but that no causal relationship has been established between the two.

Outcome

The GDG noted that that the common issue is sugar and agreed not to include obesity as a risk factor, but to note the association citing Manohar (2020).

The Caries risk assessment section of the guidance was amended.

References

Angelopoulou MV, Beinlich M, Crain A. Early Childhood Caries and Weight Status: A Systematic Review and Meta-Analysis. Pediatric Dentistry. 2019;41(4):261-72. 31439085.

British Society of Paediatric Dentistry (BSPD). Obesity and Dental Decay in Children - A Position Statement 2020; https://www.bspd.co.uk/Professionals/Resources/Position-Statements. Accessed 31 October 2023.

Fernandes TO, Carvalho PA, Abreu FV, Kirschneck C, Küchler EC, Antunes LS, Antunes LAA. Association between nutritional status and children and adolescents' dental caries experiences: an overview of systematic reviews. Journal of Applied Oral Science. 2023 Sep 25;31:e20230138.

Manohar N, Hayen A, Fahey P, Arora A. Obesity and dental caries in early childhood: A systematic review and meta-analyses. Obesity Reviews. 2020;21(3):e12960. 31721413.

Public Health England (PHE). The relationship between dental caries and body mass index. Child level analysis 2019. https://www.gov.uk/government/publications/dental-caries-and-obesity-their-relationship-in-children. Accessed 7 March 2024.

Thang Le VN, Kim JG, Yang YM, Lee DW. Risk Factors for Early Childhood Caries: An Umbrella Review. Pediatric Dentistry. 2021;43(3):176-94.

A4.3 DP6 Caries Risk Assessment Tools

Should caries risk assessment (CRA) tools be included in updated PMDCC guidance?
Background PMDCC2 guidance on prevention relies on assessing the child as at standard or increased risk of developing caries. PMDCC2 guidance (section 3.5) notes that "although several tools for caries risk assessment exist, there is no consensus on which is most effective" (SIGN 138). Delivering Better Oral Health (DBOH) (PHE 2021) observes that CRA tools are based on extensive research but can be complex and time consuming to use. CRA tools operate by a variety of methods: questionnaire-based weighted items, clinical judgement, use of algorithms and can be associated with caries management plans (e.g. CAMBRA). CRA tools often categorise caries risk differently to the PMDCC2 guidance, commonly using low, moderate, high or even, low, moderate, high, very high categories rather than standard risk and increased risk.
Assessment A number of systematic review (SRs) have investigated the performance of CRA tools since the publication of PMDCC2. It is noted however that the methodological quality of the research underpinning CRA tools has been criticised (Christian 2018). Across two SRs no direct comparison of CRA tools was possible because of the quality of the underlying studies supporting them (Cagetti 2018, Su 2021). SRs can come to variable conclusions in evaluating the performance of individual CRA tools, for example Cariogram. Cagetti (2018) concluded that there is not enough evidence to assert that Cariogram is effective in caries assessment and prediction. Jorgesen (2019) evaluated the accuracy of Cariogram as being poor to good in various populations. Su (2021) concluded that the average predictive performance of the two versions of Cariogram (full and reduced) seemed to be acceptable. Although there is evidence for the effective performance of individual tools in some situations /populations (Jorgensen 2019, Su 2021), a conclusion across reviews is that there is a lack of evidence to firmly establish if the tools are effective in determining patients' actual caries risk or in predicting their probability of developing new carious lesions (Cagetti 2018) and ultimately whether they lead to better oral care (Jorgensen 2019). Despite the shortcomings of the evidence base one SR recommends the use of CRA tools as their desirable effects are most likely to outweigh their undesirable effects (Jorgensen 2019).
Proposal for updating PMDCC2

In thinking about the update, it is worth considering what would be the usage of CRA tools by GDPs and therefore how relevant they are to PMDCC guidance.

In terms of updating PMDCC2, the following wording could be presented in the section on caries risk assessment:

Although several tools for caries risk assessment exist, there is no consensus on which is most effective and comparisons have proved difficult to conduct because of the low quality of the studies relating to different tools (Cagetti 2018, Su 2021). The collective performance of risk assessment tools remains to be proved although there is evidence for the effective performance of individual tools in some situations/populations (Jørgensen 2019, Su 2021).

Outcome

The GDG agreed to include a brief summary of the current status of caries risk assessment tools as proposed. The Caries risk assessment section of the guidance was amended.

References

Cagetti MG, Bontà G, Cocco F, Lingstrom P, Strohmenger L, Campus G. Are standardized caries risk assessment models effective in assessing actual caries status and future caries increment? A systematic review. BMC Oral Health. 2018;18(1):123.

Christian B, Armstrong R, Calache H, Carpenter L, Gibbs L, Gussy M. A systematic review to assess the methodological quality of studies on measurement properties for caries risk assessment tools for young children. International Journal of Paediatric Dentistry. 2018;29(2):106-16.

Jørgensen MR, Twetman S. A systematic review of risk assessment tools for early childhood caries: is there evidence? European archives of paediatric dentistry : official journal of the European Academy of Paediatric Dentistry. 2019; 21(2):179-184.

Public Health England (PHE). Delivering Better Oral Health: an evidence-based toolkit for prevention. 2021; https://www.gov.uk/government/publications/delivering-better-oral-health-an-evidence-based-toolkit-for-prevention. Accessed 7 November 2023.

Scottish Intercollegiate Guidelines Network (SIGN). Dental interventions to prevent caries in children. 2014; https://www.sign.ac.uk/our-guidelines/dental-interventions-to-prevent-caries-in-children/. Accessed 7 November 2023.

Su N, Lagerweij MD, van der Heijden G. Assessment of predictive performance of caries risk assessment models based on a systematic review and meta-analysis. Journal of Dentistry. 2021:103664.

A4.4 DP7 Vital Pulp Therapies in Permanent Teeth – Considered Judgement

For Discussion Point 7, the Considered Judgement methodology was adopted because it seemed likely that a key recommendation might change or a new key recommendation might be required.

Key Questions

- In children what evidence is there for the effectiveness of pulp therapy in permanent teeth as an alternative to root canal treatment for maintaining the health of all or part of the pulp?
- What evidence is there for the effectiveness of particular vital pulp therapy techniques and materials for children?

Recommendation in 2018 edition of guidance:

This question was not considered for the second edition of *Prevention and Management of Dental Caries in Children* (PMDCC2) guidance.

For information, the key recommendation associated with vital pulp therapy in *primary* teeth is:

> For a child in pain due to pulpitis in a vital primary tooth with irreversible symptoms and no evidence of dental abscess, consider carrying out a pulpotomy to preserve the tooth and to avoid the need for an extraction.
> (Conditional recommendation; low quality evidence)

1. Summary of evidence since 2018 edition of guidance

*Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the **certainty** of the evidence. Comment on the degree of **consistency** demonstrated by the available evidence. Note where evidence is lacking.*

Evidence was reviewed from a guideline and systematic review.

The effectiveness of pulp therapy in permanent teeth as an alternative to root canal treatment (RCT)

The ESE guideline (Duncan 2023) sought evidence on whether pulpotomy (partial or full) results in better patient and clinical reported outcomes, compared with RCT in permanent teeth with pulpitis characterized by spontaneous pain evaluated at various time intervals. A commissioned systematic review (SR) (Tomson 2022) identified two randomised clinical trials with a meta-analysis revealing no difference in postoperative pain (day 7) between RCT and pulpotomy (OR = 0.99, 95% CI 0.63– 1.55, I^2= 0%) and quality of evidence being graded as high in the SR but low in the guideline. Clinical success was high at year 1, 98% for both interventions, however, decreased over time to 78.1% (pulpotomy) and 75.3% (RCT) at 5 years. This led to the conclusion that pulpotomy is as effective as RCT, though, as based on only two trials, this evidence is not robust and further high-quality trials are required.

Based on this, the ESE evidence-based consensus recommendation (R2.2) is that "For patients diagnosed with nontraumatic pulpitis associated with spontaneous pain in permanent teeth we

suggest treatment with either root canal treatment or full pulpotomy. This is a weak recommendation based on the consensus agreement of 75 to 95% of participants with voting rights."

Evidence for particular vital pulp therapy techniques

Evidence was identified from the ESE guideline, a recent SR and a Cochrane review.

ESE guidance notes that in order to manage pulpal disease, the most appropriate treatment strategy needs to be evaluated in comparative studies. A commissioned SR (Jakovljevic 2022) undertook three comparisons for patients with nontraumatic pulpitis associated with no or nonspontaneous pain in permanent teeth:

i. is direct pulp capping or pulpotomy (partial/full) as effective as selective or stepwise caries removal?
ii. is pulpotomy (partial/full) as effective as direct pulp capping?
iii. is pulpotomy (partial/full) as effective as a pulpectomy, in terms of a combination of patient and clinical reported outcomes, with "tooth survival" as the most critical outcome?

For the first comparison no studies were identified. The other comparisons found there were no significant differences in effectiveness as determined by either clinical and/or radiographic success, between pulpotomy (partial/full) and direct pulp capping (two randomised controlled trials) or pulpectomy (one randomised controlled trial) in managing nontraumatic pulpitis associated with no or nonspontaneous pain. The need for high-quality randomised controlled trials in these areas is again highlighted.

Based on this, the ESE evidence-based consensus recommendation (R2.1) is that "In patients with nontraumatic pulpitis associated with no or nonspontaneous pain and pulp exposure in mature permanent teeth either direct pulp capping or pulpotomy (partial/full) may be considered. This is classified as an open recommendation (based on the consensus agreement of 75 to 95% of participants) where the evidence is not conclusive/sufficient for the panel members to make a decision meaning either option may be considered."

Regarding the effectiveness of particular pulp therapy techniques, a recent SR (Camoni 2023) evaluated the clinical and radiographic success of partial pulpotomies in deep caries processes or post-eruptive defects in young, vital permanent teeth. Five parallel randomised controlled trials were included and these compared mineral trioxide aggregate (MTA) with other materials/ devices: calcium hydroxide (n=2), calcium hydroxide and biodentine (n=1), biodentine (n=1), MTA plus an erbium CrYGG laser (n=1). A qualitative analysis noted the overall success rate considering clinical and radiographic success of partial pulpotomy at 12-month follow-up was greater than 85% in all studies. In the studies considered for the meta-analysis, partial pulpotomy with calcium hydroxide, Biodentine, and MTA plus laser had a cumulative success rate of 91.8%. In comparison, partial pulpotomy with MTA had a cumulative success rate of 92.3%. Saline or

hypochlorite solution did not significantly affect the outcomes. The Er: CrYSGG laser did not show significantly better results when applied before MTA. A quantitative synthesis of the five studies using a random effects model showed no significance in the success rate: p-value = 0.7759, 95%CI 0.00; 56.04.

The authors concluded that partial pulpotomy is a successful dental procedure when vital pulpal therapy is required in highly damaged young permanent teeth. Comparable clinical and radiological success was found for all materials used, i.e., mineral trioxide aggregate, MTA + laser, calcium hydroxide, and Biodentine.

Overview of Evidence

In response to the research questions, there is low certainty evidence that pulpotomy is as effective as RCT and there are no significant differences in effectiveness between pulpotomy (partial/full) and direct pulp capping or pulpectomy. The effectiveness of a number of materials used in vital pulp therapy has been established.

Comparative studies of vital pulp therapy approaches demonstrate a number of limitations. The evidence is drawn from a small number of studies with questions over their applicability, which reduces the generalizability of the results to general dental practice settings. It is noted that studies have been conducted in university settings, a well-controlled research environment and in the comparison of pulpotomy versus RCT all included studies have been published by the same research group involving patients from one country. These limitations highlight the need for high quality randomised trials across geographical regions.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

No serious adverse effects were reported across vital pulp therapy studies (Duncan 2023)

Vital pulp treatment including pulpotomy is generally quicker, less technically complex and less invasive than root canal treatment. It also reduces the risk of unwanted effects such as fracture, or residual periapical inflammation (ESE 2019).

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

It is likely to be important to avoid extractions in patients with bleeding disorders or patients with naturally missing teeth (hypodontia), where possible. Consequently, treatments that preserve teeth are particularly valuable for these patients.

4. Values and preferences

Summarise any evidence or information on values and preferences.

Across vital pulp therapy studies there is no evidence supporting one approach over the other but a preference for a less invasive and more affordable method would be likely (Duncan 2023)

No data are reported in studies of pulpotomy versus root canal treatment. From the patient's perspective, pain control is an important issue. However, since both interventions are equally effective in reducing postoperative pain, pain control does not seem to be a meaningful, determining factor in the choice of the final treatment approach. (Duncan 2023)

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

In cases of pulpitis associated with no or nonspontaneous pain when the pulp is cariously exposed, clinicians often prefer to carry out pulpectomy in assumption that the pulp is contaminated with bacteria. However, vital pulp treatment (i.e. pulpotomy) offers a less invasive treatment option (Duncan 2023).

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

Duncan (2023) notes the following across comparisons:

Direct pulp capping or pulpotomy versus selective or stepwise caries removal

No cost-effectiveness analysis has been made based on a study directly comparing treatments. Vital pulp treatment following pulp exposure is anticipated to be more expensive than vital pulp treatment without pulp exposure but cheaper than root canal treatment.

Pulpotomy (partial/full) versus direct pulp capping

Direct pulp capping is considered a technically less demanding procedure compared with pulpotomy. However, for both procedures, an enhanced protocol including the use of aseptic conditions, magnification, disinfection of the exposed pulp and the use of suitable bioactive capping material has been recommended.

No cost-effectiveness analysis has been made based on a study directly comparing treatments. Initial costs would most likely be comparable for both treatment options, however, it is not possible to foresee whether there might be a higher cost for unsuccessful cases of full pulpotomies as root canal treatment may be difficult to perform due to the formation of hard tissue at the canal orifices.

Pulpotomy (partial/full) versus pulpectomy

Pulpotomy (partial or full) is less costly and quicker to perform compared with pulpectomy.

Pulpotomy versus RCT

Pulpotomy would be considered easier to perform than root canal treatment and therefore it would be anticipated it would be more widely available than root canal treatment which requires more time, greater expertise and more instruments to perform.

In general, vital pulp treatment is considered less technically demanding than root canal treatment.

Root canal treatment has additional costs compared to pulpotomy, which may not appear to be justified by the added benefits (Asgary 2014).

7. Other factors

Indicate any other factors taken into account.

For some patients with First Permanent Molars of poor prognosis, extraction is the preferred option.

8. Additional information

Include any further information that is relevant to the considered judgement.

Clinicians should be aware that the depth of the carious lesion and how the excavation is performed may affect the outcomes of pulp therapy treatments (Duncan 2023).

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2018 edition of guidance:

- This question was not considered in the second edition of the guidance.

The PMDCC2 guidance advises for the management of irreversible pulpitis in permanent teeth to either carry out root canal therapy (RCT) or extract the teeth. The European Society of Endodontology (ESE) S3-level clinical practice guideline 'Treatment of pulpal and apical disease' notes that for the immediate treatment of symptomatic teeth presenting with pulpitis, symptomatic apical periodontitis or apical abscess, retention of the tooth should be considered as the standard care (Duncan 2023). Accordingly, ESE recommends either root canal treatment or pulpotomy for nontraumatic pulpitis associated with spontaneous pain in permanent teeth and either direct pulp capping or pulpotomy (partial/full) with no or nonspontaneous pain and pulp exposure to retain the tooth.

The GDG was asked to consider the recommendation for the use of vital pulp therapies in permanent teeth in updated PMDCC guidance. If in agreement, there would need to be explanation regarding which teeth/lesions are suited to this approach and the addition of a 'how to' sub-section within the Dental Techniques section. PMDCC guidance would then advise, for the management of irreversible pulpitis in permanent teeth, the use of pulp therapies and RCT in preference to extraction.

Considered judgement:

The GDG considered the proposal to update the guidance with the inclusion of vital pulp therapy for permanent teeth following a presentation of the evidence. The GDG voted as follows in favour of aligning with both ESE recommendations:

Should the updated SDCEP guidance align with the ESE recommendation as an alternative to extraction? (i.e. 'For patients diagnosed with nontraumatic pulpitis associated with spontaneous pain in permanent teeth we suggest treatment with either root canal treatment or full pulpotomy. (weak recommendation)') Yes 86% (n=12), No 14% (n=2)

Should the updated SDCEP guidance align with the ESE recommendation as an alternative to extraction? (i.e. 'In patients with nontraumatic pulpitis associated with no or nonspontaneous pain and pulp exposure in mature permanent teeth either direct pulp capping or pulpotomy (partial/full) may be considered. (open recommendation)') Yes 100% (n=15), No 0%

Following these votes, it was concluded that there was agreement to amend the guidance, in line with ESE recommendations, with the incorporation of vital pulp therapy for the treatment of permanent teeth.

As PMDCC2 already had a recommendation for primary teeth, it was considered appropriate to include an equivalent recommendation for permanent teeth in the Management of caries in permanent teeth section of the guidance.

Key recommendation for updated guidance:

For a child or young person in pain due to pulpitis in a vital permanent tooth with irreversible symptoms and no evidence of dental abscess, consider carrying out a pulpotomy to preserve the tooth and to avoid the need for an extraction.

(Conditional recommendation; low quality evidence)

Basis for recommendation

There is low certainty evidence that pulpotomy is as effective as root canal therapy in permanent teeth and there are no significant differences in effectiveness between pulpotomy (partial/full) and direct pulp capping or pulpectomy. The effectiveness of several materials used in vital pulp therapy has been established.

Main narrative update

The GDG also agreed to the suggested amended text for the Permanent tooth with pain or infection section of the guidance:

Pulpitis – irreversible symptoms

Description: Pain can occur spontaneously but if provoked by a stimulus, is typically not relieved when the stimulus is removed. The pain may last for several hours, may be difficult for the child to localise and may keep the child awake at night. The pain may be dull and throbbing,

worsened by heat and may be alleviated by cold. There are no signs and symptoms of infection such as sinuses or abscesses or periradicular pathology and the pulp is still vital, although inflamed. Usually, the tooth is not tender to percussion.

Aim: To relieve pain.

- Either carry out pulpotomy or pulpectomy or extract the tooth.
- To relieve symptoms, and to allow time for long term treatment planning, consider pulpotomy or pulpectomy and dressing of the root canals, before deciding on extraction of a permanent tooth.
    - In some cases, local measures to bring infection under control may be appropriate.

Several factors need to be considered when making the decision to carry out a pulpotomy or a pulpectomy or to extract in the young permanent dentition, including the long-term prognosis of the tooth, occlusal development and whether avoiding extraction may reduce the risk of treatment-induced anxiety. Therefore, a comprehensive assessment should be undertaken prior to undertaking one of these treatment options.

<u>Pulpitis – reversible symptoms</u>

Addition of:

- If no dentine bridge is visible, consider carrying out selective caries removal or pulpotomy.

References

Asgary, S., Eghbal, M.J. & Ghoddusi, J. Two-year results of vital pulp therapy in permanent molars with irreversible pulpitis: an ongoing multicenter randomized clinical trial. Clinical Oral Investigations. 2014, 18, 635–641.

Camoni N, Cagetti MG, Cirio S, Esteves-Oliveira M, Campus G. Partial Pulpotomy in Young Permanent Teeth: A Systematic Review and Meta-Analysis. Children (Basel). 2023 Aug 24;10(9):1447.

Duncan HF, Kirkevang LL, Peters OA, El-Karim I, Krastl G, Del Fabbro M, Chong BS, Galler KM, Segura-Egea JJ, Kebschull M; ESE Workshop Participants and Methodological Consultant. Treatment of pulpal and apical disease: The European Society of Endodontology (ESE) S3-level clinical practice guideline. International Endodontic Journal. 2023 Oct;56 Suppl 3:238-295.

European Society of Endodontology (ESE), Duncan, H.F., Galler, K.M., Tomson, P.L., Simon, S., El-Karim, I. et al. European Society of Endodontology position statement: management of deep caries and the exposed pulp. International Endodontic Journal. 2019, 52, 923‐934

Gizani S, Seremidi K, Stratigaki E, Tong HJ, Duggal M, Kloukos D. Vital Pulp Therapy in Primary Teeth with Deep Caries: An Umbrella Review. Pediatric Dentistry. 2021;43(6):426-37.

Jakovljevic A, Jaćimović J, Aminoshariae A, Fransson H. Effectiveness of vital pulp treatment in managing nontraumatic pulpitis associated with no or nonspontaneous pain: A systematic review. International Endodontic Journal. 2023 Oct;56 Suppl 3:340-354.

A 4.5 DP8 Sugar-free medicine

Should DBOH advice on sugar free medicine be included in updated PMDCC guidance?

Background

The surveillance review identified a difference between DBOH (PHE 2021) and PMDCC2 with regard to advice on sugar free medicine.

DBOH states that it is good practice for children up to 6 years to use sugar-free versions of medicines if possible. Similarly for children up to 18 years old giving concern because of dental caries risk, where the child is prescribed medication frequently or long term, dentists should liaise with the medical practitioner to request that it is sugar free.

PMDCC2 guidance provides no advice on sugar free medicine but indirectly makes reference to this in the assessment section with the question "does the child take regular sugar-containing medication?". The lack of advice on sugar free medicine in PMDCC2 may simply be an omission.

Assessment of Evidence

The DBOH considered judgement form was reviewed but it has no summary of evidence on sugar free medicine. It simply presents the good practice points on sugar free medicine.

DBOH recognises medicines containing sugars as a modifiable risk factor for caries. This may particularly effect children taking long-term medications in liquid format for chronic illnesses (e.g. epilepsy) and those taking frequent medications for common conditions including pain relief, infections, coughs and colds. DBOH advises that good practice is to use sugar versions of medicine if possible and provides the following advice:

- Where a patient is on a long-term liquid or soluble medication that is not sugar-free, clinical teams are advised to check the British National Formulary (BNF) to determine if sugar-free alternatives are available.
- Where a sugar-free version is available, the clinician should write to the patient's general medical practitioner to ask if they can change the prescription to the sugar-free version, explaining the reason for the request.
- Patients that are dentate and on long-term medication that is not sugar-free, and where sugar-free alternatives are not available, should be advised where possible to try to take medications at mealtimes.
- Parents should also be advised to discuss with pharmacists if sugar-free versions of over the counter liquid medications are available for their children.

Proposal for updating PMDCC2

Suggest adding a bullet point in 'Enhanced prevention for children at increased risk of caries' in the Dietary advice section:

- For children taking regular medication, advise the use of an alternative sugar-free formulation if available or taking medication at mealtimes, where possible. This might involve communication with the child's general practitioner and/or pharmacist to identify and arrange alternatives.

Outcome

The GDG agreed to the inclusion of the proposed text on sugar free medicine in for the guidance update, amended to apply to all children rather than those at enhanced risk only. The need to liaise with parents and other professionals should also be added.

The Dietary advice section of the guidance was amended.

References

Public Health England (PHE). Delivering Better Oral Health: an evidence-based toolkit for prevention. 2021; https://www.gov.uk/government/publications/delivering-better-oral-health-an-evidence-based-toolkit-for-prevention. Accessed 7 November 2023.

A4.6 DP9 Fissure sealant application based on age and risk

Should the SDCEP recommendation on the application of fissure sealants align with the DBOH recommendation with regard to age and risk levels?

Background

The surveillance report recommends a review of the age differences and risk levels between DBOH and PMDCC2 recommendations for the application of sealants with a view to updating these in the guidance.

DBOH's strong recommendation for children from 7 years and young people up to 18 years giving concern because of dental caries risk is to apply resin sealant to permanent teeth on eruption whereas PMDCC2's strong recommendation, based on SIGN 138, is for all children to place fissure sealants on permanent molars as early as possible after eruption.

The PMDCC2 question was "what is the evidence for effectiveness of sealants in preventing dental caries in children?".

Assessment of Evidence

A review of the respective DBOH and PMDCC2 considered judgement (CJ) forms gives an insight into the reasons for the different age recommendations.

Although DBOH (2021) retained the recommendation from the previously published third edition (2014), the CJ form notes that the age band (from 7 years and young people up to 18 giving concern because of dental caries risk) may not be appropriate and that the key factor is eruption of permanent molars. The DBOH CJ form also notes in terms of feasibility that there was a discussion around whether all children's teeth should be sealed (as recommended by PMDCC2 guidelines). It was concluded that this is expensive and risks many people receiving an unnecessary intervention as they will never develop caries anyway. Proximal sealants should be placed where necessary and possible.

The PMDCC2 CJ form notes the SIGN 138 recommendation that resin-based fissure sealants should be applied to the permanent molars of all children as early after eruption as possible (Grade A). In making the recommendation in SIGN 138, the relatively high level of disease in Scotland and the low rate of application of fissure sealants were important considerations. SIGN 138 cited an earlier version of a Cochrane review that was published in 2013 (Ahovuo-Saloranta). Both the 2013 review and the updated 2017 version (cited in PMDCC2) reached the same conclusion regarding the efficacy of pit and fissure sealants in preventing caries in occlusal surfaces. However, unlike the earlier version, the 2017 version did not conclude that the effectiveness of sealants is limited to children at high risk of caries, hence the SDCEP recommendation for all children.

Recommendation for updating PMDCC2

The CJ forms explain the reasoning for the difference in age recommendations relating to risk levels. The GDG was asked to assess whether the PMDCC recommendation that all children get fissure sealants as soon after eruption requires to be aligned with that of DBOH which recommends that it is limited to children from 7 years old giving concern because of dental caries risk.

Outcome

The GDG disagreed with the setting of an arbitrary age in a recommendation for applying a sealant. However, given consideration of the efficacy of fluoride varnish versus fissure sealants (see Discussion Point 11), it was agreed that clinicians should consider fissure placement rather than recommending them to do so for all children.

The Caries prevention section of the guidance was amended.

References

Ahovuo-Saloranta A, Forss H, Walsh T, Nordblad A, Makela M, Worthington HV. Pit and fissure sealants for preventing dental decay in permanent teeth. Cochrane Database of Systematic Reviews. 2017;7(7):CD001830. 28759120.

Public Health England (PHE). Delivering Better Oral Health: an evidence-based toolkit for prevention. 2021; https://www.gov.uk/government/publications/delivering-better-oral-health-an-evidence-based-toolkit-for-prevention. Accessed 7 November 2023.

Scottish Intercollegiate Guidelines Network (SIGN). Dental interventions to prevent caries in children. 2014; https://www.sign.ac.uk/our-guidelines/dental-interventions-to-prevent-caries-in-children/. Accessed 7 November 2023.

A4.7 DP10 Fluoride varnish application based on age and risk

Should the SDCEP recommendation on the application of fluoride varnish align with the DBOH recommendation with regard to age, risk levels and frequency of application?

Background

The surveillance report recommends a review of the age differences and risk levels between DBOH and PMDCC2 recommendations for the application of fluoride varnish with a view to updating these in the guidance. The difference in the wording of the recommended frequency of application of varnish for those at increased risk of child caries is also noted with DBOH specifying 2 or more times a year and PMDCC2 advising 4 times per year.

DBOH strongly recommends the application of fluoride varnish (2.26% NaF) to teeth

- to all children aged 3-18 years, 2 times a year
- for children giving concern because of dental caries risk, 2 or more times a year.

PMDCC2's key recommendation for standard prevention is "for all children aged 2 years over, apply sodium fluoride varnish at least twice per year" (Strong recommendation; moderate quality evidence). In addition, to provide enhanced prevention for children at increased risk of caries PMDCC2 advises the application of sodium varnish 4 times per year to children aged 2 years and over.

The PMDCC2 question was "what is the evidence for effectiveness of topical fluoride interventions in preventing dental caries in children and what are the adverse effects (e.g. risk of fluorosis)?".

Assessment of Evidence

The respective DBOH and PMDCC2 considered judgement (CJ) forms were reviewed to give an insight into the reasons for the different age recommendations.

The DBOH CJ form makes no reference to age considerations, but it is noted that that DBOH classifies children as aged up to 3 years, 3 to 6 years and 7 to 18 years.

The PMDCC2 CJ form also makes no reference to evidence on age considerations. It states that in agreement with SIGN guideline 138, all children should receive fluoride varnish application at least twice a year as part of standard prevention. More frequent applications of fluoride varnish to children assessed at higher risk of caries is also recommended. SIGN 138 cites as evidence the Marinho (2013) Cochrane review which looked at populations of preschool children 2 to 5 years, children 6 to 12 years, adolescents 13 to 18 years. DBOH also cites Marinho as a primary evidence source.

Proposal for updating PMDCC2

The CJ forms do not explain the difference in age recommendations. The GDG was asked to assess whether the PMDCC2 key recommendation to apply sodium fluoride varnish at least twice per year that for all children aged 2 years over be aligned with the equivalent DBOH recommendation which is for 3 years of age and over.

Alignment with DBOH would require the PMDCC2 key recommendation to be reworded (currently "for all children aged 2 years and over, apply sodium fluoride varnish at least twice per year") and the amendment of the related molar advice points on standard prevention for all children. The respective molar advice points for enhanced prevention for children at increased risk of caries would also have to be amended if ages were changed.

The GDG considered the difference in wording of the frequency of application of varnish for those at increased risk of child caries with DBOH specifying 2 or more times a year and PMDCC2 advising 4 times per year. The respective molar advice points for enhanced prevention for children at increased risk of caries would also have to be amended if the PMDCC2 frequency was changed.

Outcome

The GDG agreed not to change the recommendation but that more consideration would be required on the matter of the recommended frequency of application, taking into account individual patient factors such as attendance patterns and preferences, and combining FV application with examination or other treatment would be preferable.

The Caries prevention section of the guidance was amended.

References

Marinho VC, Worthington HV, Walsh T, Clarkson JE. Fluoride varnishes for preventing dental caries in children and adolescents. The Cochrane Database of Systematic Reviews. 2013;7:CD002279

Public Health England (PHE). Delivering Better Oral Health: an evidence-based toolkit for prevention. 2021; https://www.gov.uk/government/publications/delivering-better-oral-health-an-evidence-based-toolkit-for-prevention. Accessed 7 November 2023.

Scottish Intercollegiate Guidelines Network (SIGN). Dental interventions to prevent caries in children. 2014; https://www.sign.ac.uk/our-guidelines/dental-interventions-to-prevent-caries-in-children/. Accessed 7 November 2023.

A4.8 DP11 Efficacy of fluoride varnish versus fissure sealants – Considered Judgement

For Discussion Point 11, the Considered Judgement methodology was adopted because it seemed likely that a key recommendation might change or a new key recommendation might be required.

Key Questions

- What is the evidence for effectiveness of sealants in preventing dental caries in children?
- What is the evidence for the efficacy of sealants versus fluoride varnish in preventing dental caries in children?

Recommendation in 2018 edition of guidance:

For all children, place fissure sealants on the permanent molars as early as possible after eruption.
(strong recommendation; moderate quality evidence).

Basis for recommendation:

The evidence from two Cochrane systematic reviews and a systematic review by the American Dental Association supported the use of fissure sealants for the prevention of dental caries in children. Fissure sealants have been shown to reduce pit and fissure caries in primary and permanent teeth (Ahovuo-Saloranta 2013) and are more effective in reducing decay in occlusal surfaces than fluoride varnish (Ahovuo-Saloranta 2016). Both resin-based and glass ionomer sealants are effective (moderate and low to very low certainty evidence respectively). There is no clear evidence to suggest which sealant material is more effective at preventing caries but resin-based sealants have been shown to be better retained than glass ionomer sealants (Ahovuo-Saloranta 2013). This is consistent with a systematic review and recommendations of the American Dental Association (Wright 2016, 2016a).

In agreement with SIGN guideline 138, recommending the application of fissure sealants to the permanent molars of all children in Scotland to prevent dental caries was considered likely to be beneficial. In making the recommendation in SIGN 138, the relatively high level of disease in Scotland and the low rate of application of fissure sealants were important considerations. Some children may also benefit from sealant application to other teeth.

1. Summary of evidence since 2018 edition of guidance

*Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the **certainty** of the evidence. Comment on the degree of **consistency** demonstrated by the available evidence. Note where evidence is lacking.*

Two Cochrane reviews examined the effectiveness of fissure sealants (FS) in primary and permanent teeth. There is low certainty evidence that FS are ineffective in preventing caries in primary teeth (Ramamurthy 2022). However, evidence for the effectiveness of fissure sealants in permanent teeth is well established (Ahovuo-Saloranta 2013).

An updated Cochrane review (Kashbour 2020) compared the effectiveness of fissure sealants and fluoride varnish (FV). The review included 11 trials with 3374 participants aged five to 10 years when trials started. The included studies have a broad spread of countries and settings suggesting this evidence would be applicable to children in the UK. Three of the trials were new since the 2016 review and two trials did not contribute data to the analysis. The updated review agreed that applying FV or resin-based FS to first permanent molars helps prevent occlusal caries, but it was not possible to reach reliable conclusions about which one is better to apply. The available studies did not suggest either intervention was superior, and this evidence was assessed as having very low certainty. The updated Cochrane review found very low-certainty evidence that placing resin-based FS as well as applying FV works better than applying fluoride. This led the authors to conclude that available data are insufficient to reach conclusions about whether it is better to apply FS or FV on occlusal surfaces of permanent molars, and so either intervention, or both, can be used.

Two SRs (Li 2020, Rashed 2022) agree with the updated Cochrane review's finding of no difference between the relative effectiveness of FS and FV. The first SR's (Li, 2020) meta-analysis showed that there was no statistical difference on caries incidence or occlusal DMFS increment between FS group and FV group at 2 to 3 years' follow-up. The authors concluded that biannual applications of FV or FS may be equally effective on caries prevention for first permanent molars (FPMs) giving clinicians a choice between the two techniques. The second SR's (Rashed 2022) meta-analysis found no significant difference between FS and FV in caries prevention efficacy of first permanent molars at 2 years' follow-up suggesting the use of FV since it is more affordable and easier to apply.

Limitations are noted in the evidence. Significant heterogeneity was noted in studies (Kashbour 2020, Rashed 2022). Most of the included studies did not adequately control for confounders, such as fluoride exposure, socioeconomic status, and parental educational level and the long-

term efficacy of FS and FV has not been established with studies only employing two year follow-ups (Rashed 2022).

Does the evidence differ from previously?

New evidence, on the relative effectiveness of FV versus FS differs from that which was presented in PMDCC2. Very low certainty evidence now suggests that neither intervention is superior. Kashbour (2020) notes that the certainty of evidence in the previous Cochrane review (Ahovuo-Saloranta 2016) in favour of sealants over varnish was low.

Conclusions

Findings from a review of updated evidence can be summarised as follows:

- applying FV or resin-based FS to first permanent molars helps prevent occlusal caries but it is not possible to reach reliable conclusions about which one is better to apply (very low certainty evidence) (Kashbour 2020)
- placing resin-based FS as well as applying FV works better than applying fluoride (very low certainty evidence) (Kashbour 2020)
- there was no significant difference between FS and FV in caries prevention efficacy for first permanent molars at 2 years' follow-up suggesting the use of FV is preferable since it is more affordable and easier to apply (Rashed 2020)

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

Five trials reported that no adverse events resulted from use of sealants or fluoride varnishes over one to nine years. The other studies did not mention adverse events (Kashbour 2020).

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

A number of clinical factors may influence the adoption of a particular approach. For example, a very deep fissure, oddly angled tooth or difficulty cleaning would suggest the use of FS over FV.

4. Values and preferences

Summarise any evidence or information on values and preferences.

Patient's values, preferences and behaviour, for example co-operativity, should be taken into account when considering the application of FS or FV. For example, patients (and/or parent/carers) might have strong views on the use of fluoride or plastics.

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

Future choices between FS and FV may rely on technique sensitivity, accessibility and cost of these two treatments in the local community (Li 2020).

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

Evidence collected from economic evaluations with more rigorous methodological quality (i.e. Chestnutt 2017) indicates that fluoride varnish may achieve similar outcomes to fissure sealants, but at lower costs. However, it is noted that this study was conducted in the UK setting and that the findings may not be transferable to other settings or health systems (Kashbour 2020).

FV compared to FS shows better economic efficacy, requires much lower technique sensitivity and does not need modern dental equipment (Li 2020).

7. Other factors

Indicate any other factors taken into account.

When considering the application of FS or FV or both, other factors may be taken into consideration:

- applying FV has less of an environmental impact when compared to applying FS (PHE 2018)
- in terms of deliverability, FV is simpler to apply in primary care.

8. Additional information

Include any further information that is relevant to the considered judgement.

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

Recommendation from 2018 edition of guidance:

For all children, place fissure sealants on the permanent molars as early as possible after eruption. (strong recommendation; moderate quality evidence).

Considered judgement:

Delivering Better Oral Health (DBOH) (PHE 2021) recommends application of resin sealant to permanent teeth on eruption for children from 7 years and young people up to 18 years giving concern because of dental caries risk. In considering whether to align its recommendation with DBOH, the GDG disagreed with the setting of a biological age (see Discussion Point 9) and noted the difficulty of reliably assessing risk. This is why the current SDCEP recommendation is a blanket one for all children with no specified age. Given this the GDG agreed not to change the SDCEP recommendation to align with DBOH.

Given the more recent finding of no difference in effectiveness between FS and FV, the GDG judged that the guidance should include advice on when to use each approach and leave this as

a choice dependent on circumstances. It is important to take into account patient expectations and preferences in the choice of the approach. Consequently, amendment of the wording of the key recommendation is required because application of fissure sealants might not be necessary for some patients.

The GDG agreed to the following amendments in the Caries prevention section of the guidance:

Key recommendation for updated guidance:

For all children, consider placing fissure sealants on the permanent molars.

(Strong recommendation; moderate to very low certainty evidence)

Basis for recommendation

Evidence for the effectiveness of fissure sealants is well established (SIGN 2014, Ahovuo-Saloranta 2013). Both resin based and glass ionomer sealants are effective in preventing caries (moderate and low to very low certainty evidence respectively) with resin-based sealants showing better retention.

More recent very low certainty evidence indicates that the effectiveness of placing fissure sealants and applying fluoride varnish is similar (Kashbour 2020, Li 2020, Rashed 2022). In addition, very low-certainty evidence suggests that placing resin-based FS as well as applying FV works better than applying fluoride alone (Kashbour 2020).

Suggestion for main narrative:

- While all children should have fluoride varnish applied to their teeth, the clinician must decide whether to additionally place fissure sealants on permanent molars. For some children, application of fluoride varnish only might be sufficient.
- The following points should be considered when discussing and agreeing professionally-delivered preventive interventions with children and parent/carers:
    - The frequency of fluoride varnish application is risk dependant and should be determined individually for each patient.
    - Applying fluoride varnish has less environmental impact compared to placing fissure sealants (PHE 2018).
    - Combining fluoride varnish application with examination or another treatment is preferable to delivery at separate appointments because it lessens the environmental impact of travel. Having a child attend a practice for fluoride varnish application only should be avoided, if possible.
    - Fluoride varnish application is easier for children to tolerate.
    - The decision to place fissure sealants on permanent molars is risk dependant and should be determined individually for each patient

- Clinical factors might favour the placement of fissure sealants (in addition to fluoride varnish application), such as the presence of caries in other permanent molars, a very deep fissure, an oddly angled tooth or difficulty cleaning.
- Patient factors such as co-operation, expectations and preferences influence the choice of the approach used.

Note: Following subsequent peer reviewer feedback, the GDG agreed to the following clarification of the updated key recommendation:

For all children, consider all factors relevant to the individual patient when deciding whether to place fissure sealants.

(Conditional recommendation; moderate to very low certainty evidence)

References

Ahovuo-Saloranta A, Forss H, Walsh T, et al. Sealants for preventing dental decay in the permanent teeth. The Cochrane Database of Systematic Reviews. 2013(3):CD001830.

Ahovuo-Saloranta A, Forss H, Hiiri A, Nordblad A, Makela M. Pit and fissure sealants versus fluoride varnishes for preventing dental decay in the permanent teeth of children and adolescents. The Cochrane Database of Systematic Reviews. 2016;1:CD003067.

Chestnutt IG, Hutchings S, Playle R, Morgan-Trimmer S, Fitzsimmons D, Aawar N, et al. Seal or varnish? A randomised controlled trial to determine the relative cost and effectiveness of pit and fissure sealant and fluoride varnish in preventing dental decay. Health Technology Assessment. 2017;21(21):1-256.

Kashbour W, Gupta P, Worthington HV, Boyers D. Pit and fissure sealants versus fluoride varnishes for preventing dental decay in the permanent teeth of children and adolescents. Cochrane Database of Systematic Reviews. 2020. CD003067.

Li F, Jiang P, Yu F, Li C, Wu S, Zou J, et al. Comparison between Fissure Sealant and Fluoride Varnish on Caries Prevention for First Permanent Molars: a Systematic Review and Meta-analysis. Scientific Reports. 2020;10(1):2578.

Public Health England (PHE). Carbon modelling within dentistry: towards a sustainable future. 2018; https://www.gov.uk/government/publications/carbon-modelling-within-dentistry-towards-a-sustainable-future. Accessed 13 June 2024.

Public Health England (PHE). Delivering Better Oral Health: an evidence-based toolkit for prevention. 2021; https://www.gov.uk/government/publications/delivering-better-oral-health-an-evidence-based-toolkit-for-prevention. Accessed 7 November 2023.

Ramamurthy P, Rath A, Sidhu P, Fernandes B, Nettem S, Fee PA, Zaror C, Walsh T. Sealants for preventing dental caries in primary teeth. Cochrane Database of Systematic Reviews. 2022. Feb 11;2(2):CD012981.

Rashed T, Alkhalefa N, Adam A, AlKheraif A. Pit and Fissure Sealant versus Fluoride Varnish for the Prevention of Dental Caries in School Children: A Systematic Review and Meta-Analysis. International Journal of Clinical Practice. 2022; 8635254.

Scottish Intercollegiate Guidelines Network (SIGN). Dental interventions to prevent caries in children. 2014; https://www.sign.ac.uk/our-guidelines/dental-interventions-to-prevent-caries-in-children/. Accessed 7 November 2023.

Wright JT, Crall JJ, Fontana M, et al. Evidence-based clinical practice guideline for the use of pit-and-fissure sealants: A report of the American Dental Association and the American Academy of Pediatric Dentistry. Journal of the American Dental Association. Aug 2016;147(8):672-682 e612.

Wright JT, Tampi MP, Graham L, et al. Sealants for preventing and arresting pit-and fissure occlusal caries in primary and permanent molars: A systematic review of randomized controlled trials-a report of the American Dental Association and the American Academy of Pediatric Dentistry. Journal of the American Dental Association. Aug 2016a; 147:631-645 e618.

A4.9 DP12 Use of Silver Diamine Fluoride for caries prevention & treatment

For Discussion Point 12, the Considered Judgement methodology was adopted because it seemed likely that a key recommendation might change or a new key recommendation might be required

Key Question
• Is the application of silver diamine fluoride (SDF) compared to no treatment or other interventions (fluoride varnish, sealants, atraumatic restorative treatment) effective in arresting and preventing dental caries in children? Does the application of SDF have adverse effects?
Recommendation in 2018 edition of guidance: This question was not considered in the second edition of the guidance. The key recommendation associated with topical fluoride for prevention of dental caries in primary teeth is: For all children aged 2 years and over, apply sodium fluoride varnish at least twice per year. The key recommendation associated with the management of dental caries in primary teeth is: For a child with a carious lesion in a primary tooth, choose the least invasive, feasible caries management strategy, taking into account: the time to exfoliation, the site and

extent of the lesion, the risk of pain or infection, the absence or presence of infection, preservation of tooth structure, the number of teeth affected, avoidance of treatment-induced anxiety. (Strong recommendation; low quality evidence)

1. Summary of evidence since 2018 edition of guidance

*Summarise the evidence for the effects of the intervention on the important outcomes including the ratings for the **certainty** of the evidence. Comment on the degree of **consistency** demonstrated by the available evidence. Note where evidence is lacking.*

Evidence was sourced from four guidelines, an umbrella review and an unpublished Cochrane review. The guideline recommendations all focus on the use of SDF to arrest caries lesions while the umbrella review and Cochrane review assesses the ability of SDF to prevent and arrest caries.

Guidelines

The European Academy of Paediatric Dentistry (EAPD) (Duggal 2022) recommended that application of 38% SDF can be advantageous for caries arrest, with better outcomes for biannual application. This was a strong recommendation, but the certainty of evidence was not assessed due to the heterogenicity of the studies and the reviews meaning it was not possible to develop guidance using best-practice methods, such as GRADE. Evidence to support this recommendation was taken from an umbrella review (Ban-Hani 2022) of minimally invasive dentistry. The review of SDF was based on eight systematic reviews (SRs) covering 33 RCTs and CCTs. Three of the SRs included a meta-analysis. Results showed that topical application of 38% SDF showed a statistically significant caries arrest effect in primary teeth and was more effective than other treatments including 5% NaF fluoride varnish and sealing with GIC ($p < 0.05$). Caries arrest rate after single application of 38% SDF ranged between 31 and 79%, whereas biannual application significantly increased the caries arrest rate to between 53 and 91%. In addition, the mean number of arrested caries surfaces was significantly higher when 38% SDF was applied (2.5–4.5) compared to comparators (1.3–1.8) (Duangthip 2015, Jabin 2020). For the comparators the effectiveness was 41% for 5% NaF fluoride varnish, 82% for GIC, and 15–34% for no treatment.

Delivering Better Oral Health (DBOH) (PHE 2021) notes that SDF is licensed in the UK for the management of dentine hypersensitivity and not the prevention or arrest of dental caries. DBOH evaluates the evidence for SDF use as being low quality (based on two reviews) but points to an emerging body of evidence supporting its effectiveness in arresting coronal caries in the primary dentition and root caries in older adults for all comparators and it may be beneficial in preventing further root caries in older people.

The American Dental Association (ADA) (Slayton 2018) recommends that to arrest advanced cavitated carious lesions on any coronal surface of primary teeth, clinicians prioritize the use of 38% SDF solution (biannual application) over 5% NaF varnish application (once per week for 3 weeks). This is a strong recommendation based on moderate certainty evidence. Evidence to support this recommendation was taken from a SR (Urquhart 2018) which identified 4 studies (2,115 participants) that reported the effectiveness of interventions in arresting advanced

cavitated lesions on any coronal surface. Results showed that after 30 months of follow-up, 30% SDF solution applied annually on primary teeth showed a 1.5-times-greater chance of arresting advanced cavitated lesions in primary teeth versus 30% SDF solution applied once a week for 3 weeks (Risk Ratio (RR), 1.45; 95% CI 1.21 to 1.73; high certainty). Also, 30% SDF solution applied annually on primary teeth is superior to 5% NaF varnish applied once a week for 3 weeks (RR, 1.41; 95% CI, 1.20 to 1.66; high certainty). Additionally, after 30 months of follow-up, 38% SDF solution applied biannually on primary teeth was superior to 12% SDF solution applied biannually (RR, 1.29; 95% CI, 1.21 to 1.38; high certainty) and 38% SDF solution applied annually (RR, 1.13; 95% CI, 1.07 to 1.20; moderate certainty).

The American Academy of Pediatric Dentistry (AAPD) (Crystal 2017) supports the use of 38% SDF for the arrest of cavitated caries lesions in primary teeth as part of a comprehensive caries management program (conditional recommendation, low-quality evidence). The recommendation is based on data from a meta-analysis of data extracted from three RCTs and one CCT of SDF efficacy with various follow-up times and controls (Crystal 2017). Based on the pooled estimates of SDF group, approximately 68% (95% confidence interval [95% CI] =9.7 to 97.7) of cavitated caries lesions in primary teeth would be expected to be arrested two years after SDF application (with once or twice a year application). Using data with longest follow-up time (at least 30 months follow-up; n=2,567 surfaces from one RCT and one CCT), SDF had 48% higher (95% CI=32 to 66) success rate in caries lesion arrest compared to the controls (76% versus 51% arrested lesions, in absolute terms). In other words, 248 more cavitated caries lesions would be expected to arrest by treatment with SDF compared to control treatments, per 1000 surfaces after at least 30 months follow-up. Considering the stratum with most data (n=3,313 surfaces) from three RCTs and one CCT, with follow-up of 24 months or more), similar estimates of relative and absolute efficacy were produced (i.e., RR 1.42 [95% CI=1.17 to 1.72]) and 72% versus 50% arrested lesions, in absolute terms.

Umbrella Review

An umbrella review evaluated the use of SDF for carious lesion management in children (Seifo 2019). Seven SRs focusing mainly on primary dentition examined coronal carious lesions prevention and arrest and all reported that SDF outperformed the comparators regardless of the outcome measure.

Three SRs examined the prevention of carious lesions. The prevented fraction (PF) for 38% SDF compared to placebo ranged from 70 to 78% in the primary dentition based on two systematic reviews (Oliveira 2019, Rosenblatt 2009) including two studies and was 64% in the permanent first molars based on one SR (Rosenblatt 2009) with one study (Llodra 2005). The PF for fluoride varnish compared to placebo in the primary dentition was 54% based on one SR (Oliveira 2019) with one study (Chu 2002). The same SR reported that glass ionomer cement was more effective than 30% SDF at 12 months, PF = −6%, but the difference was not statistically significant.

Coronal carious lesions arrest was reported in six systematic reviews. The reported 38% SDF arrest rates in the primary dentition ranged from 65 to 91% based on three SRs (Duangthip 2015, Gao 2016, Gao 2016a). The equivalent arrest rates were 38 to 44% for fluoride varnish, 39 to 82% for glass ionomer cement, and 34% for placebo. The PF based on one SR (Rosenblatt 2009) (two studies) ranged from 55 to 96% in favour of 38% SDF when compared to fluoride varnish or placebo in primary dentition. However, this was 100% for permanent first molars based on one study (Llodra 2005). The risk ratio (RR) was 1.66 for SDF compared to fluoride varnish or Atraumatic Restorative Treatment and 2.54 compared with placebo/no treatment based on one systematic review (two studies) which focused only on the primary dentition (Chibinski 2017).

Cochrane review

The review (Worthington in press) assessed the effects of SDF for arresting and preventing caries in primary and permanent teeth (coronal and root caries) compared to any other intervention including placebo or no treatment. A total of 29 RCTs were reviewed covering 13,036 participants (12,020 children and 1016 adults); one study was a cluster-RCT, and one study used a split mouth design. The review undertook five comparisons: SDF versus placebo or no treatment; different approaches to SDF application; SDF versus other topical treatments; SDF versus sealants and infiltration; SDF versus restorative treatments. The evidence for SDF compared with fluoride varnish (FV) was considered to represent the most clinically relevant treatment comparison amongst the available evidence for other topical treatments.

Compared to placebo or no treatment:

- SDF may offer benefit in preventing new caries (primary prevention*) in primary dentition and permanent dentition (coronal) but the evidence is very uncertain (very low certainty evidence from one small study, risk of bias, imprecision and very limited use of fluoride toothpaste).
- SDF is likely to offer benefit in preventing new root caries (moderate certainty evidence).
- SDF may offer benefit in arresting caries (caries arrest*) in the primary dentition (low certainty evidence from two studies, due to risk of bias and limited use of fluoride toothpaste).
- SDF may also offer benefit in arresting caries in coronal surfaces (very low certainty evidence from one small study, risk of bias, imprecision and very limited use of fluoride toothpaste) or root surfaces (very low certainty evidence due to one small study, risk of bias and imprecision) in the permanent dentition but the evidence is very uncertain.
- The evidence is very uncertain regarding SDF compared to placebo or no treatment for the prevention of progression of existing caries (secondary prevention*) (very low certainty evidence due to risk of bias and imprecision).
- The evidence for adverse effects and aesthetics (concern about the appearance of staining on teeth) was very low certainty.

Compared to fluoride varnish:

- SDF may result in little to no difference for the prevention of caries in the primary dentition (low certainty evidence due to risk of bias and imprecision).
- The evidence is very uncertain about the effect of SDF for the prevention of caries in the permanent dentition (due to risk of bias, imprecision and small sample size in the one included study).
- The evidence is very uncertain about the effect of SDF for caries arrest or the prevention of progression of existing caries in the primary dentition (note: FV was given as weekly application for three weeks compared to annual application of SDF for three years) (due to risk of bias, imprecision and small sample size in the one included study).

* Primary caries prevention, as measured by change from baseline in the number of decayed, missing, or filled surfaces/teeth in the permanent dentition (DMFS/T), and decayed, missing, or filled surfaces/teeth in the primary dentition (dmfs/t).

Caries arrest indicated by change in caries from active to arrested (inactive), measured by visual changes in enamel and dentine or any other ways that may be used for caries arrest evaluation. A sound restoration may be considered as "arrested caries" (Kidd 2010).

Secondary prevention of caries indicated when initial lesions (e.g. lesions classed as International Caries Detection and Assessment System (ICDAS) 3 to 4) do not progress from initial classification.

Overview of evidence

There is agreement in the evidence of the effectiveness of SDF in arresting caries compared to no treatment, but differences are noted in its efficacy against comparative treatments, notably fluoride varnish. The Cochrane review (Worthington) concludes that there is no high certainty evidence that SDF is preferable/superior to fluoride varnish, in contrast to the view presented in guidance and policy documents (ADA 2021, AAPD 2023, BSPD patient leaflet) and the evidence presented in the umbrella review (Seifo 2019). The Cochrane review suggests that the difference in favour of SDF over fluoride varnish in guidance may be attributable to the underpinning evidence which may have included studies and reviews that have not accounted for high risks of performance and detection bias or the effect of clustering. In this respect the Cochrane review notes the comparability of its findings with the AAPD guideline (Crystal 2017) which assessed the quality of the evidence for SDF to be low, and the quality of some comparisons to be very low.

Limitations in the evidence are highlighted in the guidelines and reviews. The AAPD guideline (Crystal 2017) notes the small number of RCTs evaluating SDF, the heterogeneity of the included trials, and selection bias that may have been introduced by possibly poor sequence generation. Other limitations are those identified for individual trials, for example a lack of calibration and/or evidence of agreement for examiners assessing clinical outcomes and unclear definitions or inconsistent criteria for caries lesion activity. The Cochrane review (Worthington) notes low or only moderate confidence in the evidence due to the fact that the staining of teeth which occurs with SDF would make it clear to participants which treatment they were being given and may

have affected their behaviour (e.g. tooth brushing) and makes it impossible to blind the treatment for researchers assessing outcomes. Other limiting factors were differences in study approaches for applying SDF and the small sizes of included studies.

2. Balance of effects

Comment on the desirable and undesirable effects of the intervention and how substantial the effects are. Indicate whether the overall balance of effects favours the intervention or comparison.

- SDF's main disadvantage is its aesthetic appearance, in that it permanently blackens enamel and can temporarily mark skin it comes into contact with (Crystal 2017).
- In terms of suspected adverse reactions; reversible, small, mildly painful white lesions in oral mucosa, due to inadvertent contact with SDF, were reported; these healed uneventfully within 48 hours (Seifo 2019).
- SDF has a bitter metallic taste which may last for a few minutes after application (Worthington in press).
- No serious adverse events, such as allergic reactions or toxicity were reported in SDF studies (Seifo 2019).
- The reduction of child caries will have financial benefits for healthcare costs (Crystal 2017).
- SDF contributes to promoting health and quality of life (Crystal 2017).
- A major advantage of MID for the management of dentine carious lesions is that many of these techniques can be carried out without aerosol generation (Duggal 2022).
- After taking in consideration the low cost of the treatment and the disease burden of caries, AAPD panel members were confident that the benefits of SDF application in the target populations out-weigh its possible undesirable effects (Crystal 2017).

3. Subgroup considerations

Comment here on any subgroup considerations e.g. should recommendations for patients at high or low risk be considered separately?

SDF should not be used for those with an allergy to silver (Crystal 2017).

4. Values and preferences

Summarise any evidence or information on values and preferences.

Patients are likely to value SDF as it is a less invasive process which may avoid the need for surgical-restorative procedures.

SDF could be used for a broad range of situations, including, but not limited to, when local or general anaesthesia is not preferred, when a patient is not able to cooperate with treatment, or when it is necessary to offer a less costly or less invasive alternative (Slayton 2018).

5. Acceptability

Is the intervention acceptable to patients, dental team and other stakeholders?

One SR assessed carer satisfaction with their child's dental appearance after the application of 38% SDF compared to comparators including placebo as well as 5% NaF and found no significant change in the results across the intervention and control group (Trieu 2019).

The main side effect reported was black staining of the carious lesions although older adults rarely complained about that. Similarly, the discoloration was acceptable in children, being of concern to only 7% of participants in one study (Chu 2002).

A study that assessed parental perceptions and acceptance of SDF based on the staining found that staining on posterior teeth was more acceptable than on anterior teeth. Although staining on anterior teeth was perceived as undesirable, most parents preferred this option to avoid the use of advanced behavioural guidance techniques such as sedation or general anaesthesia to deliver traditional restorative care. It was also found that about one-third of parents found SDF treatment unacceptable under any circumstance due to aesthetic concerns (Crystal 2017a).

6. Feasibility

Comment on cost, resource implications and implementation considerations, if applicable.

SDF is an effective and inexpensive means of arresting cavitated caries lesions in primary teeth. It is inexpensive due to the low cost of materials and supplies and relatively short chair time required for application (Crystal 2017).

SDF will stain clothing or work surfaces if protection is not used during application (Worthington).

7. Other factors

Indicate any other factors taken into account.

In keeping with the concept of informed consent, clinicians should offer or explain all nonsurgical and restorative treatment options and their potential adverse effects (such as blackened tooth surfaces treated with SDF) to all patients (Slayton 2018).

The responsibility for the prescription of drugs "off-label" lies with the practitioner and this would require an explanation to the carers/patient. Prescribing or administering drugs that are unlicensed for a particular condition or for use in children alters (and probably increases) the practitioner's professional responsibility and potential liability, and the practitioner should be able to justify and feel competent in using such drugs.

https://www.sdcepdentalprescribing.nhs.scot/guidance/introduction/off-label-prescribing/

8. Additional information

Include any further information that is relevant to the considered judgement.

Data suggest that SDF may be more effective on anterior teeth than on posterior teeth. Hypotheses to explain this include, but are not limited to, anterior teeth being easier to keep

clean and technique-related challenges for posterior teeth (for example, it is easier to maintain a dry field in the anterior teeth) (Slayton 2018).

9. Considered judgement and key recommendation

Summarise the group's judgements for the recommendation including which criteria were most influential for the decision. Record any dissenting opinion within the group and how a consensus was reached, if applicable. State the recommendation for the guidance, clearly indicating the strength, using GRADE appropriate wording.

In response to the research question, the evidence concludes that, compared to no treatment, SDF may be effective in arresting caries in the primary dentition and the permanent dentition (low and very low certainty respectively). SDF may also be effective in preventing new caries in the primary or permanent dentition (very low certainty). The evidence is very uncertain with regard to preventing progression of existing caries compared to no treatment. However, in some of the studies there was very limited access to/use of fluoride toothpaste; this may not be applicable to all settings and contributed to the downgrading of evidence certainty.

There is uncertainty of the benefits to using SDF compared with other treatments for the primary and secondary prevention of caries or for caries arrest (low to very low certainty evidence). The main disadvantage of SDF is the permanent blackening of enamel, but no serious adverse effects have been identified.

The GDG discussed the evidence provided and other factors before voting on the various proposals to include SDF in the updated guidance.

1. Should SDF be included as a caries prevention intervention? Yes 38% (n=6) No 63% (n=10)

2. Should SDF be included as a management strategy for the arrest of caries in primary teeth? Yes 100% (n=16)

2i) If yes, should SDF be included: A) as a principal strategy for caries management? 31% (n=4)

or B) as another option which is less supported by evidence? 69% (n=9)

2ii) If yes, for which types of primary teeth (anterior and/or posterior) and for which type of lesion (initial and/or advanced) could SDF be used?

A) Initial Anterior – 93% (n=14/15)
B) Advanced Anterior – 100% (n= 15/15)
C) Initial Posterior – 67% (n=10/15)
D) Advanced Posterior – 73% (n=11/15)

Accordingly, it was concluded that SDF would be included in the guidance as a management strategy but not as a preventive measure. SDF would be classified as an 'other option less supported by the evidence' rather than a 'principal' management strategy. SDF may be used across a range of teeth types.

Use of SDF was incorporated as an option in the Management of caries in primary teeth section. A new section in Dental Techniques outlining how to apply SDF for management of caries was included, based on the BSPD protocol and NHSHighland in Right Decisions.

References

American Academy of Pediatric Dentistry (AAPD 2023). Policy on the Use of Silver Diamine Fluoride for Pediatric Dental Patients. Accessed at: https://www.aapd.org/media/Policies_Guidelines/P_SilverDiamine.pdf

American Dental Association (ADA 2021). Silver Diamine Fluoride. Accessed at: www.ada.org/en/resources/research/scienceand-research-institute/oral-health-topics/silver-diamine-fluoride

Ban-Hani A, Santamaría RM, Hu S, Maden M, Albadri S. Minimal intervention dentistry for managing carious lesions into dentine in primary teeth: an umbrella review. European Archives of Paediatric Dentistry: official journal of the European Academy of Paediatric Dentistry. 2021;23(5):667-693.

BSPD Patient Leaflet Silver Diamine Fluoride (SDF) Liquid Treatment. Accessed at: https://www.bspd.co.uk/Portals/0/BSPD_SDF%20patient%20leaflet_For%20printing.pdf

Chibinski AC, Wambier LM, Feltrin J, Loguercio AD, Wambier DS, Reis A. Silver diamine fluoride has efficacy in controlling caries progression in primary teeth: a systematic review and meta-analysis. Caries Research. 2017;51(5): 527–41.

Chu CH, Lo EC, Lin HC. Effectiveness of silver diamine fluoride and sodium fluoride varnish in arresting dentin caries in Chinese pre-school children. Journal of Dental Research. 2002;81:767–70.

Crystal YO, Marghalani AA, Ureles SD, Wright JT, Sulyanto R, Divaris K, et al. Use of Silver Diamine Fluoride for Dental Caries Management in Children and Adolescents, Including Those with Special Health Care Needs. Pediatric Dentistry. 2017;39(5):135-45.

Crystal YO, Janal MN, Hamilton DS, Niederman R. Parental perceptions and acceptance of silver diamine fluoride staining. Journal of the American Dental Association 2017a; 148(7):510-8.

Duangthip D, Jiang M, Chu CH, Lo ECM. Non-surgical treatment of dentin caries in preschool children–systematic review. BMC Oral Health. 2015;15(1):44.

Duggal M, Gizani S, Albadri S, Kramer N, Stratigaki E, Tong HJ, et al. Best clinical practice guidance for treating deep carious lesions in primary teeth: an EAPD policy document. European Archives of Paediatric Dentistry. 2022;23(5):659-66.

Gao SS, Zhao IS, Hiraishi N, Duangthip D, Mei ML, Lo ECM, Chu CH. Clinical trials of silver diamine fluoride in arresting caries among children: a systematic review. JDR Clinical Translation Research. 2016;1(3):201–10.

Gao SS, Zhang S, Mei ML, Lo EC, Chu CH. Caries remineralisation and arresting effect in children by professionally applied fluoride treatment – a systematic review. BMC Oral Health. 2016a;16(1):12.

Jabin Z, Vishnupriya V, Agarwal N, et al. Effect of 38% silver diamine fluoride on control of dental caries in primary dentition: a systematic review. Journal of Family Medical Primary Care. 2020;9:1302–7.

Llodra JC, Rodriguez A, Ferrer B, Menardia V, Ramos T, Morato M. Efficacy of silver diamine fluoride for caries reduction in primary teeth and first permanent molars of schoolchildren: 36-month clinical trial. Journal of Dental Research. 2005;84(8):721–4.

Oliveira BH, Rajendra A, Veitz-Keenan A, Niederman R. The effect of silver diamine fluoride in preventing caries in the primary dentition: a systematic review and meta-analysis. Caries Research. 2019;53(1):24–32.

Public Health England (PHE). Delivering Better Oral Health: an evidence-based toolkit for prevention. 2021; https://www.gov.uk/government/publications/delivering-better-oral-health-an-evidence-based-toolkit-for-prevention. Accessed 7 November 2023.

Rosenblatt A, Stamford TCM, Niederman R. Silver Diamine Fluoride: A Caries "Silver-Fluoride Bullet". Journal of Dent Research. 2009;88(2):116–25.

Seifo N, Cassie H, Radford JR, Innes NPT. Silver diamine fluoride for managing carious lesions: an umbrella review. BMC Oral Health. 2019 Jul 12;19(1):145.

Slayton RL, Urquhart O, Araujo MWB, Fontana M, Guzman-Armstrong S, Nascimento MM, et al. Evidence-based clinical practice guideline on nonrestorative treatments for carious lesions: A report from the American Dental Association. Journal of the American Dental Association. 2018;149(10):837-49 e19.

Trieu A, Mohamed A, Lynch E. Silver diamine fluoride versus sodium fluoride for arresting dentine caries in children: a systematic review and meta-analysis. Scientific Reports. 2019;9:2115.

Urquhart O, Tampi MP, Pilcher L, Slayton RL, Araujo MWB, Fontana M, Guzmán-Armstrong S, Nascimento MM, Nový BB, Tinanoff N, Weyant RJ, Wolff MS, Young DA, Zero DT, Brignardello-Petersen R, Banfield L, Parikh A, Joshi G, Carrasco-Labra A. Nonrestorative Treatments for Caries: Systematic Review and Network Meta-analysis. Journal of Dental Research. 2019 Jan;98(1):14-26. doi: 10.1177/0022034518800014. Epub 2018 Oct 5.

Worthington HV, Lewis SR, Glenny A-M, Huang SS, Innes NPT, O'Malley L, Riley P, Walsh T, Wong MCM, Clarkson JE, Veitz-Keenan A. Topical silver diamine fluoride (SDF) for preventing and

managing dental caries in children and adults. Cochrane Database of Systematic Reviews. 2024; Nov 7;11(11):CD012718.

A4.10 DP13 Types of lesion suitable for no caries removal and fissure seal

What is the evidence on the efficacy of no caries removal and placement of fissure sealants in permanent teeth.

Background

The PMDCC2 guidance noted that the American Dental Association recommends the use of fissure sealants on non-cavitated occlusal lesions to prevent their progression in both children and adolescents (Wright et al., 2016) and a systematic review (Tellez et al., 2013) also supported this approach. The guidance does not comment on the use of this intervention in cavitated or dentine carious lesions.

In 2021, a Cochrane review that considered the evidence related to interventions for treating cavitated or dentine carious lesions in primary or permanent teeth with vital pulps was published.

Assessment of Evidence

A Cochrane review (Schwendicke et al., 2021) considered the evidence related to interventions for treating cavitated or dentine carious lesions in primary or permanent teeth with vital pulps. Eight studies investigated the use of sealants compared to other interventions (conventional restoration [n=4]; selective excavation [n=2]) or no sealant [n=2] in non-cavitated or cavitated but not deep lesions (i.e. extending less than halfway through the dentine).

Conventional restoration (CR) vs sealant

Of 4 studies, only one parallel RCT was included in the meta-analysis, which reported that 4/20 sealed and 1/21 CR lesions required retreatment (OR 5.00, 95% CI 0.51 to 49.27; 1 study, 41 teeth, permanent teeth, cavitated, 48 month follow up). The certainty of the evidence was considered very low due to study limitations (risk of bias), and imprecision. Based on this study, there was insufficient evidence of a difference between sealing and CR for cavitated lesions in the permanent dentition.

Selective excavation (SE) vs sealant

Two RCTs reported on this comparison but it should be noted that both investigated the intervention in primary teeth. The meta-analysis indicated that there was no significant difference in failure rates between sealing with sealant materials compared to selective carious tissue excavation (OR 3.11, 95% CI 0.11 to 85.52; I^2 = 74%; 2 trials, 82 primary teeth, cavitated, 18-24 month follow up). The certainty of the evidence was considered very low due to study limitations (risk of bias), inconsistency and imprecision. The applicability of the evidence to permanent teeth is unclear.

No treatment vs sealant

Two RCTs reported on this comparison. The meta-analysis indicated that there may be little or no difference in failure rates between sealing with sealant materials compared to no treatment (pooled estimate OR 0.05, 95% CI 0.00 to 2.71; I^2 = 89%; 2 trials, 103 permanent teeth, non-cavitated, 12 month follow up). The certainty of the evidence was considered very low due to study limitations (risk of bias), inconsistency and imprecision.

Overall, the review found insufficient evidence of a difference between sealing versus CR, sealing versus SE or sealing versus no treatment in cavitated or dentine lesions. The certainty of the evidence was judged to be very low, mainly due to risk of bias, inconsistency and imprecision. There were a limited number of studies that investigated these comparisons and those identified were small and had a high risk of bias, mainly due to lack of blinding of participants and issues with data reporting. The review authors note that the concept of sealing such lesions is legitimate and in some situations may be more technically feasible and acceptable. However, regular resealing is required, which relies on patient adherence to follow-up. This may limit the intervention's effectiveness in high-risk individuals. The cost-effectiveness of sealing is unclear, although modelling suggests it could be cost effective compared to restorative interventions. The authors also note that their findings do not apply to sealing of enamel or non-cavitated lesions.

Proposal for updating PMDCC2

The PMDCC2 evidence summary on management of caries in permanent teeth could be amended to report the findings from the Cochrane review:

- there was very uncertain evidence from one study for any difference between sealing using sealant materials and non-selective carious tissue removal and CR (very low certainty evidence) (Schwendicke 2021)
- there was very uncertain evidence from two studies (in primary teeth) about the effect of sealing with sealant materials compared to SE (very low certainty evidence) (Schwendicke 2021)
- there was very low certainty from two studies that suggests there may be little or no difference between sealing using sealant materials or no treatment (very low certainty evidence) (Schwendicke 2021)

These findings could be summarised as:

Evidence is insufficient to reach conclusions about whether it is better to manage cavitated or dentine carious lesions in permanent teeth by sealing using sealant materials compared to either conventional restoration, selective excavation or no treatment.

The GDG considered whether use of sealant in preference to conventional restoration, selective excavation or no treatment should be extended to be an option for cavitated or dentinal lesions,

for situations where it is clinically feasible and there are no concerns about patient adherence to follow-up for sealant examination and replacement if required.

Outcome

The GDG agreed that the option of no caries removal and seal with a fissure sealant should be extended to include moderate lesions in permanent teeth.

The Management of caries in permanent teeth and Dental Techniques sections of the guidance were amended.

References

Schwendicke F, Walsh T, Lamont T, Al-yaseen W, Bjørndal L, Clarkson JE, Fontana M, Gomez Rossi J, Göstemeyer G, Levey C, Müller A, Ricketts D, Robertson M, Santamaria RM, Innes NPT. Interventions for treating cavitated or dentine carious lesions. Cochrane Database of Systematic Reviews 2021, Issue 7. Art. No.: CD013039.

Wright JT, Crall JJ, Fontana M, Gillette EJ, Nový BB, Dhar V, Donly K, Hewlett ER, Quinonez RB, Chaffin J, Crespin M, Iafolla T, Siegal MD, Tampi MP, Graham L, Estrich C, Carrasco-Labra A. Evidence-based clinical practice guideline for the use of pit-and-fissure sealants: A report of the American Dental Association and the American Academy of Pediatric Dentistry. Journal of the American Dental Association. 2016 Aug;147(8):672-682.e12.

Tellez M, Gomez J, Kaur S, Pretty IA, Ellwood R, Ismail AI. Non-surgical management methods of noncavitated carious lesions. Community Dental Oral Epidemiology. 2013 Feb;41(1):79-96.

A4.11 DP14 Resin infiltration for white spot lesions

What is the evidence for the use of resin infiltration techniques (e.g. Icon) for the management of initial carious lesions (aka white spot lesions) in permanent anterior teeth?

Background

The PMDCC2 guidance advises a preventive approach to permanent anterior teeth with initial carious lesions (i.e. teeth with white spot lesions but no dentinal caries). This aims to slow or arrest caries and reduce the risk of teeth requiring a restoration. Site-specific prevention is recommended, including advice on effective toothbrushing and diet, and application of fluoride varnish four times per year. The guidance notes that such non-invasive management of early carious lesions is the preferred approach, but careful long-term monitoring is required to enable more invasive prevention or restoration if the lesion progresses.

A proposed alternative approach is the use of resin infiltration to obstruct the enamel pores in the lesion, preventing the diffusion of acids and dissolved minerals into the lesion and reducing

its progression. It is also suggested that this technique improves the aesthetic appearance of these initial carious lesions.

Assessment of Evidence

A search of PubMed and Epistemonikos (using search terms "anterior", "resin infiltration" and "white spot") identified two recent reviews. One was a well-conducted umbrella review that assessed systematic reviews relevant to the topic and the other was a narrative review giving an overview of the current literature related to the topic.

The umbrella review evaluating the available systematic reviews on the effectiveness of resin infiltration technique in inhibiting caries progression and improving the aesthetic appearance of white-spot lesions was published in 2022 (Lin et al, 2022). The authors assessed the evidence to support the use of resin infiltration to treat white spot lesions. Thirteen systematic reviews were included but only eight were suitable for meta-analysis. The quality of the reviews (as assessed by AMSTAR2) ranged from very low to high; only three reviews achieved a quality rating of high.

When comparing white-spot lesions treated with resin infiltration to those in the control or placebo groups,* the overall pooled relative risk of caries progression was 0.32 (95% CI: 0.29-0.36; I^2 = 0%; 8 studies; 4967 teeth), indicating that using resin infiltration is significantly (P <0.001) more effective in arresting the caries progression of white-spot lesions.

When assessing the effectiveness based on the type of dentition, the intervention appears more effective in permanent rather than primary teeth (RR 0.22 [95% CI: 0.16-0.31; 2 studies; 1030 teeth] vs. RR 0.44 [95% CI: 0.34-0.58; 2 studies, 610 teeth] respectively).

The review does not stratify based on tooth position, so it is not possible to determine if resin infiltration is effective in permanent anterior teeth from this data.

The narrative review on resin infiltration of non-cavitated enamel lesions in paediatric dentistry (Dziaruddin & Zakaria, 2022) reports that four systematic reviews (including Lin 2022) conclude there is inconclusive evidence to support this intervention in the management of white spot lesions on anterior teeth. The authors note that this is likely due to insufficient high-quality clinical trials rather than the clinical inefficiency of the technique itself. Most of the included studies were either laboratory-based, had a high risk of bias or were short-term. In addition, all four reviews investigated the treatment of white spot lesions associated with orthodontics, fluorosis or MIH.

*interventions in control groups were no treatment or non-invasive treatments (e.g. oral hygiene instructions, fluoride varnish, fissure sealants).

Proposal for updating PMDCC2

These findings could be summarised as:

Evidence is insufficient to reach conclusions about whether it is better to manage white spot lesions on permanent anterior teeth using resin infiltration compared to other management options, such as enhanced prevention or application of fluoride varnish.

The GDG considered whether use of resin infiltration should be advised as an option for managing white spot lesion in anterior permanent teeth.

Outcome

The GDG agreed to include resin infiltration as an option for managing permanent anterior teeth with initial carious lesions (i.e. no dentinal caries, aka white spot lesions).

The Management of caries in permanent teeth and Dental Techniques sections of the guidance were amended.

References

Lin GSS, Chan DZK, Lee HY, Low TT, Laer TS, Pillai MPM, Yew YQ, Wafa SWWSST. Effectiveness of Resin Infiltration in Caries Inhibition and Aesthetic Appearance Improvement of White Spot Lesions: An Umbrella Review. Journal of Evidence Based Dental Practice. 2022 Sep;22(3):101723.

Dziaruddin N, Zakaria ASI. Resin Infiltration of Non-Cavitated Enamel Lesions in Paediatric Dentistry: A Narrative Review. Children (Basel). 2022 Dec 2;9(12):1893.

A4.12 DP15 Selective or stepwise caries removal in permanent teeth

What is the evidence on the efficacy of selective vs stepwise caries removal in permanent teeth?

Background

The PMDCC2 guidance noted that in permanent teeth, stepwise caries removal and selective caries removal are supported for deep lesions with risk of pulpal involvement. The least invasive, feasible approach is recommended. In the 'Management options for carious permanent teeth' figure, stepwise caries removal is advised for extensive molar lesions, while selective or complete caries removal is advised for moderate molar lesions.

In 2021, a Cochrane review that considered the evidence related to interventions for treating cavitated or dentine carious lesions in primary or permanent teeth with vital pulps was published. The review included a comparison of selective vs stepwise caries removal in both primary and permanent teeth.

Assessment of Evidence

A Cochrane review (Schwendicke et al., 2021) considered the evidence related to stepwise excavation of carious tissues (SW) compared to selective excavation of carious tissues (SE) for treating cavitated or dentine carious lesions. Two studies investigated the comparison in primary

teeth with deep lesions* and three studies investigated the comparison in permanent teeth with deep lesions*.

Primary teeth

In primary teeth with deep lesions, there was insufficient evidence of a difference between SW and SE of carious tissue (pooled estimate OR 2.05, 95% CI 0.49 to 8.62; I^2 = 0%; 2 studies, 126 teeth). The certainty of evidence was considered to be very low, due to study limitations (high risk of bias for sequence generation, allocation concealment and blinding for one study with 66% weight) and serious imprecision.

Permanent teeth

In permanent teeth with deep lesions, SE is likely to reduce failure compared to SW (pooled estimate OR 2.25, 95% CI 1.33 to 3.82; I^2 = 0%; 3 studies, 371 teeth). The certainty of the evidence was considered to be moderate, due to study limitations (high risk of bias, principally from lack of blinding).

Overall, the review found that there may be little or no difference between SE or SW in primary teeth with deep lesions. The certainty of the evidence was judged to be very low, mainly due to risk of bias and imprecision. In permanent teeth with deep lesions, moderate certainty evidence suggests that SE reduces failure of the restoration compared to SW. The certainty of the evidence for this comparison was downgraded due to risk of bias from a lack of blinding. Follow-up for both comparisons ranged from 12 to 60 months. The review authors note that there is evidence from primary studies and modelling that SE is more cost-effective than SW, mainly due to the reduction in initial treatment but also other non-medical and opportunity costs. There is also the issue of patient adherence to follow-up, as the SW approach requires patients to return for further treatment after a number of months.

In the review narrative, there is further discussion of the applicability of SE and SW approaches. The authors note that for very deep lesions (involving the inner one-quarter of the dentine), studies have suggested that SW should be the preferred method (Bjørndal 2017; ESE 2019). However, for deep but not very deep lesions (involving the inner one-third or inner half of the dentine), data supports SE over SW for both the primary and the permanent dentition (Elhennawy_2021; Labib 2019; Maltz 2018). Additionally, in one study that directly compared SW with SE in lesions extending to the inner half of dentine in permanent teeth (Maltz 2018), the authors noted a possible higher risk of failure in the SW arm related to failure of the patients to return for completion of treatment.

*Deep lesions are defined in this review as those close to the pulp, risking exposure, extending into inner third or quarter of dentine.

Proposal for updating PMDCC2

These findings could be summarised as:

Evidence is insufficient to reach conclusions about whether SE or SW approaches are better for managing deep lesions in primary teeth. However, for deep lesions in permanent teeth, there is moderate certainty evidence to support the SE approach over the SW approach.

The GDG considered whether:

- the choice of SW or SE should be left up to clinical judgement for management of deep lesions in primary teeth;
- the SE approach should be favoured over the SW approach for deep lesions in permanent teeth.

Outcome

The GDG agreed to remove stepwise caries removal as an option from the guidance, with selective caries removal the preferred option. The Management of caries in primary teeth, Management of caries in permanent teeth and Dental Techniques sections of the guidance were amended.

References

Schwendicke F, Walsh T, Lamont T, Al-yaseen W, Bjørndal L, Clarkson JE, Fontana M, Gomez Rossi J, Göstemeyer G, Levey C, Müller A, Ricketts D, Robertson M, Santamaria RM, Innes NPT. Interventions for treating cavitated or dentine carious lesions. Cochrane Database of Systematic Reviews 2021, Issue 7. Art. No.: CD013039.

Bjørndal L, Fransson H, Bruun G, Markvart M, Kjældgaard M, Näsman P, et al. Randomized clinical trials on deep carious lesions: 5-year follow-up. Journal of Dental Research. 2017;96(7):747-53.

Duncan HF, Galler KM, Tomson PL, Simon S, El-Karim I, Kundzina R, et al. European Society of Endodontology position statement: management of deep caries and the exposed pulp. International Endodontic Journal. 2019;52(7):923-34.

Elhennawy K, Finke C, Paris S, Reda R, Jost-Brinkmann PG, Schwendicke F. Selective vs stepwise removal of deep carious lesions in primary molars: 24 months follow-up from a randomized controlled trial. Clinical Oral Investigations. 2021;25(2):645-52.

Labib ME, Hassanein OE, Moussa M, Yassen A, Schwendicke F. Selective versus stepwise removal of deep carious lesions in permanent teeth: a randomised controlled trial from Egypt – an interim analysis. BMJ Open. 2019;9(9):e030957.

Maltz M, Koppe B, Jardim JJ, Alves LS, de Paula LM, Yamaguti PM, et al. Partial caries removal in deep caries lesions: a 5-year multicenter randomized controlled trial. Clinical Oral Investigations. 2018;22(3):1337-43.

A4.13 DP18 Molar Incisor Hypomineralisation

How does the management of MIH in the PMDCC2 guidance compare with more recently published guideline from EAPD?

Background

PMDCC2 guidance provides advice on the assessment and treatment of MIH. Stakeholders noted European Academy of Paediatric Dentistry (EAPD) guidance for children presenting with MIH (Lygidakis 2021). This is an update of the 2010 version of the guideline which was not referenced in PMDCC2 guidance.

The updated EAPD guidance document contains a number of recommendations for the treatment of MIH in molars and incisors which may be useful for supplementing the advice given in PMDCC2 guidance.

Assessment of Evidence

Management of MIH

The EAPD recommendations were mapped against PMDCC2 advice points and match broadly in the areas of applying fissure sealants, glass ionomer cement (GIC) restorations and preformed metal crowns in the treatment of MIH in molars. EAPD guidance also makes recommendations for the use of composite resin restorations and the use of laboratory manufactured restorations as a restorative option in severe cases. Evidence for recommendations about MIH in molars is typically taken from a small number of studies (ranging from 2 to 8 studies).

It is noted that evidence for the treatment of MIH in incisors is less certain and makes two recommendations to improve the appearance of affected incisors. These following recommendations would be an addition to current PMDCC2 guidance if deemed suitable for inclusion:

Resin infiltration can be used to improve the appearance of affected incisor teeth. Conditional recommendation based on moderate quality evidence (3 studies, 66 restorations/teeth).

Microabrasion can be used to improve the appearance of affected incisor teeth. Conditional recommendation based on very low quality evidence (1 study, 43 restorations/teeth).

Assessment of EAPD Guidance

The EAPD guideline was assessed using the AGREE methodology and a number of weaknesses were identified in its development. The consensus review process is not clearly described and it is unclear who was in the guideline development group. There is no indication that the guidelines were externally reviewed and there was no public involvement in their development. In addition, there is no procedure detailed for updating the guidance. A number of the recommendations are

based on a small number of studies where the evidence ranges from moderate to very low certainty.

Proposal for updating PMDCC2

The original EAPD MIH guideline (2010) is not cited in PMDCC2. There is consistency between the PMDCC2 and EAPD (2021) recommendations on MIH in molars. The GDG considered whether the inclusion of its recommendations on MIH in incisors is merited in the update of PMDCC2 given the deficiencies identified in the development of the EAPD guidelines and the small number of studies the recommendations are based upon.

Outcome

The GDG agreed that the PMDCC guidance should be updated to align with the EAPD guideline, including recommendations about MIH in incisors.

The Management of caries in permanent teeth section of the guidance was amended.

Note: Following peer review the updated advice on MIH in incisors was simplified to refer to the more detailed advice in the EAPD guideline.

References

Lygidakis NA, Garot E, Somani C, Taylor GD, Rouas P, Wong FSL. Best clinical practice guidance for clinicians dealing with children presenting with molar-incisor-hypomineralisation (MIH): an updated European Academy of Paediatric Dentistry policy document. European Archives of Paediatric Dentistry. 2021;23(1):3-21.

A4.14 DP19 Remineralisation

How does the management of MIH in the PMDCC2 guidance compare with more recently published guideline from EAPD and other evidence regarding remineralisation?

Background

PMDCC2 guidance provides advice on the assessment and treatment of MIH. Stakeholders noted European Academy of Paediatric Dentistry (EAPD) guidance for children presenting with MIH (Lygidakis 2021). This is an update of the 2010 version of the guideline which was not referenced in PMDCC2 guidance.

The updated EAPD guidance document contains recommendations for the remineralisation of MIH which may be useful for supplementing the advice given in PMDCC2 guidance. In addition. stakeholders highlighted the potential use of the remineralisation agent Self-Assembling Peptide (SAP) P11-4.

Assessment of Evidence

Remineralisation

PMDCC2 notes that professionally applied 5% sodium fluoride varnish can arrest and reverse/remineralise early enamel caries in primary and permanent teeth, although the quality of evidence for this from two systematic reviews was low.

EAPD guidance makes two recommendations for remineralisation based on the use of topical casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) and topical casein phosphopeptide-amorphous calcium fluoride phosphate (CPP-ACFP)/NaF 4–5% with and without tricalcium phosphate:

- topical casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) can be used to remineralise affected teeth (conditional recommendation, moderate evidence, based on three studies with 61 restorations/teeth)
- topical CPP-ACFP/NaF 4–5% with and without tricalcium phosphate can be used to remineralise affected teeth (conditional recommendation, very low evidence, based on three studies with 88 restorations/teeth)

The EAPD guidance concludes that topical CPP-ACP does seem to improve mineralisation. In contrast, although CPP-ACFP and sodium fluoride with and without tricalcium phosphate has been shown to remineralise affected enamel, there is insufficient evidence to recommend it for this purpose. It is noted that as casein is a milk protein derivative the use of CPP-ACP should be avoided in those allergic to milk proteins.

The EAPD recommendations are qualified in the guidance text and in the supporting SR which provided evidence for the guidance (Somani 2021). Remineralisation is difficult to measure, with an increase in laser fluorescence or quantitative light fluorescence readings reported in studies often not translating to a clinical improvement. Given this, clearly validated outcome measures are needed to verify an increased mineral content, following application of these products, before a firm recommendation for the use of these products to increase the mineral content of hypomineralised teeth and crucially, a clinical improvement, can be made.

EAPD guidance while noting a lack of evidence for the use of fluoride varnish in remineralisation, concludes that it should still be used in children with MIH for caries prevention due to their increased risk.

Assessment of EAPD Guidance

The EAPD guideline was assessed using the AGREE methodology and a number of weaknesses are identified in its development. The consensus review process is not clearly described and it is unclear who was in the guideline development group. There is no indication that the guidelines were externally reviewed and there was no public involvement in their development. In addition, there is no procedure detailed for updating the guidance. A number of the recommendations are

based on a small number of studies where the evidence ranges from moderate to very low certainty.

SAP P11-4

SDCEP have sought clarification about whether SAP P11-4 is licensed for use in the UK. A narrative review and three SRs provide an overview of evidence for the use of SAP P11-4 which is also known by the brand name Curodont Repair (CR) and with the addition of fluoride as Curodont Repair Fluoride Plus (CRFP). The included studies demonstrated a large degree of overlap across the three SRs.

A narrative review (Alsenan 2024) concluded that SAP P11-4 is more effective than other remineralising agents such as fluoride, CPP-ACP, and SDF. However, its efficacy when used alone is still considered inferior. There is a potential synergistic effect when combining SAP P11-4 with fluoride, but further investigation is recommended.

The first SR (Aparna 2022) compared the effectiveness of SAP P11-4 in remineralising early enamel lesions to that of other remineralising agents. A meta-analysis of 12 *in vitro* studies and 6 randomised controlled trials concluded that SAP P11-4 had superior effect in remineralising early enamel lesions compared to control groups.

The second SR (Rathore 2023) assessed the effectiveness of SAP P11-4 peptide with or without any fluoride agents (FA) in remineralization of the white spot lesions (WSLs)/incipient carious lesions (ICLs) compared to other enamel remineralizing agents/non-intervention/placebo. The majority of included studies (n=8) reported a high risk of bias, inconsistent, and imprecise results generating a very low quality of evidence for all outcomes assessed. The authors concluded that there is uncertainty whether SAP/SAP plus a fluoride agent increases/decreases the remineralising/regeneration of WSLs/ICLs and called for more well designed RCTs with longer follow-up to increase the quality of evidence.

The third SR (Keeper 2023) assessed a broader range of outcomes by looking at whether patients with initial caries lesions in permanent teeth treated with Curodont Repair (CR) or Curodont Repair Fluoride Plus (CRFP) compared with a randomized parallel group experienced more caries arrest or less cavitation at any end point or less lesion progression after at least 24 months. The review was based on six trials demonstrating a range of moderate to high risk of bias. The review concluded that CR is likely to be effective for arresting initial (noncavitated) caries lesions across 4 studies and for reducing lesion size across 2 studies. Further research is needed to clarify the effects on preventing cavitation and merged ICDAS scores. No included studies included the use of CRFP. In common with other reviews the authors recommend a need for longer trials with low risk of bias and the study of potential synergistic effects with CR and fluoride or antimicrobial agents.

Proposal for updating PMDCC2

The GDG considered the addition of advice to the PMDCC guidance on the use of CPP-ACP and SAP P11-4 given the evidence presented for their effectiveness. The EAPD guideline demonstrates a number of deficiencies in its development of recommendations and the evidence presented to underpin the recommendations typically come from a small number of studies.

Specifically, for CPP-ACP the GDG was asked to consider the inclusion of the EAPD recommendation:
CPP-ACP can be used to remineralise affected teeth. Conditional recommendation based on moderate quality evidence (3 studies, 61 restorations/teeth).

With regard to SAP P114, while there is some evidence of effectiveness, one SR (Rathore 2023) is unsure of its remineralisation properties and assesses the evidence as very low quality. This suggests that overall, there is insufficient evidence to recommend SAP P114 until further high quality randomised controlled trials are conducted.

Outcome

The GDG agreed to include advice based on the EAPD recommendation about use of CPP-ACP. The Management of caries in permanent teeth section of the guidance was amended.

Note: Following peer review, the updated advice on MIH in incisors was simplified to refer to the more detailed advice in the EAPD guideline.

References

Aparna B K, Yashoda R, Puranik MP. Remineralization of early enamel caries lesions using self-assembling peptides P11-4: Systematic review and meta-analysis. Journal of Oral Biology and Craniofacial Research. 2022 May-Jun;12(3):324-331.

Keper JH, Kibbe LJ, Thakkar-Samtani M, Heaton LJ, Desrosiers C, Vela K, Amaechi BT, Jablonski-Momeni A, Young DA, MacLean J, Weyant RJ, Zandona AF, Sohn W, Pitts N, Frantsve-Hawley J. Systematic review and meta-analysis on the effect of self-assembling peptide P11-4 on arrest, cavitation, and progression of initial caries lesions. Journal of American Dental Association. 2023 Jul;154(7):580-591.e11.

Lygidakis NA, Garot E, Somani C, Taylor GD, Rouas P, Wong FSL. Best clinical practice guidance for clinicians dealing with children presenting with molar-incisor-hypomineralisation (MIH): an updated European Academy of Paediatric Dentistry policy document. European Archives of Paediatric Dentistry. 2021;23(1):3-21.

Rathore K, Patnana AK, Chugh VK, Chugh A, Kumar P. Self-assembling peptides for managing white spot lesions: a systematic review and meta-analysis. European Archives of Paediatric Dentistry. 2023 Oct;24(5):519-531.

Somani C, Taylor GD, Garot E, Rouas P, Lygidakis NA, Wong FSL. An update of treatment modalities in children and adolescents with teeth affected by molar incisor hypomineralisation (MIH): a systematic review. European Archives of Paediatric Dentistry. 2022 Feb;23(1):39-64.

A4.15 DP20 Use of Pre-Formed Metal crowns on FPMs of poor prognosis

Aim

The aim of this summary is to review the evidence to support the use of pre-formed metal crowns (PMCs), applied with minimal preparation, for managing caries in permanent teeth (e.g. first permanent molars [FPMs]).

Background

For younger children with first permanent molars of poor prognosis, the PMDCC2 guidance advises the consideration of temporary measures, such as using a Hall Technique approach (no preparation and no diseased tooth tissue removal) following separator placement. This aims to keep these teeth free from symptoms until the optimal age for extractions is reached.

Assessment of Evidence

A search of PubMed and Epistemonikos (using search terms "permanent" AND "crown" AND "stainless steel" OR "preformed metal") did not find any relevant systematic reviews. A narrative review published in 2002 was identified (Randall 2002), but this found only one study evaluating permanent molar PMCs with control restorations. The failure rate for PMCs (2%) was less than for conventional amalgam restorations (11%). It should be noted that this is likely to have been a retrospective study (no full text available online) that reviewed the outcomes of restorations placed by one practitioner over a 10-year period (Roberts 1990). Therefore, the certainty of the evidence is very low. It should also be noted that the author of the review was employed by a manufacturer of PMCs.

The review was updated in 2015 (Seale 2015) and concludes that "there is evidence from case reports and randomized controlled trials supporting the use of PMCs in permanent teeth as a semi-permanent restoration for the treatment of severe enamel defects or teeth with gross caries". However, the review does not specifically discuss this evidence or cite any studies.

Proposal for updating PMDCC2

These findings could be summarised as:

Evidence is insufficient to reach conclusions about whether pre-formed metal crowns, applied with minimal preparation, can be used for managing caries in permanent teeth on a temporary basis until the tooth can be extracted.

As this approach is already included in PMDCC2 guidance, the GDG considered whether this advice should remain in the updated guidance.

Outcome

The GDG agreed to continue to advise consideration of temporary measures, such as use of preformed metal crowns (no preparation and no diseased tooth tissue removal) following separator placement for first permanent molars of poor prognosis. (Management of first permanent molars of poor prognosis)

References

Randall, RC. Preformed metal crowns for primary and permanent molar teeth: review of the literature. Pediatric Dentistry. 2002;24:489-500.

Roberts J, Sherriff, M. The fate and survival of amalgam and preformed crown molar restorations placed in a specialist paediatric dental practice. British Dental Journal. 1990; 169, 237–244.

Seale NS, Randall R. The Use of Stainless Steel Crowns: A Systematic Literature Review. Pediatric Dentistry. 2015;37(2):147-62.

A4.16 DP21 Use of Atraumatic Restorative Technique

Aim

The aim of this summary is to review the evidence for the effectiveness of atraumatic restoration treatment (ART) and preformed metal crowns (PMCs) on different types of lesions in primary teeth.

Background

Atraumatic restoration treatment is a minimally invasive approach involving removal of decayed tissue using hand instruments alone, usually without the use of anaesthesia. There are concerns that while this approach is suitable for some situations, it may be used inappropriately by some practitioners, either in terms of the technique used or the lesions treated.

Assessment of Evidence

A recent review (Pilcher 2023) aimed to determine the effect of different direct restorative materials for treating cavitated caries lesions on anterior and posterior primary and permanent teeth. One of the comparisons assessed was the use of PMCs placed using the Hall Technique verses ART with glass ionomer cement. The reviewers found one study which compared these interventions on Class II restorations‡ over 36 months. The absolute risk of restoration failure was lower in patients receiving PMCs (RD: –0.55; 95% CI: –0.69 to – 0.42; moderate certainty) by an important amount compared with patients receiving conventional GIC restorations placed using

the ART approach. In addition, the evidence suggests that patient satisfaction was near enough equivalent for both interventions.

This study was also included in the 2021 Cochrane review by Schwendicke et al. (Comparison 5: Selective Excavation [SE] versus Hall Technique [HT]). The review concluded that the evidence is very uncertain about the effect of HT compared to SE.

[‡]The study (Araujo 2020) concluded that the HT restoration survival rate was almost three times higher than ART (93.4% compared to 32.7%) for restoring occluso-proximal dentine lesions in primary molars after 3 years.

Proposal for updating PMDCC2

As advice on the use of ART is already included in PMDCC2 guidance, the GDG considered whether the guidance should be more specific about the types of lesions for which ART is suitable.

Outcome

While there were some reservations about the inclusion of ART in the guidance, and that use of PMCs via the Hall Technique might be preferable, it was agreed to clarify the types of lesion for which ART might be appropriate.

The Atraumatic restorative technique section of the guidance was amended.

References

Pilcher L, Pahlke S, Urquhart O, O'Brien KK, Dhar V, Fontana M, González-Cabezas C, Keels MA, Mascarenhas AK, Nascimento MM, Platt JA, Sabino GJ, Slayton RL, Tinanoff N, Young DA, Zero DT, Tampi MP, Purnell D, Salazar J, Megremis S, Bienek D, Carrasco-Labra A. Direct materials for restoring caries lesions: Systematic review and meta-analysis-a report of the American Dental Association Council on Scientific Affairs. Journal of the American Dental Association. 2023; Feb;154(2):e1-e98.

Schwendicke F, Walsh T, Lamont T, Al-yaseen W, Bjørndal L, Clarkson JE, Fontana M, Gomez Rossi J, Göstemeyer G, Levey C, Müller A, Ricketts D, Robertson M, Santamaria RM, Innes NPT. Interventions for treating cavitated or dentine carious lesions. Cochrane Database of Systematic Reviews. 2021, Issue 7. Art. No.: CD013039.

Araujo, M.P., Innes, N.P., Bonifácio, C.C. et al. Atraumatic restorative treatment compared to the Hall Technique for occluso-proximal carious lesions in primary molars; 36-month follow-up of a randomised control trial in a school setting. BMC Oral Health. 2020; 20, 318.

Appendix 5 Peer Reviewers

Name	Role
Sondos Albadri	Professor and Honorary Consultant in Paediatric Dentistry, University of Liverpool, Royal Liverpool University Hospitals Trust, Alder Hey Children's Hospital
David Auld	Specialist in Paediatric Dentistry, Leeds and York; Specialist Clinical Teaching Fellow, University of Leeds
Bhupinder Dawett	General Dental Practitioner, Derbyshire; Research Fellow, University of Sheffield
Vineet Dhar	Clinical Professor and Chair, Orthodontics and Pediatric Dentistry, University of Maryland School of Dentistry, Baltimore; Chair of Science Committee, International Association of Paediatric Dentistry (IAPD)
Gail Douglas	Professor of Dental Public Health and Honorary Consultant in Dental Public Health, University of Leeds; Vice President of Organisation for Caries Research (ORCA)
Anne-Marie Glenny	Professor of Health Sciences, Associate Dean for Research & Innovation, University of Manchester; Joint Coordinating Editor, Cochrane Oral Health
Roseann Gorman	Specialist Research Lead, Reducing Inequalities, NHS Education for Scotland
Fiona Lafferty	Consultant in Paediatric Dentistry, Edinburgh Dental Institute
Susan Parekh	Professor and Consultant in Paediatric Dentistry, UCL Eastman Dental Institute; Chair of the Clinical Affairs Committee, European Academy of Paediatric Dentistry (EAPD)
Rosie Power	Consultant in Paediatric Dentistry, NHS Tayside
Janine Yazdi-Doughty	General Dental Practitioner, Cheshire; Clinical Lecturer, University of Liverpool; College of General Dentistry representative