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SIGN 138 • Dental interventions to prevent caries in children

A national clinical guideline

March 2014

KEY TO EVIDENCE STATEMENTS AND GRADES OF RECOMMENDATIONS

LEVELS OF EVIDENCE

1 ⁺⁺	High quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias
1 ⁺	Well conducted meta-analyses, systematic reviews, or RCTs with a low risk of bias
1 ⁻	Meta-analyses, systematic reviews, or RCTs with a high risk of bias
2 ⁺⁺	High quality systematic reviews of case control or cohort studies High quality case control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal
2 ⁺	Well conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal
2 ⁻	Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal
3	Non-analytic studies, eg case reports, case series
4	Expert opinion

GRADES OF RECOMMENDATION

Note: The grade of recommendation relates to the strength of the evidence on which the recommendation is based. It does not reflect the clinical importance of the recommendation.

A	At least one meta-analysis, systematic review, or RCT rated as 1 ⁺⁺ , and directly applicable to the target population; <i>or</i> A body of evidence consisting principally of studies rated as 1 ⁺ , directly applicable to the target population, and demonstrating overall consistency of results
B	A body of evidence including studies rated as 2 ⁺⁺ , directly applicable to the target population, and demonstrating overall consistency of results; <i>or</i> Extrapolated evidence from studies rated as 1 ⁺⁺ or 1 ⁺
C	A body of evidence including studies rated as 2 ⁺ , directly applicable to the target population and demonstrating overall consistency of results; <i>or</i> Extrapolated evidence from studies rated as 2 ⁺⁺
D	Evidence level 3 or 4; <i>or</i> Extrapolated evidence from studies rated as 2 ⁺

GOOD PRACTICE POINTS

✓	Recommended best practice based on the clinical experience of the guideline development group
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Scottish Intercollegiate Guidelines Network

Dental interventions to prevent caries in children

A national clinical guideline



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1 Introduction

1.1 THE NEED FOR A GUIDELINE

Dental caries (tooth decay) is a preventable disease. Dental biofilm (plaque) is a naturally occurring layer of bacteria and salivary proteins present in the mouth that builds up on exposed tooth surfaces. If not removed, the bacteria metabolise dietary carbohydrates releasing acid into the biofilm layer which, over time, can demineralise the enamel and dentine giving rise to caries. The process is dynamic and can be controlled so that early lesions do not progress or established lesions can be arrested.

Dental health in Scotland has shown a steady improvement since the 1980s. The proportion of primary one pupils with no obvious dental decay has risen from 42% in 1988 to 73% in 2013.¹ This still means, however, that more than a quarter of Scottish children suffer with a preventable disease and this burden is greatest in those from disadvantaged backgrounds with just 61% of primary one pupils from the most deprived quintile of the population free from obvious decay compared with 82% from the least deprived quintile.¹

Inequalities in dental health have not narrowed significantly in recent decades and public health approaches are increasingly focusing on the social determinants of health. Conceptual models of the factors affecting children's oral health which describe a range of influences at community, family, and child-level, are helpful in understanding these wider determinants.² One approach to addressing many of these factors is the adoption of the common risk factor approach to disease prevention.³ Diet is one of the common risk factors with a role in dental caries, obesity, heart disease, stroke, cancers and diabetes. The role of diet in dental caries is not specifically addressed in this guideline as national oral health and nutritional guidance was published for health professionals in Scotland in 2012 (*see section 1.2.1*).⁴

Recommendations from previous SIGN guidelines on dental caries have been incorporated into the Scottish Dental Clinical Effectiveness Programme (SDCEP) guidance on the prevention and management of dental caries in children.⁵ They have also informed the development of the national Childsmile programme (www.child-smile.org) which provides a comprehensive, free, public health pathway for disease prevention and care to all children and young people in Scotland up to the age of 17 years.

While wider public health- and population-based programmes such as the Childsmile programme are important to develop and maintain there are still marked differences in the use and delivery of preventive approaches in dental practice. Consequently, there is still a need to review and update the evidence in order to clarify which techniques and approaches are the most effective. Due to variation in frequency of presentation of children to primary dental care services it is particularly important to take full advantage of episodes when children attend for dental care. The preventive potential of one-to-one interactions between members of the dental care team and children should be maximised by focusing attention on key interventions and messages.

1.2 REMIT OF THE GUIDELINE

1.2.1 OVERALL OBJECTIVES

This guideline provides recommendations based on current evidence for best practice in dental interventions to prevent caries in children and young people aged 0–18 years carried out by dental care teams within dental practices in Scotland. The guideline focuses on advice or interventions that are applied at an individual rather than a population level. This does not imply that population-based approaches are not important or not recommended.

In Scotland, population-based approaches designed specifically to improve children's dental health are delivered within the Childsmile programme. Policies, regulatory structures and targeted community interventions to reduce sugar consumption or promote uptake of exercise, for example, can impact positively on health outcomes and reduce marked inequalities in health. Co-ordinated action to tackle the determinants of health is needed to reduce health inequalities in Scotland. Reviewing the efficacy of these inter-related

public health approaches is, however, beyond the remit of this guideline. Nevertheless, dental care teams should remain aware of the need to address the broader determinants of health and recognise their role within the wider public health workforce.

This guideline does not consider the optimum diet for preventing dental caries nor the effects of foods on the development of dental decay. The NHS Health document "Oral Health and Nutrition Guidance for Professionals" contains diet and nutrition advice with specific information on the link between diet and tooth decay.⁴ It also contains between-meals food and drink advice for adults and children which aims to reduce harms across dental and other health outcomes. There is a particular emphasis on children under the age of five years.

This guideline replaces SIGN guideline 47 on preventing dental caries in children at high caries risk and SIGN guideline 83 on prevention and management of dental decay in the pre-school child. While the whole guideline has been newly developed, section 3 on predicting caries risk has been drawn from these previous guidelines. Section 3.4.1 has been updated with new evidence.

1.2.2 TARGET USERS OF THE GUIDELINE

This guideline will be of interest to healthcare professionals providing oral health advice to children in a one-to-one situation. It is intended for members of the dental care team. It may also be of interest to parents and carers, primary care and public health staff and others involved in children's health, well-being and development.

1.3 DEFINITIONS

1.3.1 PREVENTED FRACTION

The prevented fraction (PF) of a health problem, also known as preventive or preventable fraction, is the proportion of its incidence in a given time period that can be avoided by implementing an intervention in that population. For example, if the relative risk of developing caries is estimated to be 0.75 in a population that is toothbrushing using fluoride toothpaste compared with a population that is not using fluoride toothpaste over a defined period, the PF is calculated as 25% (ie, the reduction in dental caries between experimental and control participants, expressed as a percentage). It can be calculated as $1 - (\text{relative risk})$ or $1 - (\text{odds ratio}) \times 100$.

1.3.2 THE DMF INDEX

DMFT and DMFS are used to describe numerically the prevalence of dental caries in an individual's permanent teeth. They are obtained by calculating the number of decayed (D), missing (M) and filled (F) teeth (T) or surfaces (S). Calculation of these figures requires determining the number of teeth which:

- have caries lesions (incipient caries are not included)
- have been extracted
- have fillings or crowns.

The sum of the three figures forms the DMFT value. For example: DMFT of 4/3/9=16 means that four teeth are decayed, three teeth are missing and nine teeth have fillings. It also means that 12 teeth are intact. If a tooth has both a caries lesion and a filling it is calculated as D only. DMFT of 28 (or 32, if third molar ('wisdom') teeth are included) is the maximum, meaning that all teeth are affected.

A more detailed index is DMF calculated per tooth surface (DMFS). Molars and premolars are considered to have five surfaces and front teeth have four surfaces. Again, a surface with both caries and filling is scored as D. The maximum value for DMFS is therefore 128 for 28 teeth (or 148 if third molar teeth are included).⁶

For the primary dentition, consisting of a maximum of 20 teeth, the corresponding designations are dmft or dmfs, with maximum available scores of 20 and 88 respectively.⁷

1.3.3 DENTAL NEGLECT

Dental neglect is defined by the British Society of Paediatric Dentistry as the persistent failure to meet a child's basic oral health needs, likely to result in the serious impairment of a child's oral or general health or development.⁸ Registered dental practitioners are expected to be aware of the procedures involved in raising concerns about the possible abuse or neglect of children. While factors such as the multifactorial basis for the development of caries, variation in susceptibility to disease and differences in treatments offered by dental professionals make universal criteria for identifying neglect difficult, the following features give cause for particular concern after dental problems have been pointed out to parents and appropriate and acceptable treatment offered:

- severe untreated dental disease, particularly that which is obvious to a lay person or other non-dental health professional
- dental disease resulting in a significant impact on the child
- parents or carers have access to but persistently fail to obtain treatment for the child, as may be indicated by:
 - irregular attendance and repeated missed appointments
 - failure to complete planned treatment
 - returning in pain at repeated intervals
 - requiring repeated general anaesthesia for dental extractions.

Further information is available from the Department of Health website Child Protection and the Dental Team (www.cpd.org.uk).

1.4 STATEMENT OF INTENT

This guideline is not intended to be construed or to serve as a standard of care. Standards of care are determined on the basis of all clinical data available for an individual case and are subject to change as scientific knowledge and technology advance and patterns of care evolve. Adherence to guideline recommendations will not ensure a successful outcome in every case, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same results. The ultimate judgement must be made by the appropriate healthcare professional(s) responsible for clinical decisions regarding a particular clinical procedure or treatment plan. This judgement should only be arrived at following discussion of the options with the patient, covering the diagnostic and treatment choices available. It is advised, however, that significant departures from the national guideline or any local guidelines derived from it should be fully documented in the patient's case notes at the time the relevant decision is taken.

1.4.1 PRESCRIBING OF LICENSED MEDICINES OUTWITH THEIR MARKETING AUTHORISATION

Recommendations within this guideline are based on the best clinical evidence. Some recommendations may be for medicines prescribed outwith the marketing authorisation (MA) also known as product licence. This is known as 'off label' use.

Medicines may be prescribed outwith their product licence in the following circumstances:

- for an indication not specified within the marketing authorisation
- for administration via a different route
- for administration of a different dose
- for a different patient population.

An unlicensed medicine is a medicine which does not have MA for medicinal use in humans.

Generally 'off label' prescribing of medicines becomes necessary if the clinical need cannot be met by licensed medicines within the marketing authorisation. Such use should be supported by appropriate evidence and experience.⁹

“Prescribing medicines outside the conditions of their marketing authorisation alters (and probably increases) the prescribers’ professional responsibility and potential liability”.⁹

The General Medical Council (GMC) recommends that when prescribing a medicine ‘off label’, doctors should:

- be satisfied that such use would better serve the patient’s needs than an authorised alternative (if one exists)
- be satisfied that there is sufficient evidence/experience of using the medicines to show its safety and efficacy, seeking the necessary information from appropriate sources
- record in the patient’s clinical notes the medicine prescribed and, when not following common practice, the reasons for the choice
- take responsibility for prescribing the medicine and for overseeing the patient’s care, including monitoring the effects of the medicine.

Non-medical prescribers should ensure that they are familiar with the legislative framework and their own professional prescribing standards.

Prior to any prescribing, the licensing status of a medication should be checked in the summary of product characteristics (SPC).¹⁰ The prescriber must be competent, operate within the professional code of ethics of their statutory bodies and the prescribing practices of their employers.¹¹

1.4.2 ADDITIONAL ADVICE TO NHSSCOTLAND FROM HEALTHCARE IMPROVEMENT SCOTLAND AND THE SCOTTISH MEDICINES CONSORTIUM

Healthcare Improvement Scotland processes multiple technology appraisals (MTAs) for NHSScotland that have been produced by the National Institute for Health and Care Excellence (NICE) in England and Wales.

The Scottish Medicines Consortium (SMC) provides advice to NHS Boards and their Area Drug and Therapeutics Committees about the status of all newly licensed medicines and any major new indications for established products.

No relevant evidence was identified from SMC.

2 Key recommendations

The following recommendations were highlighted by the guideline development group as the key clinical recommendations that should be prioritised for implementation. The grade of recommendation relates to the strength of the supporting evidence on which the recommendation is based. It does not reflect the clinical importance of the recommendation.

2.1 DELIVERY OF DENTAL BRIEF INTERVENTIONS IN THE PRACTICE SETTING

B Oral health promotion interventions should facilitate daily toothbrushing with fluoride toothpaste.

2.2 TOOTHBRUSHING WITH FLUORIDE TOOTHPASTE

A Following risk assessment, children and young people up to the age of 18 years who are at standard risk of developing dental caries should be advised to use toothpastes in the range 1,000 to 1,500 ppmF.

A Following risk assessment, children aged from 10 to 16 years who are at increased risk of developing dental caries should be advised to use toothpastes at a concentration of 2,800 ppmF.

A Toothbrushing with fluoride toothpaste should take place at least twice daily.

2.3 TOPICAL ANTICARIES INTERVENTIONS

A Fluoride varnish should be applied at least twice yearly in all children.

2.4 SEALANTS

A Resin-based fissure sealants should be applied to the permanent molars of all children as early after eruption as possible.

3 Predicting caries risk

3.1 INTRODUCTION

There are two approaches to caries prevention: population-based approaches, such as water fluoridation, and targeted prevention, either to individuals or to populations assessed as being at increased risk.¹²

The detection of populations or individuals at increased risk of developing dental caries would allow preventive efforts to be focused on those most at risk of developing caries, in a cost-effective fashion, without reducing the community-wide benefits of preventive methods, such as oral health promotion.

3.2 CARIES RISK INDICATORS

Caries risk assessment in pre-school children has been approached using a variety of factors:

- dietary factors (*further information can be found in the SDCEP guidance on prevention and management of dental caries*)⁵
- oral hygiene factors
- microbiological risk factors
- sociodemographic markers
- previous caries experience.

Potential risk factors for dental caries in children under seven years of age include: oral hygiene, diet, bacterial exposure, socioeconomic status, factors relating to breast and bottle feeding, fluoride exposure, and parental smoking.¹³ The presence of these factors is not necessarily predictive of decay. A child appears to be most at risk of caries if he or she acquires oral mutans streptococci at a young age. A high level of oral mutans streptococci may be partly compensated by other factors such as good oral hygiene and a non-cariogenic diet.¹⁴

2⁺⁺

3.2.1 MICROBIOLOGICAL RISK FACTORS

One cross-sectional and six cohort studies were identified. The authors concluded that caries in young children is associated with high oral levels of mutans streptococci.¹⁵⁻²¹

2⁺⁺

3.2.2 SOCIODEMOGRAPHIC RISK FACTORS

Data from studies on older children demonstrate that caries is most prevalent in children from low socioeconomic status families.²² Infants living in areas of high deprivation have significantly more caries than those from more affluent areas.^{16, 23}

2⁺⁺

One systematic review concluded that no relationship between low birth weight and caries development has been demonstrated.²⁴ One of the studies included in the review showed that low birth weight could be associated with enamel defects and caries in the primary dentition.²⁵ More research is required in this area before conclusions can be drawn.

2⁺⁺

No conclusive evidence was found to show that pre-school children with special needs are at increased caries risk.

3.2.3 PREVIOUS CARIES EXPERIENCE

Four cohort studies have shown that children with previous caries experience are at increased risk of future caries.²⁶⁻²⁹

The majority of caries risk assessment studies have involved multiple risk indicators or interactions between these indicators. The most important risk indicators for caries identified in these cohort studies were previous caries experience and high levels of oral mutans streptococci.^{22, 26, 28-35}

2⁺⁺

3.2.4 SALIVA

Saliva fulfils a major protective role against dental caries.³⁶ A small proportion of children may have reduced salivary flow, usually as a consequence of their medical history and related drug therapy, and are at high risk of dental caries. Despite the association between low salivary flow and caries, salivary markers have generally proved unhelpful in the formal assessment of caries risk.^{37,38} | 2⁺⁺
4

3.3 INFLUENCE OF PARENTAL ORAL HEALTH STATUS

The presence of maternal active decay, oral mutans streptococci, or reported high maternal sucrose consumption have not been proven to be predictive indicators of caries risk in children.³⁹ | 2⁺

Parental deprivation is a risk indicator for caries development in their children.^{16,22} | 3

3.4 CARIES RISK ASSESSMENT

For individual patients, the objective clinical judgement of the dentist, their ability to combine and use these risk factors and their knowledge of the patient has been shown to be one of the most powerful predictors of that individual's caries risk.⁴⁰ In particular, the dentist's subjective judgement of the size of the DMF/dmf increment (newly developing caries) over subsequent years is also a relatively strong predictor.²² | 4
2⁺

C The following factors should be considered when assessing caries risk:

- 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.

✓ Clinicians should be aware of individuals with a medical or physical disability for whom the consequences of dental caries could be detrimental to their general health. These patients should receive intensive preventive dental care.

The Childsmile programme contacts children within Scotland from the age of three months after being introduced to the family by the public health nurse or health visitor.^{41,42} The aim is to encourage dental attendance from the age of six months and provide additional support to children and families in most need. This approach should result in early identification of most young children at highest risk of caries.

3.4.1 CARIES RISK ASSESSMENT TOOLS

There is evidence to show that the development of a generalisable risk assessment tool (risk model) for pre-school children in Scotland is feasible.⁴³ However, no evidence was identified that shows that the use of a caries risk assessment tool results in those at increased caries risk receiving enhanced caries prevention. Further, although there are many caries risk assessment tools in existence (for example, Dundee Caries Risk Assessment Model (DCRAM), Caries Management by Risk Assessment (CAMBRA), American Dental Association (ADA) caries risk assessment, American Academy of Pediatric Dentistry caries risk assessment tool (AAPD CAT), Cariogram) the published evidence offers no consensus as to which tool is most effective.⁴⁴ | 3
2⁺

The DCRAM was developed from data collected annually for over 1,500 children born in one calendar year in Dundee. Health visitors and a dentist collected longitudinal social, medical and dental data for four years. The two most significant risk indicators at age one year for the child having at least three carious teeth at age four years were living in council housing and the health visitor's opinion that the child was at risk of caries (sensitivity=65%, specificity=69%).⁴³ Another study has also shown that healthcare workers' subjective assessment was an important factor in the assessment of caries risk in young children.⁴⁵

This risk model is appropriate for use by both dental and non-dental personnel and is applicable in a primary care setting.

- D** Specialist child healthcare professionals should consider carrying out a caries risk assessment of children in their first year as part of the child's overall health assessment.
- D** Children whose families live in a deprived area should be considered as at increased risk of early childhood caries when developing preventive programmes.
- ✓** A child considered by the healthcare professional to be at high caries risk should be referred to the appropriate health service provider.

4 Delivery of dental brief interventions in the practice setting

4.1 INTRODUCTION

Although some preventive dental procedures are carried out by the dental care team in the dental practice setting or other environment, the most effective and cheapest methods of prevention involving individuals are those carried out regularly at home (for example, use of fluoride toothpaste and diet management).

The term 'dental brief intervention' refers to dialogue, between the clinician and the child or parent/carer, to support positive dental health behaviour change as part of an overall package aimed at improving the patient's oral health. Brief interventions have been used successfully to address substance abuse or treatment of addiction such as smoking cessation and hazardous drinking.^{46,47} Brief interventions and brief therapies may be thought of as elements on a continuum of care, but they can be distinguished from each other according to differences in outcome goals. Generally, interventions are aimed at motivating a client to perform a particular action (for example, to enter treatment, change a behaviour or think differently about a situation), whereas therapies are used to address larger concerns (such as treating a mental illness, maintaining abstinence, or addressing longstanding problems that exacerbate substance abuse).

In general, for young children the intervention is aimed at the parent/carer's behaviour change, but for older children the brief interventions are targeted directly at the child to support their adoption of dentally healthy behaviours. The NHS supports the targeting of health behaviour change through brief intervention, and current practice and capacity within Childsmile allows for more intensive health promotion interventions to be undertaken within NHS dental practices in Scotland. It is acknowledged, however, that consideration would need to be given to training to support increased delivery.

There is a growing field of research in this area, however, the overall quality of the evidence identified was variable and generally low, with much of the research either not conducted in the dental setting or not translatable to it. There were issues of heterogeneity between the included studies with regard to the interventions, target groups, assessment timescales and outcomes measured. However, consistent findings were increase in knowledge,⁴⁸⁻⁵⁰ improved self efficacy and planning,^{51,52} and increase in behaviours promoting dental health.⁵²⁻⁵⁴ A selection of outcome measures of self reported behaviour change were used in the trials, such as recall of flossing, frequency and duration of toothbrushing and amount or timing of food and drink consumption. As these were often only recorded over a short period of time it was not always possible to assess either the long-term effects of the interventions or the duration and repetition frequency that would be needed for the interventions to maintain effect.^{52,54-56} A number of studies did record clinical indicators such as plaque scores and DMFS/dmfs.^{50,57-61} Lastly, the interventions were applied in a variety of age groups. However, as this guideline covers young people up to the age of 18 years, and often involves parents or carers adopting the positive dental health behaviour on behalf of the child, selected evidence from studies conducted on adults has been included. Consideration has been given to the issues arising from extrapolating the results to younger children and their parents/carers and the validity of drawing conclusions on the likely effectiveness of interventions in this group of patients.

The application of brief interventions to the dental field is a recent field of research and interest in the use of motivational interviewing techniques over other behavioural change approaches may result in bias (ie motivational interviewing (MI), appearing more favoured by being more investigated) and further research comparing interventions is needed. Developments to promote improvements in the reporting of behaviour-change interventions and agreed definitions of behaviour change techniques along with theoretical frameworks should assist in improving the consistency of studies in this area.⁵⁴

4.2 EFFECTIVENESS OF DENTAL BRIEF INTERVENTIONS

Three systematic reviews and three trials of brief interventions for prevention of dental caries or improvement in oral health outcomes were identified.^{48, 57, 60-63} A further systematic review included interventions aimed at enhancing general as well as dental health.⁵⁴

An overview of systematic reviews of interventions to reduce caries identified three systematic reviews of oral health promotion activities. It reported that although health promotion activities may improve oral health knowledge, there was a lack of evidence to support health promotion and educational activities impacting directly on dental caries.⁶² The weak causal relationship between increasing knowledge and changing behaviours was noted.

1+

This weak relationship was also noted in a systematic review which investigated one-to-one dietary interventions undertaken in a dental setting.⁵⁴ Despite some evidence that interventions aimed at improving general health could be effective at changing dietary behaviour, there is still little evidence for effectiveness of interventions to prevent dental caries.

1++

A systematic review which focused on oral health promotion for patients with fixed orthodontic appliances found positive effects on plaque and gingival health in four out of the seven included trials. It concluded that a short-term (up to five months) reduction in plaque and improvement in gingival health was possible following an oral health promotion intervention, however no particular method could be shown to produce a greater short-term benefit.⁶³ These findings were consistent with a further systematic review which included 36 randomised controlled trials (RCTs) (n=3,353), 80 quasi-experimental studies (ie non-randomised clinical trials), 33 single-group pre-test post-test studies, seven multiple baseline and six mass media studies. The review concluded that oral health promotion which brought about the use of fluoride was effective (mean caries reduction 1.8 surfaces, 95% confidence interval (CI) 0.384 to 3.264) and that chairside interventions were generally more effective than other methods (meta-analysis was not possible due to variability in study design and population).⁴⁸

2+

2++

One Australian RCT found that providing first-time mothers with information on oral health care for their infants significantly decreased the rate of severe early childhood caries (defined as any sign of smooth surface caries in children younger than three years of age). The incidence of severe early childhood caries in the group receiving health information was 1.7% and in the control group was 9.6% (p<0.05).⁶⁰ A Turkish study of 15 year old children with fixed orthodontic appliances which investigated five different methods for oral hygiene motivation showed that all were effective in reducing plaque after four weeks compared with baseline under the supervision of the clinician (p<0.05).⁵⁷

1-

Results from a controlled clinical trial (CCT) showed that a comprehensive programme based on repeated parent education, including dietary guidance and support for daily toothbrushing was effective in preventing caries in two to three year old children living in an area of socioeconomic deprivation. Caries prevalence in the experimental group was significantly lower than in the control group after one year ('decayed, marked for extraction, filled teeth' index 3.0 v 4.4, p<0.01).⁶¹

1+

B

Oral health promotion interventions should facilitate daily toothbrushing with fluoride toothpaste.

4.3 FORMAT OF DENTAL BRIEF INTERVENTIONS

A systematic review of models for individual health promotion reported that in clinical prevention and health education, two studies showed interventions using standardised messages failed to improve oral health in the long term.⁶⁴ Within the same review, a systematic review and one RCT showed no effect of counselling on any health outcome and were only short term in follow up. Another RCT which included oral hygiene and dietary counselling and non-invasive preventive measures was effective in reducing the total need for restorative care although lesion-specific results in regard to reversing active caries lesions were not reported in the study's findings. The results also showed that frequent counselling sessions alone had little effect on oral health and dietary habits of the participants. The large number of fluoride varnish applications received by children in the experimental group also contributed to the reduction in DMFS increment obtained among this group. Seven studies on model-based interventions which met the quality criteria found these to be effective in reducing risk behaviours and levels of disease. Only one of these studies related to dental outcomes. Of the nine studies on MI (comprising seven RCTs and two systematic reviews), eight found positive results for MI in changing health-related behaviours and although only one study directly involved dental outcomes, the authors concluded that an MI approach has the potential to be effective in the dental field.

2+

Four further RCTs assessed MI techniques for their effectiveness in changing dental health behaviours.^{50,52,53,58} Their conclusions supported the approach to achieve oral health improvement. Although a wide variety of outcomes were measured making it difficult to give an overall effect size range, positive effects were consistent. The positive effects varied from finding improved plaque scores and oral hygiene knowledge with a brief MI intervention (although follow up was short with maximum of eight weeks);⁵⁰ increased self efficacy with Farquar's six-step model (adapted) compared with traditional oral hygiene instruction alone;⁵² mothers increasing toothbrushing episodes (although there was only four weeks of follow up);⁵³ and, in one study involving four different interventions, the 45-minute MI intervention was found to be the most effective, giving a 46% reduction in dmfs compared to the other groups at two-year follow up (hazard ratio 0.54, 95% CI 0.35 to 0.84).⁵⁸ There was heterogeneity in respect of the duration and format of the interventions across studies.

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There is evidence from one RCT conducted in Scotland in general dental practice, that a simple theory-based intervention was more effective than routine care in positively influencing oral hygiene behaviour.⁵¹ This is supported by the results of an RCT which looked at an integrated cognitive and behavioural tailored approach.⁵⁹ Two other RCTs found that a planned approach to undertaking health behaviours can be effective in supporting individuals to act in accordance with their intentions, however, the patient's readiness to change should be considered.^{55,56}

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The Childsmile programme provides training on the delivery of planned, evidence based interventions that seek to motivate and support health behaviour change. NHS Health Scotland (www.healthscotland.com) has downloadable resources for health professionals to support the delivery of brief interventions.

B

Oral health promotion interventions should be based on recognised health behaviour theory and models such as motivational interviewing.

4.4 SOCIAL DETERMINANTS OF ORAL HEALTH

As previously discussed, multi-agency co-ordinated action is key in addressing the determinants of health and reducing health inequalities in our society. The World Health Organization (WHO) states that the social or wider determinants of health are the conditions in which people are born, grow, live, work and age. These conditions or circumstances are shaped by the distribution of money, power and resources at global, national and local levels. WHO makes clear the link between the social determinants of health and health inequalities, defined as "the unfair and avoidable differences in health status seen within and between countries."^{65,66} Those who live in more disadvantaged areas are more likely to experience poor health at all stages throughout their life span.⁶⁵

A systematic review of models for individual health promotion which included 32 studies concluded that the evidence supported effective models for chairside oral health promotion incorporating the underlying social determinants of oral disease which should be considered during the clinical encounter. The review favours integrated health behaviour change models which, by taking account of social factors, are more supportive than judgemental and move away from the traditional biomedical model.⁶⁴ 2+

These may be considered as part of the caries risk assessment (*see section 3*). There is consistent evidence for MI approaches having positive results in eliciting behaviour change despite variations in design between studies.^{50, 52, 53, 58, 64} This reinforces the need for these approaches to be applied with social context and other factors being taken into consideration.

C As part of the patient assessment, a social history should be taken which will contribute to dental brief interventions being specific to individuals and tailored to their particular needs and circumstances.

✓ Dental health professionals should take a common risk factor approach supporting a variety of topic-based brief interventions and when possible provide support to colleagues to expand the delivery of brief interventions across other appropriate settings.

5 Toothbrushing with fluoride toothpaste

5.1 INTRODUCTION

In December 2010, UK Medicines Information reported that 133 out of 168 products contained some fluoride in a survey of toothpastes which were widely available in the UK.⁶⁷ The main component of any toothpaste by volume is an abrasive agent, which facilitates the removal of plaque during brushing. The most common active chemical ingredient of toothpastes is fluoride which has beneficial effects on dental hard tissue. Generally, the available fluoride concentration is recorded as parts per million fluoride (ppmF).

5.2 USE OF FLUORIDE TOOTHPASTE

For several decades fluoride toothpaste has been commercially available and recommended for twice daily use. The concentration of commercially available fluoride toothpaste has varied from 250 to 5,000 ppmF. Over-the-counter (OTC) toothpaste is currently available in concentrations ranging from around 700 ppmF to 1,500 ppmF, while 2,800 ppmF and 5,000 ppmF toothpastes are available on prescription.

5.2.1 CARIES PREVENTION ASSOCIATED WITH USE OF FLUORIDE TOOTHPASTE

Several systematic reviews have demonstrated that use of fluoride toothpaste reduces the development of new dental caries. This effect increases with increased concentration of fluoride and with increased baseline caries levels.⁶⁸⁻⁷⁶

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One meta-analysis (70 studies, n=42,300) observed a significant reduction in caries (DMFS pooled PF 24%, 95% CI 21 to 28%; p<0.0001) with the use of fluoride toothpaste compared with non-fluoride toothpaste or no toothpaste at all.⁶⁹

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A further meta-analysis showed that use of standard concentration (1,000–1,500 ppmF) fluoride toothpaste reduced caries in primary teeth compared to placebo or no intervention (dmfs PF 31%, 95% CI 18 to 43%).⁷⁶ It should be noted, however, that four out of five of the trials contributing to this meta-analysis were conducted in China where prevalence of dental caries in pre-school children is high. It is known that absolute benefit of fluoride toothpaste increases as baseline caries increases, thus this finding should be interpreted with caution when considering other populations.⁶⁹

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5.2.2 EFFECT OF AGE OF FLUORIDE APPLICATION AND AMOUNT OF TOOTHPASTE USED ON RISK OF FLUOROSIS

Dental fluorosis is a defect in the mineralisation of tooth enamel caused by the ingestion of an excessive amount of fluoride when primary and permanent teeth are developing in the jaws. Clinically, the appearance of teeth with fluorosis depends on the severity of the condition. In its mildest form, there are faint white lines or streaks visible only to trained examiners under controlled examination conditions. In the most severe form, brown staining or pitting of the tooth enamel may be present and actual breakdown of the enamel may occur.⁷⁵ Due to the developmental nature of the mechanism for fluorotic effects, children are only at risk of fluorosis of cosmetic importance until the age of around three years. During this period, the use of fluoridated products is a risk factor for the development of later fluorosis due to inadvertent swallowing of toothpaste and mouthwash.

In 1997, the Food and Nutrition Board of the United States Institute of Medicine developed a comprehensive set of reference values for dietary nutrient intakes.⁷⁷ They recommended an estimated maximum intake level of fluoride from all sources (fluoridated water, food, beverages, fluoride dental products and dietary fluoride supplements) that should not produce unwanted effects on health at 0.10 mg/kg/day for infants, toddlers, and children up to eight years of age. For older children and adults, who are no longer at risk of dental fluorosis, the maximum level for fluoride was set at 10 mg/day regardless of weight (*see Table 1*).

Table 1: Estimated daily maximum intake level of fluoride from all sources

Age group	Reference weight kg (lb)	Tolerable upper intake (mg/day)
0–6 months	7 (16)	0.7
Infants 7–12 months	9 (20)	0.9
Children 1–3 years	13 (29)	1.3
Children 4–8 years	22 (48)	2.2
Children 9–13 years	40 (88)	10
Boys 14–18 years	64 (142)	10
Girls 14–18 years	57 (125)	10

A meta-analysis of four cross-sectional surveys showed a statistically significant reduction in mild fluorosis if brushing of a child's teeth with fluoride toothpaste commenced after the age of 12 months (odds ratio (OR) 0.70, 95% CI 0.57 to 0.88).⁷⁵ There was an inconsistent association between starting using fluoride toothpaste/toothbrushing before or after the age of 24 months and fluorosis. However, there was no significant association with the frequency of toothbrushing (brushing less than twice daily compared with twice daily or more OR 0.88, 95% CI 0.71 to 1.08). While the review provides some evidence that brushing a child's teeth with fluoride toothpaste before the age of 12 months may be associated with an increased risk of developing mild fluorosis, for children assessed by their dentist to be at high risk of tooth decay the benefit of reducing caries probably outweighs the risk of mild fluorosis. Fluorosis was treated as a binary (present or absent) variable rather than the continuous variable that it is in reality. The authors note the difficulty in providing a threshold for determining presence or absence of fluorosis and note that all of the evidence in the review is describing mild levels of fluorosis in terms of its effect on aesthetic appearance. Reported frequency of toothbrushing is one proxy measure for the amount of fluoride ingested. Other measures were considered by the authors to be more subjective and not included.

2**

Risk of fluorosis associated with concentration of fluoride in toothpaste is discussed in section 5.3.2.

Considering the tolerable upper intake limits listed in Table 1, it is possible to calculate safe limits of toothpaste ingestion for children in different age groupings (see Table 2). Note that these figures assume that a child's entire daily intake of fluoride is drawn from ingested toothpaste and not from other sources such as fluoridated water or dietary content.

Table 2: Approximate tolerable daily limit of fluoride toothpaste ingestion for children

Toothpaste strength (ppmF)	Approximate tolerable daily volume of toothpaste ingestion (mls)		
	1–3 year old child (13 kg)	4–8 year old child (22 kg)	9–13 year old child (40 kg)
1,000	1.3	2.2	10
1,500	0.86	1.46	6.7
2,800	0.46	0.79	3.6

Note: cells with strikethrough formatting indicate that this concentration of fluoride is not licensed or recommended for this age group.

A study comparing fluoride ingested from toothpaste by 1.5 to 3.5 year old children in seven European countries indicated that there was considerable variation between countries in types and amounts of toothpaste used and amounts ingested. The amount of fluoride ingested ranged from 0.01 to 0.04 mg/kg day.⁷⁸

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- ✓ To reduce the risk of mild fluorosis and reinforce good oral health the amount of toothpaste used by children up to the age of three years should be supervised.

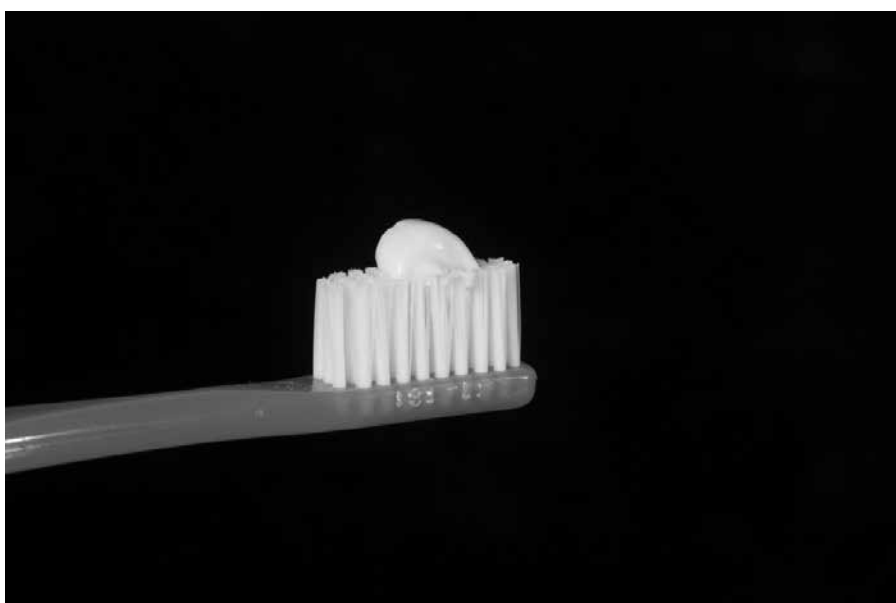
It has been previously recommended that in order to balance the benefits of preventing dental caries against the potential harms of fluorosis associated with ingesting fluoride toothpaste, children under three years of age should use no more than a smear of toothpaste.^{5,79} An average smear is approximately 0.1 ml (*see Figure 1*) which would allow 13 brushing episodes with 1,000 ppmF toothpaste per day before breaching the upper tolerable limit of fluoride intake, assuming that 100% of toothpaste used was ingested. For children over the age of three years a pea-sized amount (0.25 ml) per brushing is recommended (*see Figure 2*). This would allow eight brushing episodes with 1,000 ppmF toothpaste per day before breaching the upper tolerable limit of fluoride intake.

Figure 1: Smear of toothpaste (approximately 0.1 ml) representing the recommended volume for children under the age of three years



Brushing with a smear of 1,000 ppmF toothpaste involves $0.1 \text{ ml} \times 1 \text{ mg F/g} = 0.1 \text{ mg F}$.

Figure 2: Pea-sized amount of toothpaste (approximately 0.25 ml) representing the recommended volume for children over the age of three years



Brushing with a pea-sized amount of 1,000 ppmF toothpaste involves $0.25 \text{ ml} \times 1 \text{ mg F/g} = 0.25 \text{ mg F}$.

5.3 CONCENTRATION OF FLUORIDE TOOTHPASTE

5.3.1 EFFECT OF CONCENTRATION OF FLUORIDE TOOTHPASTE ON PREVENTION OF CARIES

The maximum amount of fluoride allowed in toothpaste, by UK and European Community law, for use as an oral hygiene product before it is classified as a medicine, is 0.15%. This is equivalent to 1,500 ppmF.⁸⁰ Systematic reviews involving toothpastes with different concentrations of fluoride suggest a dose-response relationship between the amount of fluoride in toothpaste and the level of caries reduction occurring as a result of different concentrations used.

Standard concentrations of fluoride (1,000–1,500 ppmF) in toothpaste available OTC have been shown to be effective for the prevention of dental caries in several systematic reviews.^{70, 73, 74, 81}

One systematic review compared the anticaries effect of brushing with fluoride toothpaste at 1,000–1,500 ppmF on the permanent dentition to placebo, fluoride-free toothpaste or no intervention in 23 RCTs or CCTs. The average PF was 25.8% (standard deviation $\pm 10.5\%$).⁷³

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The review also compared daily brushing with toothpastes at concentrations of 1,000–1,100 ppmF to those at 1,500 ppmF and found a mean difference in PF of 9.7% in favour of the higher concentration.

A network meta-analysis showed a beneficial effect of fluoride toothpastes on prevention of caries when used by children and adolescents but not at all concentrations. Results from 74 RCTs were combined in a multiple treatments meta-analysis to provide direct comparisons (*see Table 3*) and indirect comparisons. Fluoride toothpastes significantly prevented caries compared with placebo but only from a concentration of 1,000 ppmF and above (DMFS PF 23%, 95% credible interval (CrI) 19% to 27%; DMFT PF 25%, 95% CrI 19% to 30%) with the PF increasing thereafter.⁷⁴

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There was a greater caries preventive benefit of brushing with a toothpaste containing 1,000 ppmF and higher when compared to brushing with toothpaste containing 250 ppmF. For the active comparisons, using 250 ppmF as the baseline, fluoride concentrations of 1,000, 1,055, 1,100, 1,250 ppmF and above were associated with a statistically significant increase in DMFS prevented fraction ranging from 14%, (95% CrI 1% to 27%); through to 26% (95% CrI 11% to 41%) at concentrations of 2,400, 2,500 and 2,800 ppmF. The authors noted some evidence of a dose-response relationship in that the PF increased as the fluoride concentration increased from the baseline. However the increase in PF was not statistically significant in all studies.

A meta-analysis of five RCTs, some of which were also included in the study reported above, concluded that the overall weighted mean DFS increment was 0.60 (95% CI 0.22 to 0.99) greater in the 250 ppmF group than the 1,000 ppmF group.⁸¹

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One systematic review evaluated six studies reporting DMFS, and three reporting DMFT data in children using high concentration fluoride toothpastes.⁷⁴ Toothpastes with fluoride in the range 2,400 to 2,800 ppmF were significantly better at reducing caries than toothpastes with fluoride in the range 1,000 to 1,500 ppmF (*see Table 3*). While it might be argued that this benefit is only seen in populations with high baseline levels of disease, mean baseline DMFS values ranged between 2.5 and 7.4, where reported.

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Table 3: DMFS increments (prevented fractions) from meta-analysis of direct comparisons between fluoride toothpastes of different concentrations in children and adolescents⁷⁴

Concentration of Fluoride (ppm)	Placebo	250	440–550	1,000–1,250
250	8.90 (-1.62 to 19.42) 3 trials			
440–550	7.91 (-6.11 to 21.94) 2 trials			
1,000–1,250	22.20 (18.68 to 25.72) 54 trials	16.80 (8.47 to 25.12) 2 trials	0.48 (-14.98 to 15.94) 1 trial	
1,450–1,500	22.07 (15.26 to 28.88) 4 trials			9.58 (2.52 to 16.64) 6 trials
1,700–2,200				9.44 (2.12, 16.76) 2 trials
2,400–2,800	36.55 (17.46 to 55.64) 4 trials		12.66 (-1.65 to 26.97) 1 trial	12.15 (5.95 to 18.35) 6 trials

Figures in bold represent prevented fractions demonstrating a statistically significant difference in caries reduction.

Data extracted from Walsh T, Worthington HV, Glenny AM, Appelbe P, Marinho VCC, Shi X. Fluoride toothpastes of different concentrations for preventing dental caries in children and adolescents. Cochrane Database of Systematic Reviews 2010, Issue 1¹.

5.3.2 EFFECT OF CONCENTRATION OF FLUORIDE TOOTHPASTE ON RISK OF FLUOROSIS

Two RCTs reported in a systematic review compared the association between concentrations of fluoride toothpaste used and fluorosis.⁷⁵ One RCT compared 550 with 1,000 ppmF and the other compared 440 with 1,450 ppmF. Both studies found statistically significant differences (relative risk (RR) 0.75, 95% CI 0.57 to 0.99) and (RR 0.59, 95% CI 0.44 to 0.79), indicating a higher concentration of fluoride toothpaste was associated with an increased risk of fluorosis. The first study recruited children at 12 months as opposed to two years and continued it to the age of five to six years, as opposed to a three-year period in the second study which confounds the issue of concentration of fluoride as it is unclear whether the increased risk of fluorosis is due to duration of exposure to fluoride, age at commencement of toothbrushing or concentration of fluoride. Meta-analysis of three cross-sectional surveys did not show a significant association between concentration of fluoride and risk of fluorosis (OR 0.79, 95% CI 0.61 to 1.02).

Toothbrushing with fluoride toothpastes at concentrations of 1,000 to 1,500 ppmF is significantly associated with prevention in the development of new caries in all children, with greater magnitude of effect in children with the highest levels of baseline decay (see section 5.3.1). Weaker evidence also indicates that it is associated with an increase in risk of mild fluorosis. Mild fluorosis has no effect on tooth function and may render the enamel more resistant to caries. It is not readily apparent to the affected individual or casual observer and often requires a trained specialist to detect. Most investigators regard even the more advanced forms of enamel fluorosis as a cosmetic effect rather than a functional adverse effect.⁷⁷

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Toothpastes at concentrations up to 1,500 ppmF are readily available OTC at relatively low prices and, as cosmetic products, are not subject to licensing restrictions. Toothpaste at 2,800 ppmF is available on prescription only to adults and children over the age of 10 years. Toothpaste at 5,000 ppmF is available on prescription only to adults and children over the age of 16 years.

A Following risk assessment, children and young people up to the age of 18 years who are at standard risk of developing dental caries should be advised to use toothpastes in the range 1,000 to 1,500 ppmF.

✓ Following risk assessment, children up to the age of 10 years who are at increased risk of developing dental caries should be advised to use toothpastes at 1,500 ppmF.

A Following risk assessment, children aged from 10 to 16 years who are at increased risk of developing dental caries should be advised to use toothpastes at a concentration of 2,800 ppmF.

5.4 COMPOSITION OF FLUORIDE TOOTHPASTE

Since the initial production of commercially available fluoride-containing toothpastes in the 1950s there has been a number of developments with regard to the specific active fluoride ingredient. Most toothpastes currently available in Scotland contain either sodium fluoride (NaF) and/or sodium monofluorophosphate (SMFP). Stannous fluoride (SnF₂) is also available in combination with sodium hexametaphosphate.

It is likely that toothpaste is the fluoride delivery vehicle with which children in Scotland will be in contact on the most frequent basis, however no evidence was identified which directly investigated the comparative efficacy or harms of the different chemical compositions as caries preventive agents. It is likely that the most important factor is the concentration of fluoride within the preparation rather than the particular chemical composition of the material (*see section 5.3*).

5.5 FREQUENCY AND DURATION OF BRUSHING

5.5.1 FREQUENCY OF TOOTHBRUSHING

A Cochrane review found the effect of fluoride toothpaste increases with higher frequency of use.⁶⁹ There were statistically significant associations between estimates of DMFS prevented fractions and frequency of use, with a 14% increase in PF (95% CI 6% to 22%) with twice daily brushing as opposed to once daily. 1⁺⁺

Since the publication of this systematic review a small number of cross-sectional studies of variable quality (n=10) have reported associations between an increase in frequency of brushing and a reduction in dental caries.⁸²⁻⁹¹ These studies have been undertaken in developed and developing countries, for children at different age groups and socioeconomic statuses. All studies showed a categorical effect of brushing frequency (for example, those who brushed twice or more per day experienced fewer caries than those who brushed less than once daily) although the definitions of the categories (daily frequency of brushing) in which children were analysed varied between studies. Most studies showed a significantly greater reduction in caries incidence associated with brushing at least twice daily compared with less than twice daily. 3

A Toothbrushing with fluoride toothpaste should take place at least twice daily.

5.5.2 DURATION OF TOOTHBRUSHING

Toothbrushing for at least two minutes is recommended by the Childsmile programme, the SDCEP guidance⁵ and some toothpaste manufacturers. However, no studies were identified relating to duration of brushing and caries prevention.

There is insufficient evidence on which to recommend a specific duration for an episode of toothbrushing for the prevention of caries.

5.5.3 SUPERVISED TOOTHBRUSHING

In reviewing the evidence relating to the supervision of toothbrushing it was noted that there was a lack of consistency in the use of the term supervision. This was not clearly defined and there appeared to be a variety of interpretations of this term ranging from the presence of an adult to ensure that brushing has taken place to the close monitoring of dental hygiene techniques within controlled quadrant brushing.

None of the reviewed studies considered the variables of age, manual dexterity or the impact of supervision on brushing technique.

As neither supervision nor toothbrushing were terms which had a standardised interpretation, references to supervised toothbrushing within the research may be best considered to simply signify an episode of verifiable exposure to fluoride toothpaste.

There is evidence from two Cochrane systematic reviews that supervised toothbrushing is associated with a reduction in the incidence of caries development. Meta-regression of relevant covariates in one of the reviews indicated that supervised brushing resulted in a statistically significant 10% greater PF (95% CI 4% to 17%) than unsupervised brushing.⁶⁹ In the second review, meta-regression of indirect comparisons suggested that the effect of self-applied supervised use of topical fluoride therapy (mostly toothpaste) was 11% (95% CI 3.7% to 17%) greater than that of operator-applied and unsupervised home use of such therapies.⁵⁶ One Cochrane systematic review found no statistically significant association between supervision of toothbrushing and caries PF.⁶²

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A systematic review concluded that daily toothbrushing with fluoride toothpaste has a significant caries-preventive effect which is boosted by the use of supervised toothbrushing. Although studies involving supervised toothbrushing reported a higher PF than those with unsupervised toothbrushing when compared to placebo (31.0% v 23.3%) and other fluoride-containing controls (12.0% v 3.9%), no estimates of statistical significance were reported.⁷³

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One RCT measuring caries increment following an intervention comparing daily teacher-supervised toothbrushing against no supervision found a significantly lower overall caries increment in the group who had supervision of brushing (2.60 v 2.92; $p < 0.001$).⁹²

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A follow-up study of a Scottish RCT in which supervised toothbrushing took place at school along with the provision of take home toothpaste and brushes concluded that 54 months after the end of the trial the intervention group still had fewer caries than the non-intervention group (DFS caries increment 1.62 v 2.65; $p = 0.002$).^{93, 94}

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Supervised brushing has been shown to be important in regulating the amount of toothpaste applied to the brush and the tendency for young children to swallow large amounts of toothpaste, thereby decreasing the risk of fluorosis.⁹⁵

4

A Supervision of toothbrushing with fluoride toothpaste is recommended as an effective caries prevention measure.

✓ Children who are unable to brush their teeth unaided should be assisted to do so.

5.6 AGE AT COMMENCEMENT OF BRUSHING

The younger children are when they start toothbrushing the lower the proportion developing tooth decay.⁹⁶ Overall, 88% of children who started brushing before the age of one year remained caries free, compared with 81% of those who started between the ages of one and two years, and 66% of those who started toothbrushing after the age of two years ($p < 0.01$).

3

The link between age of toothbrushing and risk of mild fluorosis is discussed in section 5.2.2.

One cross-sectional study, involving seven year old Flemish children, showed a significant OR of 1.22 (95% CI 1.14 to 1.30; $p < 0.001$) for an increased risk of caries when age at start of brushing increases by one year.⁹⁷ It demonstrated a 46% likelihood of remaining caries free if brushing commences before three years of age as opposed to 36% if older than three years of age at commencement of brushing. The earlier toothbrushing commences (particularly before two years of age), the larger the decrease in caries risk.⁹⁸

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✓ Children should be assisted to brush their teeth as soon as they erupt.

5.7 TOOTHBRUSHING PRACTICE

5.7.1 POST-BRUSHING RINSING

A Swedish RCT of children aged four to seven years found that reducing the amount of rinsing water and refraining from eating for two hours after brushing decreased the amount and rate of fluoride removal from the mouth. In the test groups, children rinsed an average of 1.2 times (range 1–2 times) using the toothpaste slurry to form an active mouthrinse, compared to 2.8 times (range 0–5 times) in the control groups. The mean amount of water used in the test groups was 20 ml (range 10–70 ml) compared to 80 ml (range 0–100 ml) in the control groups ($p < 0.01$). Children in the test groups developed a mean of 1.14 new dfs during the three years of the study compared to 1.55 in the control groups ($p < 0.05$). This modified toothpaste technique resulted in an average of 26% fewer new proximal carious lesions, clinically and radiographically among test subjects, compared to children in the control groups.⁹⁹

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A Scottish trial carried out among older children (mean age 12.5 years) found that the caries increment in those who self reported using a beaker to rinse with water following brushing (6.84) was significantly higher than that in children who reported not using a beaker (5.84), ($p < 0.05$).¹⁰⁰

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Additional rinsing with water after brushing reduces the caries-preventive effect of fluoride toothpaste and should be discouraged.

A Children should be encouraged to spit out excess toothpaste and not rinse with water after brushing.

5.7.2 TIMING OF TOOTHBRUSHING

Brushing last thing at night before bedtime allows fluoride concentration levels to remain high during the night as salivary flow rates are lower during sleep.⁹⁵ An observational study found that fluoride concentrations in saliva 12 hours after brushing last thing at night were comparable with those found one to four hours after brushing during the day.¹⁰¹

4

✓ Children's teeth should be brushed last thing at night before bedtime and on at least one other occasion.

5.7.3 USE OF POWERED VERSUS MANUAL TOOTHBRUSHES

No evidence was identified to show that powered toothbrushes are more effective than manual toothbrushes in preventing dental caries in children. One systematic review, four RCTs and a position paper have reported on other oral health outcomes in powered versus manual toothbrushes.

A Cochrane review (42 trials, $n = 3,855$) included five trials of children or adolescents and four trials of combined populations of adults and children.¹⁰² Results were not presented separately for children. The review concluded that in short term trials (≤ 3 months) brushing with a powered toothbrush with a rotation oscillation action removed significantly more plaque (11%) and significantly reduced gingival bleeding (6%) than brushing with a manual toothbrush. In longer term trials (> 3 months), gingival bleeding reduced by 17%.

1++

Four RCTs were identified which compared the effects of manual versus powered toothbrushing on plaque removal. All were small (range $n = 20-84$) and associated with methodological weaknesses, and it is not possible to draw robust conclusions from these trials.¹⁰³⁻¹⁰⁶

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A position paper based on a non-systematic review concluded that the only type of powered toothbrushes to be superior to manual brushes in removing plaque and reducing gingival bleeding were those with an oscillating rotating mechanism. Other types of powered brushes were considered to be at least as effective as manual toothbrushes and no more damaging to oral tissues. In common with the systematic review, the subgroup conclusions were primarily based on studies with adult participants and no sub-group analyses by age were carried out.¹⁰⁷

4

✓ Children's teeth can be brushed with either manual or powered toothbrushes as an effective means of administering fluoride.

5.7.4 FREQUENCY OF TOOTHBRUSH REPLACEMENT

Five RCTs were identified that investigated the effect of replacing toothbrushes on oral health.¹⁰⁸⁻¹¹² However, the outcome assessed was plaque reduction rather than dental caries. All five studies were carried out overseas. Only two were conducted in children and these were carried out in Burma and Iran.

One trial noted that in 7–8 year olds plaque removal was no less effective using toothbrushes with severe bristle matting than with new toothbrushes.¹¹² The other study found three-month old brush heads, even with marked wear, were as effective as new brush heads in the hands of schoolchildren.¹⁰⁹

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Of the three adult studies, one was conducted on a large number (n=110) of young adults (mean 20.3±2.0 years)¹¹¹ while the others only had 35 and 12 participants respectively.^{108,110}

Overall, four of the five studies suggested that there was no difference between new and worn head brushes in relation to plaque control, although no studies report on caries incidence.^{108,109,111,112} The studies were very heterogeneous using different plaque and toothbrush wear scoring systems and different population ages and groups.

There is insufficient evidence to recommend when a worn toothbrush should be replaced.

6 Other tooth cleaning methods

6.1 INTRODUCTION

Toothbrushing is the most common method used to remove biofilm (plaque) from the teeth in the UK. Although the toothbrush can effectively clean the occlusal, lingual and buccal surfaces, the use of dental floss and interdental brushes may be more appropriate methods to achieve good oral health in the mesial and distal surfaces.

6.2 DENTAL FLOSS

Evidence regarding flossing was provided by one systemic review, two controlled trials (both included in the systematic review but not all comparisons were reported) and one cohort study providing long term follow up to the two controlled trials.

One systematic review identified six CCTs involving 808 children from four to 13 years of age. Flossing was performed professionally on school days in two trials, professionally every three months in two trials, supervised on school days in one trial and unsupervised daily in one trial. Follow up ranged from 1.7 to three years. There were significant study-to-study differences and the authors considered there was a moderate to high risk of bias.¹¹³

In four trials differences in interproximal caries rates between the flossing and non-flossing groups were not statistically significant whereas in two trials the difference was statistically significant. The relative caries risk in four trials was lower in the flossing group (range 19% to 54%), but slightly increased in two trials. Although there was substantial heterogeneity across the studies meta-analysis was carried out. Fixed effects modelling found a 14% lower relative risk of caries on flossed surfaces over a two-year period ($p=0.01$) and an absolute risk reduction of 3% ($p<0.001$). Random effects modelling found a 21% lower relative risk of caries on flossed surfaces over a two-year period, but this was not statistically significant ($p=0.06$) and an absolute risk reduction of 3% ($p=0.02$).

A subgroup analysis of two trials found a reduction in caries relative risk of 40% in children aged five to six years with professional flossing on school days. These two trials were conducted in the UK and details of fluoride exposure were not reported. It was assumed that participants had relatively low exposure to fluoride and poor oral hygiene. In the two trials where flossing was conducted professionally every three months and in the two trials where flossing was self performed there was no evidence of benefit. In these trials fluoride exposure was reported and included water fluoridation, fluoride rinsing and fluoride toothpaste. The evidence suggests that fluoride attenuates any benefits from flossing.

Given the inconsistent results across the trials and their moderate to high risk of bias the results are difficult to interpret. As noted by the authors the evidence is of poor quality but is consistent with the hypothesis that regular professional quality flossing may reduce interproximal caries risk in young children with low fluoride exposure and poor oral hygiene.

Two CCTs which were included in the above systematic review have additional outcomes relating to flossing with chlorhexidine gluconate (CHX) gel which were not reported in the review.

In the first study, participants were 12 years of age at the beginning of the trial and 15 years of age at its conclusion. Allocation was by school class not individual child. All participants resided in a fluoridated water area and received a weekly fluoride rinse (sodium fluoride 0.2%). Blinding of outcome assessors was not reported. Compared to the control group the percentage of children who did not develop any new caries lesions was significantly higher in the group that received professional application of CHX gel and flossing every three months (18% v 44%; $p<0.001$). The mean number of new caries was lower in the CHX gel group (2.50) than in the control group (5.25). Analysis did not take account of clustering within school class.¹¹⁴

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In the second study, participants were four years of age at the beginning of the trial and seven years of age at its conclusion. Allocation was determined by year of birth. All participants resided in a fluoridated water area and were advised to use fluoride toothpaste 250 ppmF. Outcome assessment was not fully blinded. Assessment in the two gel groups was conducted by a single dentist who was not aware of gel allocation. Assessment in the control group was carried out by three other dentists in the same clinic. Results show that the number of children that did not develop any caries lesions on the proximal tooth surfaces was significantly higher in the CHX group (49.2%) than in the no flossing group (25.9%; $p < 0.01$). Also of the children who were caries free at baseline the percentage that remained so was significantly higher in the CHX group (51.9%) than in the no flossing group (28.6%; $p < 0.01$).¹¹⁵

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A cohort study followed up the results of the two CCTs which investigated the effects of professional flossing with CHX gel.¹¹⁶ The pre-school children were followed up to the age of 16 years and the teenager group to the age of 19. Of the total number of original children, 71% and 80% were available at the age of 16 and 19 years, respectively. At nine-year follow up, when the children were 16 years old, the former CHX group had still significantly lower mean DFS than the control group ($p < 0.05$). The differences in caries increment occurred between seven and 12 years of age, whereas the number of new caries lesions during the next four years was almost the same in the three groups. At four-year follow up, when the teenagers were 19 years old, DFS was 6.9 in the former CHX group compared to 10.4 in the control group ($p < 0.05$). The results indicate a long term benefit on proximal caries development of three-monthly professional application of CHX gel with flossing. This beneficial effect was more pronounced when the treatment began in the primary dentition.

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The evidence regarding the effectiveness of flossing in addition to toothbrushing for reducing dental caries in children is of insufficient quality and consistency to make a recommendation.

6.3 INTERDENTAL BRUSHES AND MISWAKS

No studies were identified which described the effects of interdental brushes on the development of caries.

A double-blinded RCT evaluated the effect of frequent use of fluoridated miswaks (chewing sticks) on remineralisation of white spot lesions (WSL) on debonding and debanding. The mean age of participants was 17.2 years. In the intervention group ($n = 19$) participants used fluoridated miswaks paying special attention to the white spot lesions on one side of the maxilla. The other side was protected by a plastic mouth tray before and for 30 minutes following use. In the control group ($n = 18$) the participants followed the same process using non-fluoridated miswaks. All participants were asked to use fluoride toothpaste twice daily.¹¹⁷

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Remineralisation of WSL was significantly greater in patients using fluoridated miswaks impregnated with 0.5% sodium fluoride five times daily than in patients using non-fluoridated miswaks at six weeks. In the non-fluoridated group there was no difference in the amount of remineralisation occurring on the side of the mouth to which the miswak was applied compared to the side of the mouth where it was not. This suggests that it was not the use of the miswak in itself that caused the reduction in WSL but the reduction was caused by the application of fluoride.

The evidence regarding the effectiveness of interventions for cleaning teeth in addition to toothbrushing for reducing dental caries in children is of insufficient quality and consistency to make a recommendation.

7 Topical anticaries interventions

7.1 INTRODUCTION

With the possible exception of water fluoridation, the most widely employed anticaries intervention is the use of fluoride toothpaste which works primarily through topical interactions with tooth structure and dental plaque. Other chemical agents, for example CHX, and other delivery vehicles for fluoride, for example varnishes, may be used to prevent, arrest and remineralise dental caries.

7.2 TOPICAL CHLORHEXIDINE VARNISH

Chlorhexidine gluconate has substantial antimicrobial properties and is an effective component of mouthwashes used in the treatment of gingivitis, periodontitis, and dental trauma. The rationale for the use of such antiseptic agents for the prevention of caries, however, relies on the ability to change the biofilm ecology from cariogenic to non-cariogenic without harming native bacteria which play no part in the development of decay but which may provide other benefits to the host.

One systematic review showed inconclusive results for the use of CHX varnish, gel or mouthwash to prevent dental caries against a background of fluoride intake (particularly toothpaste).¹¹⁸ Of the 22 studies, many looked at adults, particularly older people with root caries. The majority of studies showed no significant caries-inhibiting effect of CHX with only four studies showing a reduction in occlusal caries of between 16% and 50%. However none of these studies were placebo-controlled and all were at high risk of bias.

A second systematic review also reported inconclusive results for the prevention of dental caries in children by CHX varnish.¹¹⁹ Of the 12 studies included, all six parallel group trials showed no significant difference between CHX varnish and placebo or no treatment in caries increment. There were conflicting results from the split-mouth trials with two studies showing a statistically significant reduction in caries associated with CHX use and two studies showing no significant difference. Only one study, which was at low risk of bias, reported a significant caries preventive effect of CHX varnish compared with a placebo in primary molar teeth.

It is not possible to form a recommendation on the use of chlorhexidine varnish due to the inconclusive results of relevant studies and their low methodological quality.

7.3 TOPICAL FLUORIDE VARNISH

Four systematic reviews pooled the results of 43 different RCTs and CCTs investigating the effectiveness of fluoride varnish for the prevention of dental caries.¹²⁰⁻¹²³ These trials were judged to be of low to moderate quality with a wide spread of data resulting in some findings being inconclusive. Fluoride varnish substantially reduced the caries increment for the target population in most studies, however, the size of effect varied widely between studies.

The largest and most recent systematic review identified 22 trials on the effect of fluoride varnish on caries prevention.¹²² Meta-analysis of the effects of fluoride varnish on permanent teeth (13 trials) reported a pooled DMFS prevented fraction of 43% (95% CI 30% to 57%) compared with placebo or no treatment. Substantial heterogeneity was recorded ($I^2=75%$). The effect of fluoride varnish on primary teeth (10 trials) was also statistically significant with a pooled dmfs prevented fraction of 37% (95% CI 24% to 51%). Some heterogeneity was also noted in this analysis ($I^2=59%$).

Most studies involved twice yearly application of fluoride varnish, although a small number involved up to four applications per year. Meta-regression showed no significant effect of modifying the frequency of application of varnish on estimates of PF for either permanent teeth (slope estimate -4.85%, 95% CI -24.27% to 14.57%; $p=0.59$), or primary teeth (slope estimate 5.09%, 95% CI -19.33% to 29.51%; $p=0.64$) suggesting that four applications per year did not decrease caries incidence compared with twice-yearly application. The relative benefit of fluoride varnish application applied in children irrespective of their baseline caries risk.

The remaining systematic reviews did not provide consistent evidence for the most effective frequency of varnish application although one recommended twice-yearly application in those assessed at high risk of caries.¹²⁰ | 1⁺⁺

A Fluoride varnish should be applied at least twice yearly in all children.

7.4 SLOW-RELEASE FLUORIDE BEADS

Glass beads have been developed which release fluoride over several years in the oral environment. One or more beads may be bonded to the sides of teeth with minimal inconvenience, thereby releasing fluoride continually within the oral cavity at low levels with the aim of preventing dental caries and promoting remineralisation of early caries lesions.

One systematic review identified a single RCT which, after two years, analysed just over 36% of the original cohort as many of the slow-release fluoride devices had been lost. The caries increment in the slow release fluoride group was lower but the data were regarded as weak and unreliable as the results were from participants who were effectively selected on the basis of bead retention.¹²⁴ | 1⁺

The evidence for the efficacy of slow-release fluoride devices is minimal, weak and unreliable and further studies are required.

7.5 FLUORIDE GELS

Within the dental surgery, high-concentration fluoride gels may be applied to teeth with the aim of preventing dental caries and remineralising early caries lesions. Often such gels are applied to the teeth in disposable trays which fit loosely over the teeth.

Two systematic reviews demonstrated a clear caries-inhibiting effect of fluoride gels.

The first systematic review only included one RCT which investigated application of different topical fluoride concentrations at two different frequencies in three- to four year old children in Croatia (n=199).¹²⁵ The group receiving topical amine fluoride solution at a concentration of 5,000 ppmF once a month experienced 31% less new decay than the control group. The group receiving topical amine fluoride solution at a concentration of 10,000 ppmF every two months experienced 23% less new decay. The authors concluded that increased frequency of application of a low-fluoride topical solution (10 times per year) may provide caries protection in pre-school children with relatively high caries activity. | 1⁺

A meta-analysis which included 23 RCTs involving 7,747 children reported the DMFS pooled PF estimate was 28% (95% CI 19% to 37%; p<0.0001). There was clear heterogeneity, confirmed statistically (p<0.0001). The effect of fluoride gel varied according to type of control group used, with DMFS prevented fraction on average being 19% (95% CI 5% to 33%; p<0.009) higher in non-placebo-controlled trials.¹²⁶ | 1⁺⁺

The comparatively high frequency of applications needed (monthly or bi-monthly) to achieve the caries reductions reported along with the time needed to construct appliances and the time taken in application to allow use of the gels make the practicalities of this modality a considerable barrier to its use. There is evidence for the use of fluoride gels to prevent caries but this has been garnered against a background lack of daily use of fluoride. Fluoride gels may be useful in controlling dental caries in the absence of fluoride toothpaste. However, no recommendation can be given as complete absence of fluoride toothpaste is unlikely in Scotland. For those children where this may be a factor, ensuring daily use of fluoride toothpaste would be the simplest intervention.

7.6 FLUORIDE DROPS OR TABLETS

Drops of high-concentration fluoride solution may be added to drinks or cooking water to increase the systemic intake of fluoride. In addition, tablets may be sucked before swallowing providing both a topical and systemic effect.

A systematic review which investigated the effects of fluoride supplementation on the prevention of dental caries only identified one trial in primary dentition, which had a high level of bias (83% dropout rate).¹²⁷ A trial in which expectant mothers used fluoride supplements from the fourth month of pregnancy until childbirth and the children used supplements until the age of three years did not show a caries preventive effect of supplementation compared to a control group (risk ratio 0.90, 95% CI 0.41 to 1.97). Regarding older children, the review identified nine trials which reported consistent findings that children who chewed and swallowed 1 mg fluoride tablets daily on school days had significantly lower caries levels than other children who were not using fluoride supplements. The results could not be combined in a meta-analysis due to the variation in outcome measures used and the range of follow-up periods applied. The authors note that many of these trials were conducted at a time when fluoride toothpastes were not used widely and so the magnitude of effect in the context of regular use of fluoride toothpaste, for example, may be lower.

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A Cochrane review identified 11 studies involving 7,196 children in the investigation of the effects of fluoride supplementation. Meta-analysis of three studies in permanent teeth showed that the use of fluoride supplements was associated with a 24% (95% CI 16 to 33%) reduction in DMFS. The effect of fluoride supplements on primary teeth was unclear. In one study, no caries-inhibiting effect was observed on primary teeth while in another study, the use of fluoride supplements was associated with a substantial reduction in caries increment.¹²⁸

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Accordingly, there is insufficient evidence to recommend the use of fluoride drops or tablets against a background of fluoride toothpaste use.

7.7 FLUORIDE MOUTHWASH

Fluoride at concentrations of 250 ppmF is often a key component of OTC daily mouthwashes. Fluoride at higher concentration is available but generally not as OTC preparations.

Three systematic reviews addressed the question of fluoride mouthwash use although one of these evaluated the effectiveness for orthodontic patients only.¹²⁹⁻¹³¹ There were no reports of adverse effects. Three studies involving a total of 51 participants undergoing orthodontic treatment were evaluated specifically to determine the efficacy of fluoride mouthwash. Over 40 studies involving 20,000 patients were identified for the remaining two systematic reviews. The heterogeneity of the studies was either not evaluated or was not substantial and the studies included were generally not highly rated for quality.

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A Cochrane review reported some evidence that a daily sodium fluoride mouthwash reduced the severity of enamel decay surrounding a fixed brace (weighted mean difference for lesion depth -70.0, 95% CI -118.2 to -21.8) in patients undergoing orthodontic treatment.¹²⁹

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Meta-analysis of 34 trials in a Cochrane review of RCTs investigating the effect of fluoride mouthwash on dental caries (n=14,600) showed a DMFS pooled PF of 26% (95% CI 23% to 30%; p<0.0001). No significant association between estimates of DMFS prevented fractions and baseline caries severity, background exposure to fluorides, rinsing frequency or fluoride concentration was found in meta regression analyses, nor was there a relationship between PF and study precision.¹³⁰

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A systematic review compared the use of fluoride mouthwashes in studies which were grouped according to the presence of other sources of fluoride. In eight studies where there was no background exposure to fluoride, the use of fluoride mouthwash significantly reduced the development of caries by an average of 29% (weighted mean difference PF range 14–53%). However, where fluoride mouthwash was compared with placebo or other fluoride regimens and/or conducted in areas with fluoridated water or regular use of fluoride toothpaste (15 studies), results were inconclusive. The overall mean PF was 6% (range 0–30%) which was not a statistically significant difference.¹³¹

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There appears to be a clear preventive effect of topical fluoride, in the form of a mouthwash, on dental caries in permanent teeth in the absence of a daily fluoride toothpaste use, but there were inconsistent results when viewed against the background of fluoride toothpaste use.

7.8 COMBINED TOPICAL INTERVENTIONS

It has been suggested that adding topical anticaries interventions to toothbrushing with fluoride toothpaste might have an increased effect on the reduction of caries incidence.¹³² Six systematic reviews have investigated the relative and combined efficacy of fluoride and CHX mouthwashes, gels and varnishes with fluoride toothpaste on caries prevention.^{62, 68, 132-135}

While not all systematic reviews analysed data in ways which allowed quantifiable reporting of the additional benefit accrued from combination topical fluoride treatment, one Cochrane review was specifically designed with this outcome in mind.¹³² This study included nine trials (n=4,026) which compared the use of fluoride toothpaste alone with the combined use of fluoride toothpaste plus one other topical fluoride treatment (varnish, gel or mouthwash). The pooled estimate of DMFS prevented fraction from the meta-analysis was 10% (95% CI 2% to 17%; p=0.01), indicating that simultaneous use of a topical fluoride treatment with fluoride toothpaste resulted, on average, in a 10% reduction in decayed, missing and filled tooth surfaces compared with toothbrushing with fluoride toothpaste alone. The only other combination of topical fluoride interventions which was shown to be statistically significantly more effective at preventing caries than a single intervention was the combined use of fluoride gel and mouthwash in comparison to gel alone (pooled DMFS PF 23%, 95% CI 4% to 43%; p=0.02), however, this result was based on only two trials (n=497). It should be noted that all of the trials included in this meta-analysis involved children with permanent teeth.

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No data were reported detailing any adverse effects. The reviews evaluated the evidence from more than 100 clinical studies which were a combination of RCTs, CCTs and other studies. Evidence was of variable quality and generally there was variable consistency between the papers identified.

Topical fluoride interventions or combinations of such interventions are effective in controlling caries in permanent teeth but evidence is sparse in primary teeth. With the additional use of daily fluoride toothpaste, the added benefit of topical fluoride interventions seems to be minimal or equivocal, with the exception of fluoride varnish. There is no robust evidence of additional reduction in caries incidence when using topical CHX interventions in addition to topical fluoride interventions.

8 Sealants

8.1 INTRODUCTION

A fissure sealant is a protective plastic coating which is applied by a dentist to the biting surfaces of the back teeth, forming a hard shield that keeps food and bacteria from getting into the tiny grooves in the teeth and causing decay. Sealants have been in use for over 50 years and are available as resin-based or glass ionomer compounds.

8.2 USE OF SEALANTS

A Cochrane review compared the effects of different types of fissure sealants in preventing caries in the permanent teeth of children and adolescents.¹³⁶ It included 34 trials with 6,529 participants aged between five and 16 years. All of the trials investigated use of sealants on occlusal surfaces and none considered proximal surfaces.

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Thirteen studies (n=2,979) compared any type of sealant against control without sealant. Twenty-one trials, with 3,202 participants, compared one type of sealant (material) with another and a single trial compared two different types of sealant with no sealant.

8.2.1 RESIN-BASED SEALANTS COMPARED TO NO TREATMENT

Twelve trials in the Cochrane review, (n=2,575) compared sealants with a no sealant control. There were nine split-mouth and three parallel group studies and these included children aged five to ten years. Meta-analysis of eight split-mouth studies and one parallel group study comparing second or third generation resin sealants with a control was highly significant, with pooled OR values for prevention of caries in first molar teeth of 0.16 (95% CI 0.08 to 0.30), 0.12 (95% CI 0.07 to 0.19), 0.17 (95% CI 0.11 to 0.27), and 0.21 (95% CI 0.16 to 0.28) at 12, 24, 36 and 48–54 months follow up, respectively (p<0.00001). Long term effectiveness of sealants for the prevention of caries was shown by one study with nine years of follow up which reported 27% of sealed surfaces to be decayed compared to 77% of surfaces without sealant. Considerable heterogeneity was identified across all analyses (I² range 45–90%). Retention of resin sealants was generally good with four of seven studies reporting retention rates of around 90% at 12 months. At 24 months, six of the eight studies reported retention rates of over 80%. Even after 48–54 months, the complete retention of resin-based sealants was 70% in three of the five studies.¹³⁶

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8.2.2 GLASS IONOMER SEALANTS COMPARED TO NO TREATMENT

The Cochrane review reported a single parallel group study (n=404) which compared the 24-month DFS increments for two glass ionomer sealant groups with one control group receiving no treatment for age group 12 to 13 years. There was no significant difference in caries increments between the groups (mean difference in DFS -0.18, 95% CI -0.039 to 0.03).¹³⁶

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The Cochrane review reported a single study which provided results comparing resin-modified glass ionomer cement with oral health education every three months against oral health education every three months alone. The comparison was performed separately for children at high and low risk of caries. After 24 months, only the children at high risk of caries who received both sealant application and oral health education showed statistically lower DMF increments on occlusal surfaces of first permanent molars compared with the children at high risk of caries who received only oral health education. For children at low risk of caries, no statistical difference was observed between the treatment groups. The study authors concluded "that in a 2-year period, oral health education was sufficient to control occlusal caries in low-risk children while for high-risk children, sealant application in addition to oral health education was considered the best strategy".¹³⁶

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8.2.3 RESIN-BASED SEALANTS COMPARED TO GLASS IONOMER SEALANTS

The Cochrane review analysed 15 trials comparing glass ionomer with resin sealants and concluded that the evidence was too inconsistent to make any conclusions about the superiority of either of the two materials. Four studies found better caries reductions for resin-based sealants than for glass ionomers, two studies found better caries reductions for glass ionomers than for resin-based sealants, and nine studies did not find differences between these materials for this outcome. The retention figures in the studies favoured resin sealants at 36–48 months follow up. In five studies for which follow-up data was available, the complete retention for resin sealants was documented to be good (mean 76%), and for glass ionomers was poor (mean 8%).¹³⁶

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A Resin-based fissure sealants should be applied to the permanent molars of all children as early after eruption as possible.

✓ Glass ionomer sealants may be considered if the application of a resin-based sealant is not possible.

9 Provision of information

This section reflects the issues likely to be of most concern to patients and their carers. These points are provided for use by health professionals when discussing dental caries with children, parents and carers and in guiding the production of locally produced information materials.

It is important that children and their families are fully aware that dental caries (tooth decay) is a preventable disease and that there is much that they can do to reduce or eliminate the child's risk of suffering from this common problem.

9.1 SOURCES OF FURTHER INFORMATION

British Dental Health Foundation

Smile House, 2 East Union Street, Rugby, Warwickshire CV22 6AJ
Tel: 01788 546365 • Fax: 01788 541982 • Helpline: 0845 063 1188
Email: helpline@dentalhealth.org • www.dentalhealth.org

The British Dental Health Foundation is an independent charity that along with its global arm, the International Dental Health Foundation, is dedicated to improving the oral health of the public by providing free and impartial dental advice, by running educational campaigns and by informing and influencing the public, profession and government on issues such as mouth cancer awareness and fluoridation.

Childsmile Programme

www.child-smile.org.uk

Childsmile is a national programme designed to improve the oral health of children in Scotland and reduce inequalities both in dental health and access to dental services.

Scottish Dental

www.scottishdental.org

Scottish Dental provides information on dentistry for the public and oral health professionals.

NHS Inform

Tel: 0800 224488
www.nhsinform.co.uk

NHS Inform provides a coordinated single source of quality-assured health and care information for the people of Scotland.

9.2 CHECKLIST FOR PROVISION OF INFORMATION

This section gives examples of the information patients/carers may find helpful at the key stages of the patient journey. The checklist was designed by members of the guideline development group based on their experience and their understanding of the evidence base. The checklist is neither exhaustive nor exclusive.

The initial professional concerned (eg health visitor, public health nurse) should:	<ul style="list-style-type: none"> • be aware that the Childsmile Practice programme should have been introduced to the parent/carer at 6–8 weeks after birth. • explain to the parent/carer that dental appointments should be encouraged from the age of six months. • be aware that dental health support workers are available in all Scottish Health Boards to facilitate family participation in the Childsmile programme through attendance at the dental practice.
The parent/carer should:	<ul style="list-style-type: none"> • supervise toothbrushing of their children, particularly in those under three years of age. • expect to receive age-relevant information in a manner specific to the needs and circumstances of the child and parents/carer about: <ul style="list-style-type: none"> – the Childsmile programme – the effect of diet on dental health – the importance of toothbrushing – how and when to brush teeth – the application of fluoride varnish – the application of fissure sealants.
The dental care team should:	<ul style="list-style-type: none"> • ensure the child and parents/carer receive appropriate dietary advice, particularly in relation to the frequency of sugary food and drink consumption. • provide the child and parents/carer with advice on the importance of thorough toothbrushing and following key messages: <ul style="list-style-type: none"> – supervise brushing, particularly in children under three years of age – brush at least twice a day – use an age- and risk-appropriate fluoride toothpaste (standard risk $\geq 1,000$ ppmF $\leq 1,500$ ppmF for those at any age) (increased risk 1,500 ppmF for those ≤ 10 years) (increased risk 2,800 ppmF for those from 10–16 years). – spit out excess toothpaste and do not rinse with water after brushing. • apply fluoride varnish (22,600 ppmF) to teeth from the age of two years at least twice yearly unless a valid reason not to is recorded. • apply fissure sealants to all susceptible pits and fissures on permanent molars within one year of eruption. • provide dental hygiene advice for families of children who have been prescribed medicines containing cariogenic sugars.
The GP or secondary care physician should:	<ul style="list-style-type: none"> • prescribe sugar-free medicines to children who are receiving long-term drug treatment, whenever possible.

10 Implementing the guideline

10.1 IMPLEMENTATION STRATEGY

Implementation of national clinical guidelines is the responsibility of each NHS Board and is an essential part of clinical governance. Mechanisms should be in place to review care provided against the guideline recommendations. The reasons for any differences should be assessed and addressed where appropriate. Local arrangements should then be made to implement the national guideline in individual hospitals, units and practices.

Implementation of this guideline will be encouraged and supported by SIGN. The implementation strategy for this guideline encompasses the following tools and activities.

10.2 RESOURCE IMPLICATIONS OF KEY RECOMMENDATIONS

No recommendations are considered likely to reach the £5 million threshold which warrants full cost impact analysis.

Recommendations associated with significant material costs are as follows:

10.2.1 FLUORIDE VARNISH

A Fluoride varnish should be applied at least twice yearly in all children.

Maximum direct costs of providing two varnish applications to all eligible people aged 18 years or under in Scotland is around £1.5 million, however, a proportion of these will already be receiving varnish through Childsmile or through routine attendance at dental services. The Scottish Government has established a HEAT target aiming to achieve at least two applications of fluoride varnish per year in 60% of three- and four-year old children by March 2014. While the national percentage of three- and four-year old children receiving at least two varnish applications increased in 2013, the overall levels are 20.2% and 22.5% respectively.

10.2.2 FISSURE SEALANTS

A Resin-based fissure sealants should be applied to the permanent molars of all children as early after eruption as possible.

Sealants should be applied to permanent molars within one year of eruption which usually takes place between the ages of six to seven years for first molars and 11–12 years for second molars.^{137,138} There is a degree of variability, however, in the age of eruption for individual children which can be anywhere from five to nine years of age for first molars and eight to 14 years for second molars.

The National Dental Inspection Programme reported approximately 30% of primary 7 children (mean age 11.5 years) received sealants in 2012–2013. In order to capture the possible age of first presentation with permanent first and second molars, costs have been estimated for two age ranges (6–7 years and 11–12 years). In practice, this may overestimate the total cohort eligible for sealants as some children with dental decay may receive fillings rather than sealants.

Table 4: Estimated direct costs of increasing sealant uptake from 30% to 60% in Scottish children aged 6–7 years and 11–12 years

Number of children aged 6–7 years	Proportion with sealants	Costs per sealant (£)	Total costs (£)
111,327	30%	7.95	1,062,059.58
	60%		2,124,119.16
Incremental cost of moving from 30% to 60% uptake			1,062,059.58

Number of children aged 11–12 years	Proportion with sealants	Costs per sealant (£)	Total costs (£)
110,956	30%	7.95	1,058,520.24
	60%		2,117,040.48
Incremental cost of moving from 30% to 60% uptake			1,058,520.24

In Table 4 costs of consultations have not been factored into the calculations. It was not possible to segregate visits incorporating treatment with visits representing routine examinations in this analysis, therefore the costs reported here may underestimate the total cost of service provision in NHSScotland. However, potential savings from fillings avoided are also excluded.

10.3 AUDITING CURRENT PRACTICE

A first step in implementing a clinical practice guideline is to gain an understanding of current clinical practice. Audit tools designed around guideline recommendations can assist in this process. Audit tools should be comprehensive but not time consuming to use. Successful implementation and audit of guideline recommendations requires good communication between staff and multidisciplinary team working.

The guideline development group has identified the following as key points to audit to assist with the implementation of this guideline:

- the proportion of children who have been formally assessed for individual caries risk and for whom this is documented in the clinical record
- evaluation of oral health promotion interventions to determine the degree to which these are based on recognised health behaviour theory models
- the proportion of children at different ages and different assessed caries risk levels receiving fluoride toothpaste at recommended concentrations
- the proportion of children participating in a supervised toothbrushing programme at nursery or school
- the proportion of children engaging in twice-daily supervised toothbrushing at home
- the proportion of children receiving at least twice-yearly application of fluoride varnish
- the proportion of children who have received an application of fissure sealant to their permanent molar teeth, measured at intervals proportionate to permanent molar eruption
- the proportion of children who have been assessed at risk of dental caries and in whom clinically effective preventive interventions have not been provided in the absence of justification in the clinical record.

11 The evidence base

11.1 SYSTEMATIC LITERATURE REVIEW

The evidence base for this guideline was synthesised in accordance with SIGN methodology. A systematic review of the literature was carried out using an explicit search strategy devised by a SIGN Evidence and Information Scientist. Databases searched include Medline, Embase, Cinahl, PsycINFO and the Cochrane Library. The year range covered was 2000–2011. Internet searches were carried out on various websites including the US National Guidelines Clearinghouse. The main searches were supplemented by material identified by individual members of the development group. Each of the selected papers was evaluated by two members of the group using standard SIGN methodological checklists before conclusions were considered as evidence.

11.1.1 LITERATURE SEARCH FOR PATIENT ISSUES

At the start of the guideline development process, a SIGN Evidence and Information Scientist conducted a literature search for qualitative and quantitative studies that addressed patient issues of relevance to the prevention of dental caries in children. Databases searched include Medline, Embase, Cinahl and PsycINFO, and the results were summarised by the SIGN Patient Involvement Officer and presented to the guideline development group.

11.2 RECOMMENDATIONS FOR RESEARCH

The guideline development group was not able to identify sufficient evidence to answer all of the key questions asked in this guideline (*see Annex 1*). The following areas for further research have been identified:

- What is the relationship between the results of caries risk assessment models in children and professional caries preventive behaviours?
- What are the relative effects of fluoride toothpaste delivered as sodium fluoride, sodium monofluorophosphate or stannous fluoride (or in a mixed composition) on the incidence of dental caries and fluorosis in children?
- What is the effect of powered toothbrushes compared with manual toothbrushes on the incidence of dental caries in children?
- What effect does duration of toothbrushing have on the incidence of dental caries and fluorosis in children?
- What personal or parental factors are associated with compliance with toothbrushing and dietary advice in children?
- Is there any relationship between the frequency of replacement of toothbrush and the incidence of dental caries in children?
- What effect does supervised dental flossing have on the incidence of dental caries in children? Is any effect modified by separate exposure to fluoride?
- What effect does supervised use of dental sticks have on the incidence of dental caries in children?
- What effect do specific topical fluoride interventions (mouthwash, tooth mousse, slow-release beads and tablets) have on the incidence of dental caries and fluorosis in children?
- What is the effect of resin-based sealants compared with glass ionomer sealants on the incidence of dental caries?
- Is there an effect of changing the frequency of fluoride varnish application to the primary or permanent teeth of children on the incidence of dental caries?

12 Development of the guideline

12.1 INTRODUCTION

SIGN is a collaborative network of clinicians, other healthcare professionals and patient organisations and is part of Healthcare Improvement Scotland. SIGN guidelines are developed by multidisciplinary groups of practising clinicians using a standard methodology based on a systematic review of the evidence. Further details about SIGN and the guideline development methodology are contained in “SIGN 50: A Guideline Developer’s Handbook”, available at www.sign.ac.uk

12.2 THE GUIDELINE DEVELOPMENT GROUP

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Dr Linda Young	<i>Research and Development Manager, Scottish Dental Clinical Effectiveness Programme, NHS Education for Scotland</i>

The membership of the guideline development group was confirmed following consultation with the member organisations of SIGN. All members of the guideline development group made declarations of interest. A register of interests is available in the supporting material section for this guideline at www.sign.ac.uk

Guideline development and literature review expertise, support and facilitation were provided by the SIGN Executive. All members of the SIGN Executive make yearly declarations of interest. A register of interests is also available on the contacts page of the SIGN website www.sign.ac.uk.

Euan Bremner	<i>Project Officer</i>
Lesley Forsyth	<i>Events Coordinator</i>
Karen Graham	<i>Patient Involvement Officer</i>
Gemma Hardie	<i>Distribution and Office Coordinator</i>
Stuart Neville	<i>Publications Designer</i>

12.3 ACKNOWLEDGEMENTS

SIGN is grateful to the following former members of the guideline development group and others who have contributed to the development of the guideline.

Mrs Jane McConnell *Lay representative, Lanark*

12.4 CONSULTATION AND PEER REVIEW

12.4.1 PUBLIC CONSULTATION

The draft guideline was available on the SIGN website for a month to allow all interested parties to comment. All contributors made declarations of interest and further details of these are available on request from the SIGN Executive.

12.4.2 SPECIALIST REVIEW

This guideline was also reviewed in draft form by the following independent expert referees, who were asked to comment primarily on the comprehensiveness and accuracy of interpretation of the evidence base supporting the recommendations in the guideline. The guideline group addresses every comment made by an external reviewer, and must justify any disagreement with the reviewers' comments. All expert referees made declarations of interest and further details of these are available on request from the SIGN Executive.

SIGN is very grateful to all of these experts for their contribution to the guideline.

Dr Paul Ashley and Dr Elizabeth O'Sullivan	<i>Senior Lecturer/Consultant in Paediatric Dentistry, University College London Eastman Institute on behalf of the British Dental Society of Paediatric Dentistry</i>
Professor Marion Bain	<i>Medical Director, NHS National Services Scotland, Edinburgh</i>
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Professor Christopher Deery	<i>Professor of Paediatric Dentistry, University of Sheffield</i>
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Mrs Rowena McArtney	<i>Senior Information Pharmacist, Welsh Medicines Information Centre, University Hospital of Wales on behalf of the Neonatal and Paediatric Pharmacists Group</i>
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Ms Charlotte Worker	<i>Public Affairs, PR and Policy Manager on behalf of the Faculty of General Dental Practice (UK)</i>
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12.4.3 SIGN EDITORIAL GROUP

As a final quality control check, the guideline is reviewed by an editorial group comprising the relevant specialty representatives on SIGN Council to ensure that the specialist reviewers' comments have been addressed adequately and that any risk of bias in the guideline development process as a whole has been minimised. The editorial group for this guideline was as follows. All members of SIGN Council make yearly declarations of interest. A register of interests is available on the SIGN Council Membership page of the SIGN website www.sign.ac.uk

Professor Keith Brown	<i>Chair of SIGN (to December 2013); Co-editor</i>
Dr Roberta James	<i>SIGN Programme Lead; Co-Editor</i>
Professor John Kinsella	<i>Chair of SIGN (from January 2014); Co-editor</i>
Dr Sara Twaddle	<i>Director of SIGN; Co-Editor</i>

Abbreviations

AAPD	American Academy of Pediatric Dentistry
ADA	American Dental Association
CAMBRA	Caries Management by Risk Assessment
CAT	caries risk assessment tool
CCT	controlled clinical trial
CHX	chlorhexidine gluconate
CI	confidence interval
CrI	credible interval
DCRAM	Dundee Caries Risk Assessment Model
dmfs	number of decayed (d), missing (m) and filled (f) surfaces (s) in primary teeth
DMFS	number of decayed (D), missing (M) and filled (F) surfaces (S) in permanent teeth
dmft	number of decayed (d), missing (m) and filled (f) primary teeth (t)
DMFT	number of decayed (D), missing (M) and filled (F) permanent teeth (T)
GMC	General Medical Council
MA	marketing authorisation
MI	motivational interviewing
MTA	multiple technology appraisals
NaF	sodium fluoride
NICE	National Institute for Health and Care Excellence
OR	odds ratio
OTC	over-the-counter
PF	prevented fraction
ppmF	parts per million fluoride
RCT	randomised controlled trial
RR	relative risk
SDCEP	Scottish Dental Clinical Effectiveness Programme
SIGN	Scottish Intercollegiate Guidelines Network
SMC	Scottish Medicines Consortium
SMFP	sodium monofluorophosphate
SnF₂	stannous fluoride
SPC	summary of product characteristics
WHO	World Health Organization
WSL	white spot lesions

Annex 1

Key questions used to develop the guideline

This guideline is based on a series of structured key questions that define the target population, the intervention, diagnostic test, or exposure under investigation, the comparison(s) used and the outcomes used to measure efficacy, effectiveness, or risk. These questions form the basis of the systematic literature search.

Key question	See guideline section
1. Is there any evidence that using a risk assessment tool increases the number of children referred for enhanced interventions above the benchmark level of standard care?	3.4
2. Is there any evidence to support the use of caries risk assessment tools for identifying caries risk in children (caries risk measured in terms of caries increment)? Consider: <ul style="list-style-type: none"> • Cariogram • Caries Management by Risk Assessment (CAMBRA) • American Dental Association (ADA) • American Academy of Pediatric Dentistry (AAPD) • Dundee Caries Risk Assessment Model (DCRAM). 	3.4
3. Is there any evidence that delivery of dental brief interventions (oral health education) by members of the dental health team in a practice setting lead to health behaviour changes/healthy dental behaviours (eg compliance with toothbrushing)?	4.1–4.4
4. What are the benefits (prevention) and harms (fluorosis) of using fluoride toothpaste in the prevention of dental caries in children? Consider: <ul style="list-style-type: none"> • no toothbrushing • fluoride concentrations of 500 ppm, 1,000 ppm 1,250 ppm, 1,500 ppm and above. 	5.2, 5.3
5. Is there evidence of benefits (prevention) and harms (fluorosis) of any specific fluoride composition (or mixed composition) in the prevention of dental caries in children? Consider: <ul style="list-style-type: none"> • sodium fluoride (NaF) • sodium monofluorophosphate (SMFP) • stannous fluoride (SnF₂) 	5.4
6. Does frequency and duration of toothbrushing affect dental caries prevention or incidence of fluorosis in children?	5.5.1, 5.5.2
7. Is there evidence that supervision of toothbrushing in children (up to the age of 7 years) reduces the incidence of dental caries or fluorosis?	5.5.3
8. Is there evidence to show that powered brushes are more effective than manual toothbrushes in preventing dental caries in children and improving oral hygiene?	5.7.3
9. Is there any evidence associating how often toothbrushes are replaced with the effectiveness of toothbrushing for the prevention of dental caries?	5.7.4

<p>10. Is there any evidence for the effectiveness of methods used for cleaning teeth in addition to toothbrushing for reducing dental caries in children? Consider:</p> <ul style="list-style-type: none"> • floss • interdental brushes and miswaks. 	6.2, 6.3
<p>11. What is the evidence for effectiveness of topical interventions (fluoride, chlorohexidine, etc) in preventing dental caries in children and what are the adverse effects (eg risk of fluorosis)?</p> <p>(Compare toothbrushing + single topical intervention method to toothbrushing alone. Compare among topical intervention methods). Consider:</p> <ul style="list-style-type: none"> • mouthwash • tooth mousse • fluoride drops, tablets or lozenges • fluoride beads • varnishes • gel. 	7.2–7.8
<p>12. What is the evidence for effectiveness of sealants in preventing dental caries in children? Consider:</p> <ul style="list-style-type: none"> • fissure sealants • resin sealants • glass ionomers. 	8.2

References

- Information Services Division, NHS National Services Scotland. Report of the 2013 detailed National Dental Inspection Programme of Primary 7 children and the Basic Inspection of Primary 1 and Primary 7 children. [cited 14 Feb 2014]. Available from url: <http://www.isdscotland.org/Health-Topics/Dental-Care/Publications/2013-10-29/2013-10-29-NDIP-Report.pdf>
- Fisher-Owens SA, Gansky SA, Platt LJ, Weintraub JA, Soobader MJ, Bramlett MD, et al. Influences on children's oral health: a conceptual model. *Pediatrics* 2007;120(3):e510-20.
- Sheiham A, Alexander D, Cohen L, Marinho V, Moyses S, Petersen PE, et al. Global oral health inequalities: task group--implementation and delivery of oral health strategies. *Adv Dent Res* 2011;23(2):259-67.
- NHS Health Scotland. Oral Health and Nutrition Guidance for Professionals. 2012. [cited 02 Dec 2013]. Available from url: <http://www.healthscotland.com/documents/5885.aspx>
- Scottish Dental Clinical Effectiveness Programme. Prevention and management of dental caries in children. Dundee; 2010. [cited 02 Dec 2013]. Available from url: <http://www.sdcep.org.uk/index.aspx?o=2332>
- Klein H, Palmer CE, Knutson JW. Studies on dental caries. Dental status and dental needs of elementary school children. *Public Health Rep* 1938;53(19):751-65.
- Gruebbel AO. A measurement of dental caries prevalence and treatment service for deciduous teeth. *J Dent Res* 1944;23(3):163-8.
- Kandiah T, Johnson J, Fayle SA. British Society of Paediatric Dentistry: a policy document on management of caries in the primary dentition. *Int J Paediatr Dent* 2010;20(Suppl 1):5.
- Guidance on Prescribing. In: The British National Formulary No 66. London: British Medical Association and Royal Pharmaceutical Society of Great Britain; 2013.
- electronic Medicines Compendium (eMC). [cited 03 Dec 2013]. Available from url: <http://www.medicines.org.uk>
- Medicines and Healthcare products Regulatory Agency. Off-label or unlicensed use of medicines: prescribers' responsibilities. *Drug Safety Update* 2009;2(9):6-7.
- Batchelor P, Sheiham A. The limitations of a 'high-risk' approach for the prevention of dental caries. *Community Dent Oral Epidemiol* 2002;30(4):302-12.
- Harris R, Nicoll AD, Adair PM, Pine CM. Risk factors for dental caries in young children: a systematic review of the literature. *Community Dent Health* 2004;21(1 Suppl):71-85.
- Gibson S, Williams S. Dental caries in pre-school children: associations with social class, toothbrushing habit and consumption of sugars and sugar-containing foods. Further analysis of data from the National Diet and Nutrition Survey of children aged 1.5-4.5 years. *Caries Res* 1999;33(2):101-13.
- Barsamian-Wunsch P, Park JH, Watson MR, Tinanoff N, Minah GE. Microbiological screening for cariogenic bacteria in children 9 to 36 months of age. *Pediatr Dent* 2004;26(3):231-9.
- Radford JR, Ballantyne HM, Nugent Z, Beighton D, Robertson M, Longbottom C, et al. Caries-associated micro-organisms in infants from different socio-economic backgrounds in Scotland. *J Dent* 2000;28(5):307-12.
- O'Sullivan DM, Thibodeau EA. Caries experience and mutans streptococci as indicators of caries incidence. *Pediatr Dent* 1996;18(5):371-4.
- Twetman S, Petersson LG. Interdental caries incidence and progression in relation to mutans streptococci suppression after chlorhexidine-thymol varnish treatments in schoolchildren. *Acta Odontol Scand* 1999;57(3):144-8.
- Tenovuo J, Hakkinen P, Paunio P, Emilson CG. Effects of chlorhexidine-fluoride gel treatments in mothers on the establishment of mutans streptococci in primary teeth and the development of dental caries in children. *Caries Res* 1992;26(4):275-80.
- Thibodeau EA, O'Sullivan DM. Salivary mutans streptococci and incidence of caries in preschool children. *Caries Res* 1995;29(2):148-53.
- Thibodeau EA, O'Sullivan DM. Salivary mutans streptococci and caries development in the primary and mixed dentitions of children. *Community Dent Oral Epidemiol* 1999;27(6):406-12.
- Disney JA, Graves RC, Stamm JW, Bohannon HM, Abernathy JR, Zack DD. The University of North Carolina Caries Risk Assessment study: further developments in caries risk prediction. *Community Dent Oral Epidemiol* 1992;20(2):64-75.
- Prendergast MJ, Beal JF, Williams SA. The relationship between deprivation, ethnicity and dental health in 5-year-old children in Leeds, UK. *Community Dent Health* 1997;14(1):18-21.
- Burt BA, Pai S. Does low birthweight increase the risk of caries? A systematic review. *J Dent Educ* 2001;65(10):1024-7.
- Lai PY, Seow WK, Tudehope DI, Rogers Y. Enamel hypoplasia and dental caries in very-low birthweight children: a case-controlled, longitudinal study. *Pediatr Dent* 1997;19(1):42-9.
- Grindefjord M, Dahllof G, Nilsson B, Modeer T. Prediction of dental caries development in 1-year-old children. *Caries Res* 1995;29(5):343-8.
- Saemundsson SR, Slade GD, Spencer AJ, Davies MJ. The basis for clinicians' caries risk grouping in children. *Pediatr Dent* 1997;19(5):331-8.
- Wandera A, Bhakta S, Barker T. Caries prediction and indicators using a pediatric risk assessment teaching tool. *J Dent Child* 2000;67(6):408-12, 375.
- Wendt LK, Hallonsten AL, Koch G. Oral health in pre-school children living in Sweden. Part III--A longitudinal study. Risk analyses based on caries prevalence at 3 years of age and immigrant status. *Swed Dent J* 1999;23(1):17-25.
- Vanobbergen J, Martens L, Lesaffre E, Bogaerts K, Declerck D. Assessing risk indicators for dental caries in the primary dentition. *Community Dent Oral Epidemiol* 2001;29(6):424-34.
- Franco E, Saunders CP, Roberts GJ, Suwanprasit A. Dental disease, caries related microflora and salivary IgA of children with severe congenital cardiac disease: an epidemiological and oral microbial survey. *Pediatr Dent* 1996;18(3):228-35.
- Holbrook WP, de Soet JJ, de Graaff J. Prediction of dental caries in pre-school children. *Caries Res* 1993;27(5):424-30.

33. Mohan A, Morse DE, O'Sullivan DM, Tinanoff N. The relationship between bottle usage/content, age, and number of teeth with mutans streptococci colonization in 6-24-month-old children. *Community Dent Oral Epidemiol* 1998;26(1):12-20.
34. Pienihakkinen K, Jokela J, Alanen P. Assessment of caries risk in preschool children. *Caries Res* 2004;38(2):156-62.
35. Habibian M, Beighton D, Stevenson R, Lawson M, Roberts G. Relationships between dietary behaviours, oral hygiene and mutans streptococci in dental plaque of a group of infants in southern England. *Arch Oral Biol* 2002;47(6):491-8.
36. Stookey GK. The effect of saliva on dental caries. *J Am Dent Assoc*. 2008;139(Suppl):11S-7S.
37. Cunha-Cruz J, Scott J, Rothen M, Mancl L, Lawhorn T, Brossel K, et al. Salivary characteristics and dental caries: evidence from general dental practices. *J Am Dent Assoc*. 2013;144(5):e31-40.
38. Sanchez-Perez L, Golubov J, Irigoyen-Camacho ME, Moctezuma PA, Acosta-Gio E. Clinical, salivary, and bacterial markers for caries risk assessment in schoolchildren: a 4-year follow-up. *Int J Paediatr Dent*. 2009;19(3):186-92.
39. Smith RE, Badner VM, Morse DE, Freeman K. Maternal risk indicators for childhood caries in an inner city population. *Community Dent Oral Epidemiol* 2002;30(3):176-81.
40. Review of methods of identification of high caries risk groups and individuals. Federation Dentaire Internationale Technical Report No. 31. *Int Dent J*. 1988;38(3):177-89.
41. Macpherson LM, Ball GE, Brewster L, Duane B, Hodges CL, Wright W, et al. Childsmile: the national child oral health improvement programme in Scotland. Part 1: Establishment and development. *Br Dent J* 2010;209(2):73-8. doi: 10.1038/sj.bdj.2010.628.
42. Turner S, Brewster L, Kidd J, Gnich W, Ball GE, Milburn K, et al. Childsmile: the national child oral health improvement programme in Scotland. Part 2: Monitoring and delivery. *Br Dent J* 2010;209(2):79-83. doi: 10.1038/sj.bdj.2010.629.
43. MacRitchie HMB, Longbottom C, Robertson M, Nugent Z, Chan K, Radford JR, et al. Development of the Dundee Caries Risk Assessment Model (DCRAM)--risk model development using a novel application of CHAID analysis. *Community Dent Oral Epidemiol* 2012;40(1):37-45.
44. Tellez M, Gomez J, Pretty I, Ellwood R, Ismail A. Evidence on existing caries risk assessment systems: are they predictive of future caries? *Community Dent Oral Epidemiol* 2013;41(1):67-78.
45. Disney JA, Abernathy, JR, Graves, RC, Mauriello SM, Bohannon HM, Zack, DD. Comparative effectiveness of visual/tactile and simplified screening examinations in caries risk assessment. *Community Dent Oral Epidemiol* 1992;20:326-32.
46. Aveyard P, Begh R, Parsons A, West R. Brief opportunistic smoking cessation interventions: a systematic review and meta-analysis to compare advice to quit and offer of assistance. *Addiction* 2012;107(6):1066-73.
47. McQueen J, Howe TE, Allan L, Mains D, Hardy V. Brief interventions for heavy alcohol users admitted to general hospital wards. *Cochrane Database of Systematic Reviews* 2011, Issue 8.
48. Kay E, Locker D. A systematic review of the effectiveness of health promotion aimed at improving oral health. *Community Dent Health* 1998;15(3):132-44.
49. Kay EJ, Locker D. Is dental health education effective? A systematic review of current evidence. *Community Dent Oral Epidemiol* 1996;24(4):231-5.
50. Almomani F, Williams K, Catley D, Brown C. Effects of an oral health promotion program in people with mental illness. *J Dent Res* 2009;88(7):648-52.
51. Clarkson JE, Young L, Ramsay CR, Bonner BC, Bonetti D. How to influence patient oral hygiene behavior effectively. *J Dent Res* 2009;88(10):933-7.
52. Kakudate N, Morita M, Sugai M, Kawanami M. Systematic cognitive behavioral approach for oral hygiene instruction: a short-term study. *Patient Educ Couns* 2009;74(2):191-6.
53. Freudenthal JJ, Bowen DM. Motivational interviewing to decrease parental risk-related behaviors for early childhood caries. *J Dent Hyg* 2010;84(1):29-34.
54. Harris R, Gamboa A, Dailey Y, Ashcroft A. One-to-one dietary interventions undertaken in a dental setting to change dietary behaviour. *Cochrane Database of Systematic Reviews* 2012, Issue 3.
55. Schuz B, Wiedemann AU, Mallach N, Scholz U. Effects of a short behavioural intervention for dental flossing: randomized-controlled trial on planning when, where and how. *J Clin Periodontol* 2009;36(6):498-505.
56. Sniehotta FF, Araujo Soares V, Dombrowski SU. Randomized controlled trial of a one-minute intervention changing oral self-care behavior. *J Dent Res* 2007;86(7):641-5.
57. Ay ZY, Sayin MO, Ozat Y, Goster T, Atilla AO, Bozkurt FY. Appropriate oral hygiene motivation method for patients with fixed appliances. *Angle Orthod* 2007;77(6):1085-9.
58. Harrison R, Benton T, Everson-Stewart S, Weinstein P. Effect of motivational interviewing on rates of early childhood caries: a randomized trial. *Pediatr Dent* 2007;29(1):16-22.
59. Jonsson B, Ohrn K, Oscarson N, Lindberg P. The effectiveness of an individually tailored oral health educational programme on oral hygiene behaviour in patients with periodontal disease: a blinded randomized-controlled clinical trial (one-year follow-up). *J Clin Periodontol* 2009;36(12):1025-34.
60. Plutzer K, Spencer AJ. Efficacy of an oral health promotion intervention in the prevention of early childhood caries. *Community Dent Oral Epidemiol* 2008;36(4):335-46.
61. Wennhall I, Mårtensson EM, Sjunnesson I, Matsson L, Schröder U, Twetman S. Caries-preventive effect of an oral health program for preschool children in a low socio-economic, multicultural area in Sweden: results after one year. *Acta Odontol Scand* 2005;63(3):163-7.
62. Rozier RG. Effectiveness of methods used by dental professionals for the primary prevention of dental caries. *J Dent Educ* 2001;65(10):1063-72.
63. Gray D, McIntyre G. Does oral health promotion influence the oral hygiene and gingival health of patients undergoing fixed appliance orthodontic treatment? A systematic literature review. *J Orthod* 2008;35(4):262-9.
64. Yevlahova D, Satur J. Models for individual oral health promotion and their effectiveness: a systematic review. *Aust Dent J* 2009;54(3):190-7.
65. Commission on Social Determinants of Health. Closing the gap in a generation: health equity through action on the social determinants of health. Final Report of the Commission on Social Determinants of Health. Geneva: World Health Organization; 2008. [cited 02 Dec 2013]. Available from url: http://whqlibdoc.who.int/publications/2008/9789241563703_eng.pdf

66. World conference on social determinants of health: meeting report, Rio de Janeiro, Brazil, 19-21 October 2011. Geneva: World Health Organization; 2012. [cited 02 Dec 2013]. Available from url: http://www.who.int/sdhconference/resources/Conference_Report.pdf
67. UK Medicines Information. Medicines Q&As. Q&A 357.2. What are the excipients in toothpastes? [cited 02 Dec 2013]. Available from url: <http://www.ukmi.nhs.uk/filestore/ukmias/NWQA357.2/Whataretheexcipientsintoothpastes.doc>
68. Marinho VC, Higgins JP, Logan S, Sheiham A. Topical fluoride (toothpastes, mouthrinses, gels or varnishes) for preventing dental caries in children and adolescents. *Cochrane Database of Systematic Reviews* 2003, Issue 4.
69. Marinho VC, Higgins JP, Sheiham A, Logan S. Fluoride toothpastes for preventing dental caries in children and adolescents. *Cochrane Database of Systematic Reviews* 2003, Issue 1.
70. Steiner M, Helfenstein U, Menghini G. Effect of 1000 ppm relative to 250 ppm fluoride toothpaste. A meta-analysis. *Am J Dent* 2004;17(2):85-8.
71. Twetman S. Prevention of early childhood caries (ECC): review of literature published 1998-2007. *Eur Arch Paediatr Dent* 2008;9(1):12-8.
72. Twetman S. Caries prevention with fluoride toothpaste in children: an update. *Eur Arch Paediatr Dent* 2009;10(3):162-7.
73. Twetman S, Axelsson S, Dahlgren H, Holm AK, Kallestal C, Lagerlof F, et al. Caries-preventive effect of fluoride toothpaste: a systematic review. *Acta Odontol Scand* 2003;61(6):347-55.
74. Walsh T, Worthington HV, Glenny AM, Appelbe P, Marinho VC, Shi X. Fluoride toothpastes of different concentrations for preventing dental caries in children and adolescents. *Cochrane Database of Systematic Reviews* 2010, Issue 1.
75. Wong MC, Glenny AM, Tsang BW, Lo EC, Worthington HV, Marinho VC. Topical fluoride as a cause of dental fluorosis in children. *Cochrane Database of Systematic Reviews* 2010, Issue 1.
76. Santos AP, Nadanovsky P, Oliveira BH. A systematic review and meta-analysis of the effects of fluoride toothpastes on the prevention of dental caries in the primary dentition of preschool children. *Community Dent Oral Epidemiol* 2013;41(1):1-12.
77. Institute of Medicine (US) Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. *Dietary Reference Intakes for Calcium, Phosphorus, Magnesium, Vitamin D, and Fluoride*. Washington (DC): National Academies Press (US); 1997. [cited 03 Dec 2013]. Available from url: <http://www.nap.edu/catalog/5776.html>
78. Cochran JA, Ketley CE, Duckworth RM, van Loveren C, Holbrook WP, Seppa L, et al. Development of a standardized method for comparing fluoride ingested from toothpaste by 1.5-3.5-year-old children in seven European countries. Part 2: Ingestion results. *Community Dent Oral Epidemiol* 2004;32(Suppl 1):47-53.
79. DenBesten P, Ko HS. Fluoride levels in whole saliva of preschool children after brushing with 0.25 g (pea-sized) as compared to 1.0 g (full-brush) of a fluoride dentifrice. *Pediatr Dent*. 1996;18(4):277-80.
80. The Cosmetic Products (Safety) Regulations 2008, Schedule 4 Part 1, List of substances which cosmetics products must not contain except subject to restrictions and conditions. London: The Stationary Office Ltd; 2008. (Statutory Instruments 2008 No. 1284). [cited 03 Dec 2013]. Available from url: <http://www.legislation.gov.uk/uksi/2008/1284/schedule/4/made>
81. Ammari AB, Bloch-Zupan A, Ashley PF. Systematic review of studies comparing the anti-caries efficacy of children's toothpaste containing 600 ppm of fluoride or less with high fluoride toothpastes of 1,000 ppm or above. *Caries Res* 2003;37(2):85-92.
82. Liu HY, Chen CC, Hu WC, Tang RC, Tsai CC, Huang ST. The impact of dietary and tooth-brushing habits to dental caries of special school children with disability. *Res Dev Disabil* 2010;31(6):1160-9.
83. Jerkovic K, Binnekade JM, van der Kruk JJ, van der Most JA, Talsma AC, van der Schans CP. Differences in oral health behaviour between children from high and children from low SES schools in The Netherlands. *Community Dent Health* 2009;26(2):110-5.
84. Levine RS, Nugent ZJ, Rudolf MC, Sahota P. Dietary patterns, toothbrushing habits and caries experience of schoolchildren in West Yorkshire, England. *Community Dent Health* 2007;24(2):82-7.
85. Lillehagen M, Grindejord M, Mejare I. Detection of approximal caries by clinical and radiographic examination in 9-year-old Swedish children. *Caries Res* 2007;41(3):177-85.
86. Martens L, Vanobbergen J, Willems S, Aps J, De Maeseneer J. Determinants of early childhood caries in a group of inner-city children. *Quintessence Int* 2006;37(7):527-36.
87. Maserejian NN, Tavares MA, Hayes C, Soncini JA, Trachtenberg FL. Prospective study of 5-year caries increment among children receiving comprehensive dental care in the New England children's amalgam trial. *Community Dent Oral Epidemiol* 2009;37(1):9-18.
88. Molina-Frechero N, Castaneda-Castaneira E, Marques-Dos-Santos MJ, Soria-Hernandez A, Bologna-Molina R. Dental caries and risk factors in adolescents of Ecatepec in the State of Mexico. *Rev Invest Clin* 2009;61(4):300-5.
89. Pakpour AH, Hidarnia A, Hajizadeh E, Kumar S, Harrison AP. The status of dental caries and related factors in a sample of Iranian adolescents. *Med Oral Patol Oral Cir Bucal* 2011;16(6):e822-7.
90. Senesombath S, Nakornchai S, Banditsing P, Lexomboon D. Early childhood caries and related factors in Vientiane, Lao PDR. *Southeast Asian J Trop Med Public Health* 2010;41(3):717-25.
91. Vazquez-Nava F, Vazquez RE, Saldivar GA, Beltran GF, Almeida AV, Vazquez RC. Allergic rhinitis, feeding and oral habits, toothbrushing and socioeconomic status. Effects on development of dental caries in primary dentition. *Caries Res* 2008;42(2):141-7.
92. Jackson RJ, Newman HN, Smart GJ, Stokes E, Hogan JI, Brown C, et al. The effects of a supervised toothbrushing programme on the caries increment of primary school children, initially aged 5-6 years. *Caries Res* 2005;39(2):108-15.
93. Pine CM, Curnow MM, Burnside G, Nicholson JA, Roberts AJ. Caries prevalence four years after the end of a randomised controlled trial. *Caries Res* 2007;41(6):431-6.
94. Curnow MMT, Pine CM, Burnside G, Nicholson JA, Chesters RK, Huntington E. A randomized controlled trial of the efficacy of supervised toothbrushing in high-caries-risk children. *Caries Res* 2002;36(4):294-300.
95. Davies RM, Davies GM, Ellwood RP. Prevention. Part 4: Toothbrushing: what advice should be given to patients? *Br Dent J* 2003;195(3):135-41.
96. Hinds K, Gregory JR. National diet and nutrition survey: children aged 1.5 to 4.5 years. Volume 2: Report of the dental survey. London: HMSO; 1995.
97. Vanobbergen J, Martens L, Lesaffre E, Bogaerts K, Declerck D. Assessing risk indicators for dental caries in the primary dentition. *Community Dent Oral Epidemiol* 2001;29(6):424-34.

98. Verrips GH, Kalsbeek H, Van Woerkum CM, Koelen M, Kok-Weimar TL. Correlates of toothbrushing in preschool children by their parents in four ethnic groups in The Netherlands. *Community Dent Health* 1994;11(4):233-9.
99. Sjogren K, Birkhed D, Rangmar B. Effect of a modified toothpaste technique on approximal caries in preschool children. *Caries Res* 1995;29(6):435-41.
100. Chestnutt IG, Schafer F, Jacobson AP, Stephen KW. The influence of toothbrushing frequency and post-brushing rinsing on caries experience in a caries clinical trial. *Community Dent Oral Epidemiol* 1998;26(6):406-11.
101. Duckworth RM, Moore MS. Salivary fluoride concentrations after overnight use of toothpastes. *Caries Res*. 2001;35(4):285.
102. Robinson P, Deacon SA, Deery C, Heanue M, Walmsley AD, Worthington HV, et al. Manual versus powered toothbrushing for oral health. *Cochrane Database of Systematic Reviews* 2005, Issue 2.
103. Mascarenhas AK, Soparkar P, Al-Mutawaa S, Udani TM. Plaque removal using a battery-powered toothbrush compared to a manual toothbrush. *J Clin Dent* 2005;16(1):23-5.
104. Costa MR, Silva VC, Miqui MN, Sakima T, Spolidorio DM, Cirelli JA. Efficacy of ultrasonic, electric and manual toothbrushes in patients with fixed orthodontic appliances. *Angle Orthod* 2007;77(2):361-6.
105. Silvestrini Biavati A, Gastaldo L, Dessi M, Silvestrini Biavati F, Migliorati M. Manual orthodontic vs. oscillating-rotating electric toothbrush in orthodontic patients: a randomised clinical trial. *Eur J Paediatr Dent* 2010;11(4):200-2.
106. Ousehal L, Lazrak L, Es-Said R, Hamdoune H, Elquars F, Khadija A. Evaluation of dental plaque control in patients wearing fixed orthodontic appliances: a clinical study. *Int Orthod* 2011;9(1):140-55.
107. Asadoorian J. CDHA position paper on tooth brushing. *CJDH* 2006;40(5):232-48.
108. Hogan LM, Daly CG, Curtis BH. Comparison of new and 3-month-old brush heads in the removal of plaque using a powered toothbrush. *J Clin Periodontol* 2007;34(2):130-6.
109. Malekafzali B, Biria M, Tadayon N, Abbasi H. Comparison of plaque removal efficacy of new and 3-month-old toothbrushes in children. *East Mediterr Health J* 2011;17(2):115-20.
110. Muller-Bolla M, Lupi-Pegurier L, Bertrand MF, Velly AM. Manual toothbrush wear and consequences on plaque removal. *J Clin Dent* 2007;18(3):73-8.
111. Pochapski MT, Canever T, Wambier DS, Pilatti GL, Santos FA. The influence of toothbrush age on plaque control and gingivitis. *Oral Health Prev Dent* 2011;9(2):167-75.
112. van Palenstein Helderman WH, Kyaing MM, Aung MT, Soe W, Rosema NA, van der Weijden GA, et al. Plaque removal by young children using old and new toothbrushes. *J Dent Res* 2006;85(12):1138-42.
113. Hujoel PP, Cunha-Cruz J, Banting DW, Loesche WJ. Dental flossing and interproximal caries: a systematic review. *J Dent Res* 2006;85(4):298-305.
114. Gisselsson H, Birkhed D, Bjorn AL. Effect of professional flossing with chlorhexidine gel on approximal caries in 12- to 15-year-old schoolchildren. *Caries Res* 1988;22(3):187-92.
115. Gisselsson H, Birkhed D, Bjorn AL. Effect of a 3-year professional flossing program with chlorhexidine gel on approximal caries and cost of treatment in preschool children. *Caries Res* 1994;28(5):394-9.
116. Gisselsson H, Emilson CG, Birkhed D, Bjorn AL. Approximal caries increment in two cohorts of schoolchildren after discontinuation of a professional flossing program with chlorhexidine gel. *Caries Res* 2005;39(5):350-6.
117. Baeshen HA, Lingstrom P, Birkhed D. Effect of fluoridated chewing sticks (Miswaks) on white spot lesions in postorthodontic patients. *Am J Orthod Dentofacial Orthop* 2011;140(3):291-7.
118. Twetman S. Antimicrobials in future caries control? A review with special reference to chlorhexidine treatment. *Caries Res* 2004;38(3):223-9.
119. James P, Parnell C, Whelton H. The caries-preventive effect of chlorhexidine varnish in children and adolescents: a systematic review. *Caries Res* 2010;44(4):333-40.
120. Azarpazhooh A, Main PA. Fluoride varnish in the prevention of dental caries in children and adolescents: a systematic review. *J Can Dent Assoc* 2008;74(1):73-9.
121. Carvalho DM, Salazar M, Oliveira BH, Coutinho ES. Fluoride varnishes and decrease in caries incidence in preschool children: a systematic review. *Rev Bras Epidemiol* 2010;13(1):139-49.
122. Marinho VCC, Worthington HV, Walsh T, Clarkson JE. Fluoride varnishes for preventing dental caries in children and adolescents. *Cochrane Database of Systematic Reviews* 2013, Issue 7.
123. Petersson LG, Twetman S, Dahlgren H, Norlund A, Holm AK, Nordenram G, et al. Professional fluoride varnish treatment for caries control: a systematic review of clinical trials. *Acta Odontol Scand* 2004;62(3):170-6.
124. Bonner BC, Clarkson JE, Dobbyn L, Khanna S. Slow-release fluoride devices for the control of dental decay. *Cochrane Database of Systematic Reviews* 2006, Issue 4.
125. Ammari JB, Baqain ZH, Ashley PF. Effects of programs for prevention of early childhood caries. A systematic review. *Med Princ Pract* 2007;16(6):437-42.
126. Marinho VC, Higgins JP, Logan S, Sheiham A. Fluoride gels for preventing dental caries in children and adolescents. *Cochrane Database of Systematic Reviews* 2002, Issue 2.
127. Ismail AI, Hasson H. Fluoride supplements, dental caries and fluorosis: a systematic review. *J Am Dent Assoc* 2008;139(11):1457-68.
128. Tubert-Jeannin S, Auclair C, Amsallem E, Tramini P, Gerbaud L, Ruffieux C, et al. Fluoride supplements (tablets, drops, lozenges or chewing gums) for preventing dental caries in children. *Cochrane Database of Systematic Reviews* 2011, Issue 12.
129. Benson PE, Parkin N, Millett DT, Dyer F, Vine S, Shah A. Fluorides for the prevention of white spots on teeth during fixed brace treatment. *Cochrane Database of Systematic Reviews* 2004, Issue 3.
130. Marinho VC, Higgins JP, Logan S, Sheiham A. Fluoride mouthrinses for preventing dental caries in children and adolescents. *Cochrane Database of Systematic Reviews* 2003, Issue 3.
131. Twetman S, Petersson L, Axelsson S, Dahlgren H, Holm AK, Kallestall C, et al. Caries-preventive effect of sodium fluoride mouthrinses: a systematic review of controlled clinical trials. *Acta Odontol Scand* 2004;62(4):223-30.

132. Marinho VC, Higgins JP, Sheiham A, Logan S. Combinations of topical fluoride (toothpastes, mouthrinses, gels, varnishes) versus single topical fluoride for preventing dental caries in children and adolescents. *Cochrane Database of Systematic Reviews* 2004, Issue 1.
133. Hiiri A, Ahovuo-Saloranta A, Nordblad A, Makela M. Pit and fissure sealants versus fluoride varnishes for preventing dental decay in children and adolescents. *Cochrane Database of Systematic Reviews* 2010, Issue 3.
134. Marinho VC, Higgins JP, Sheiham A, Logan S. One topical fluoride (toothpastes, or mouthrinses, or gels, or varnishes) versus another for preventing dental caries in children and adolescents. *Cochrane Database of Systematic Reviews* 2004, Issue 1.
135. Strohmer L, Brambilla E. The use of fluoride varnishes in the prevention of dental caries: a short review. *Oral Dis* 2001;7(2):71-80.
136. Ahovuo-Saloranta A, Forss H, Walsh T, Hiiri A, Nordblad A, Mäkelä M, et al. Sealants for preventing dental decay in the permanent teeth. *Cochrane Database of Systematic Reviews* 2013, Issue 3.
137. Elmes A, Dykes E, Cookson MJ. A cross-sectional survey to determine the ages of emergence of permanent teeth of Caucasian children of the Colchester area of the UK. *Br Dent J* 2010;209(6):E10.
138. Ekstrand KR, Christiansen J, Christiansen ME. Time and duration of eruption of first and second permanent molars: a longitudinal investigation. *Community Dent Oral Epidemiol* 2003;31(5):344-50.

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