STRATEGIES TO PREVENT DENTAL CARIES IN CHILDREN AND ADOLESCENTS

Guidance on identifying high caries risk children and developing preventive strategies for high caries risk children in Ireland

Summary Guideline

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

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University College Cork, Ireland

HRB
Health Research Board

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The full guideline is available at: http://ohsrc.ucc.ie/

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Acknowledgements

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Contents

What is an evidence-based guideline?

Evidence-based clinical practice guidelines are systematically developed statements containing recommendations for the care of individuals by healthcare professionals that are based on the highest quality scientific evidence available. Guidelines are designed to help practitioners assimilate, evaluate and apply the ever-increasing amount of evidence and opinion on current best practice, and to assist them in making decisions about appropriate and effective care for their patients. Their role is most clear when two factors are present: (a) evidence of variation in practice that affects patient outcomes, and (b) a strong research base providing evidence of effective practice.[1] It is important to note that guidelines are not intended to replace the healthcare professional's expertise or experience, but are a tool to assist practitioners in their clinical decision-making process, with consideration for their patient's preferences.

To assist the reader of this guideline, the key to the grading of evidence and recommendations is presented below.

LEVELS OF EVIDENCE	
1++	High quality meta-analyses, systematic reviews of randomised controlled trials (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, e.g. case reports, case series
4	Expert opinion
GRADES OF RECOMMENDATIONS	
A	At least one meta-analysis, systematic review, or RCT rated as 1++, and directly applicable to the target population OR 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 OR 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 OR Extrapolated evidence from studies rated as 2++
D	Evidence level 3 or 4 OR Extrapolated evidence from studies rated as 2+
GPP **Good Practice Point**	Recommended best practice based on the clinical experience of the Guideline Development Group

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About this guideline

This guideline has been developed for the public dental service in Ireland, which is the main provider of state-funded dental services to children under the age of 16. For the purposes of this guideline, the term “high caries risk” refers to children or adolescents who are at risk of developing high levels of dental caries, or who are at risk from the consequences of caries, including those who are at risk by virtue of their medical, psychological or social status, i.e. at risk *of* or *from* caries.

What the guideline covers

The guideline covers approaches to identifying “high caries risk” children and adolescents at both the individual and the population level, and addresses effective strategies to prevent caries at the individual and the population level in high caries risk children under the age of 16.

What the guideline does not cover

The following areas are not covered by this guideline:

- Restoration and re-restoration of carious teeth
- Dental erosion
- Systemic fluoride delivery systems.

The aim of this guideline is to:

- Encourage early identification of high caries risk children
- Assist clinicians in making decisions on preventive strategies for individual high caries risk children and adolescents
- Assist policy makers and those responsible for planning public dental services for children and adolescents in making decisions on the provision of caries prevention programmes for high caries risk children.

Who is this guideline for?

This guideline is of relevance to all clinical staff working in the public dental service, those responsible for the planning and management of public dental services, oral health promoters, the primary health care team (Public Health Nurses, GPs, practice nurses etc.), parents and children, teachers and other social, health and education services dealing with children. Although developed for the public dental service, this guideline will also be of interest to general dental practitioners and their dental teams.

How was this guideline developed?

This guideline was developed by a Guideline Development Group in line with international best practice, as described in the AGREE Instrument.[2] Details of the guideline development process can be found in Appendix 2. The guideline will be updated in 2011.

Summary of Recommendations

The recommendations in this guideline take into account the statutory role of the public dental service in both the prevention and treatment of dental caries in children and adolescents in Ireland. The focus of the recommendations is early identification of high caries risk children in order to initiate early preventive measures. This represents a reorientation of dental services from its present target group of school-aged children towards a younger – i.e. preschool and early school age – target group. The Guideline Development Group acknowledges the resource restrictions facing all public health services, but also recognises that the preventive strategies outlined here for high caries risk children need to be underpinned by a regular, background, systematic dental service for all children, regardless of caries risk. For the purposes of this guideline, the term "high caries risk" refers to children who are at risk of developing high levels of dental caries, or who are at risk from the consequences of caries, including those who are at risk by virtue of their medical, psychological or social status, i.e. at risk *of* or *from* caries.

Identification of high caries risk individuals	Grade of recommendation
Public Health Nurses, practice nurses, General Practitioners and other primary care workers who have regular contact with young children should have training in the identification of high caries risk preschool children	**D**
An oral assessment should be incorporated into each child's developmental visit from age 8 months and recorded in the child's health record	**D**
Referral pathways should be developed to allow referral of high caries risk preschool children from primary, secondary and social care services into dental services	**GPP**
Children should be offered a dental assessment during their first year in primary school	**D**
A formal caries risk assessment should be done for children attending the dental clinic for dental assessment or emergency care, using the Caries Risk Assessment Checklist	**D**
The Caries Risk Assessment Checklist should be integrated into the electronic patient record	**GPP**

Identification of high caries risk populations	Grade of recommendation
An agreed set of oral health indicators for the planning, targeting and evaluation of dental services should be developed. Methods of measurement and reporting of these indicators need to be decided	**GPP**
Data should be collected at local level, but standardised and co-ordinated nationally	**GPP**
Electronic patient record systems should be designed to produce small area data on the agreed oral health indicators for children	**GPP**
The use of Health Atlas Ireland and the All Ireland Health and Well-being Data Set (AIHWDAS) should be explored as a means of using area based information and demographics to identify populations in small geographic areas who are likely to have high caries levels	**GPP**

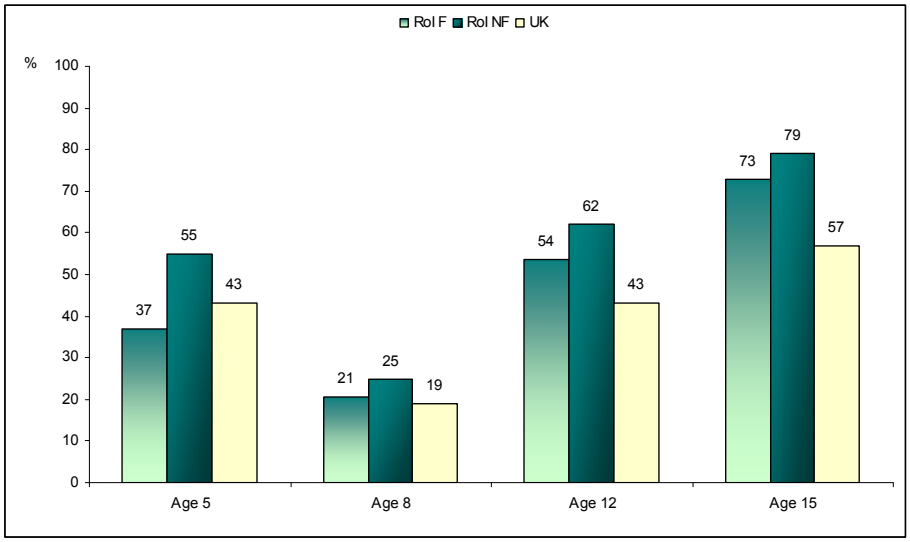
Preventive strategies for preschool children (age 0–4 years)		Grade of recommendation
POPULATION STRATEGIES		
Oral health education and diet advice should be incorporated into each child's developmental visits from age 8 months and at any appropriate opportunity that arises		**D**
Oral health messages should be incorporated into relevant general health promotion interventions for young children, as part of a common risk factor approach to improving oral health		**D**
Age <2	Parents/carers should be encouraged to brush their child's teeth as soon as the first tooth appears, using a soft toothbrush and water only	**D**
Age 2–4	Parents/carers should be encouraged to brush their child's teeth, or help them to brush:	
	• with fluoride toothpaste containing at least 1,000 ppm F	**A**
	• twice a day	**B**
	• at bedtime and at one other time during the day	**GPP**
	• using a small pea size amount of toothpaste	**D**
	Children should be encouraged to spit out toothpaste and not rinse after brushing	**B**
INDIVIDUAL STRATEGIES FOR HIGH CARIES RISK CHILDREN		
A formal caries risk assessment should be done for children attending the dental clinic for dental assessment or emergency care, using the Caries Risk Assessment Checklist		**D**
Age 0–4	Parents/carers of children who are assessed as being at high caries risk should be encouraged to brush their child's teeth:	
	• with fluoride toothpaste containing at least 1,000 ppm F	**A**
	• twice a day	**B**
	• at bedtime and at one other time during the day	**GPP**
	• using a small pea size amount of toothpaste	**D**
	Children should be encouraged to spit out toothpaste and not rinse after brushing	**B**
Oral health education for parents/carers should encourage healthy eating, in line with national dietary guidelines		**D**
Parents/carers of children who use a baby bottle should be advised never to put sweet drinks, including fruit juice, into the bottle		**C**
Parents/carers should be advised not to let their child sleep or nap with a baby bottle or feeder cup		**GPP**
Parents/carers should be encouraged to limit their child's consumption of sugar-containing foods and drinks, and when possible, to confine their consumption to mealtimes		**D**
Parents/carers should be advised that foods and drinks containing sugar substitutes are available, but should be consumed in moderation		**D**
Sugar free medicines should be used when available		**D**
Resin-based fluoride varnish application (22,600 ppm F) should be offered to children who are assessed as being at high caries risk, at intervals of 6 months or 3 months		**A**
The use of chlorhexidine for caries prevention is not recommended		**D**
Recall of high caries risk children should be based on the clinician's assessment of the child's caries risk status using the Caries Risk Assessment Checklist, and should not exceed 12 months		**D**

Preventive strategies for school-aged children (age 5–15 years)	Grade of recommendation
POPULATION STRATEGIES	
Oral Health Education should be incorporated into the Social and Personal Health Education (SPHE) programme of the school curriculum	**D**
Oral health messages should be incorporated into general health promotion interventions for children and adolescents, as part of a common risk factor approach to improving oral health	**D**
All children should be encouraged to brush their teeth:	
• with fluoride toothpaste containing at least 1,000 ppm F	**A**
• twice a day	**B**
• at bedtime and at one other time during the day	**GPP**
• using a small pea size amount of toothpaste (up to age 7)* *Over the age of 7, the risk of ingesting toothpaste is greatly reduced, and a pea size amount or more of toothpaste can be used	**D**
Children under the age of 7 should be supervised by an adult when brushing their teeth	**B**
Children should be encouraged to spit out toothpaste and not rinse after brushing	**B**
INDIVIDUAL STRATEGIES FOR HIGH CARIES RISK CHILDREN	
A formal caries risk assessment should be done for children attending the dental clinic for dental assessment or emergency care, using the Caries Risk Assessment Checklist	**D**
Children who are assessed as being at high caries risk should have resin-based fissure sealant applied and maintained in vulnerable pits and fissures of permanent teeth	**A**
Resin-based fluoride varnish application (at least 22,600 ppm F) should be offered to children who are assessed as being at high caries risk, at intervals of 6 months or 3 months	**A**
The use of chlorhexidine for caries prevention is not recommended	**D**
There is insufficient evidence on which to base a recommendation on the use of remineralising products (CPP-ACP) for caries prevention	
Oral health education for parents/carers and children should encourage healthy eating, in line with national dietary guidelines	**D**
Parents/carers should be encouraged to limit their child's consumption of sugar-containing foods and drinks and, when possible, to confine their consumption to meal times	**D**
Children should be advised to limit their consumption of sugar-containing foods and drinks and, when possible, to confine their consumption to meal times	**D**
Parents/carers and children should be advised that foods and drinks containing sugar substitutes are available, but should be consumed in moderation	**D**
Sugar free medicines should be used, when available	**D**
Recall of high caries risk children should be based on the clinician's assessment of the child's caries risk status using the Caries Risk Assessment Checklist, and should not exceed 12 months	**D**
Targeted population strategies (All ages)	
Community-based interventions involving the use of fluoride toothpaste, varnish or mouthrinse should be considered for targeted populations of children who are at high risk of developing dental caries, in line with the recommendations of the Topical Fluoride guideline (Appendix 1)	

1. Introduction

Dental caries (tooth decay) is the single most common chronic disease of childhood.[3] In the Republic of Ireland, 37% of 5-year-olds in fluoridated areas and 55% in non-fluoridated areas have experienced decay, i.e. they have one or more teeth that is decayed, filled or extracted because of decay. More than one fifth of 8-year-olds, half of all 12-year-olds and three quarters of all 15-year-olds have experienced decay in their permanent teeth.[4] Compared to the UK[5], the prevalence of decay is slightly higher for Irish 8-year-olds and considerably higher for Irish 12- and 15-year-olds in both fluoridated and non-fluoridated areas (Figure 1).

Figure 1: Percentage of children with caries experience (mean $d_{3vc}mft/D_{3vc}MFT> 0$) in the Republic of Ireland (RoI) 2002 by fluoridation status (F: fluoridated, NF: non-fluoridated)[4], and in the UK 2003[5]



The severity of decay experienced by Irish children is also of concern. A substantial proportion of 5-, 12- and 15-year-olds, particularly in non-fluoridated areas, have experienced decay in 5 or more teeth, which represents higher than average decay experience for each age group. There is considerable geographic variation, measured at former health board level, in the proportion of children with high levels of caries, and variation in caries levels across smaller geographic areas has also been recorded in Ireland.[6–12]

There are no national data on the oral health of preschool children in Ireland and only three small-area oral health surveys of Irish preschool children have been conducted.[13–15] The most recent of these[15], found that approximately one in four 3-year-olds (27.4%) had decay. The prevalence and severity of decay was significantly higher among disadvantaged children (where disadvantage was measured as parental medical card ownership) compared to those who were not disadvantaged (prevalence: 41.5% vs 18%, $p<0.001$; mean dmft: 1.31 vs 0.76, $p<0.05$).[15] This finding is consistent with the results of the North South survey, which, in a country-wide representative sample of 5-, 8-, 12- and 15-year-olds, found that caries levels were significantly higher among disadvantaged children.[4]

Tooth decay in young children is of particular concern for a number of reasons:

- It is painful for the child, disturbs eating and sleeping patterns and is distressing for both child and parent;
- Treatment is challenging and often requires secondary and specialist care under conscious sedation or general anaesthesia;
- It may impact on the developing permanent dentition, self esteem and aesthetics;
- It highlights that an opportunity has been missed to prevent what should have been preventable.

All of these factors are of even more concern if the child has special care needs. Caries levels in Irish children with special care needs tend to be similar or lower than those of children attending mainstream schools and the level of untreated decay also tends to be lower. However, considerable variation in caries experience has been found between groups with different types of disabilities.[16,17] The prevention of caries is of particular importance for children with disabilities, and yet fewer children with special care needs have fissure sealants on their teeth compared to children in mainstream schools.[16,17] However, one study conducted in the greater Dublin area found that the proportion of children attending special schools who had fissure sealants was higher than that reported in other studies of children attending special schools.[16] An unpublished Irish study[17] found that one in three children aged 12 and 15 with special care needs had already undergone general anaesthesia for dental treatment.

Three out of the four oral health goals for 5- and 12-year-old children set by the Department of Health in the first national health strategy in 1994[18] were not achieved by 2002[4] (Table 1.2). The authors of the North South survey identified the need for new caries preventive programmes, particularly for the younger age group, to reduce caries levels in Irish children.[4]

Table 1.2: Oral health goals for 5- and 12-year-old children

	Age 5 years		Age 12 years	
	F	**Non F**	**F**	**Non F**
Oral Health Goal[18]	At least 85% free of dental caries	At least 60% free of dental caries	No more than 1 decayed, missing or filled tooth	No more than 2 decayed, missing or filled teeth
Outcome measured at cavitation level in the North South Survey 2002[4]	70%	53%	1.2	1.4
Outcome measured at visual and cavitation level in the North South Survey 2002[4]	63%	45%	1.4	1.8

1.1. Current approaches to caries prevention in the public dental service

State-funded dental services for children under the age of 16 are provided mainly by the public dental service. Apart from water fluoridation, the caries preventive strategies currently adopted by the public

dental service are focused almost exclusively on school-aged children and concentrate on the prevention of caries in permanent teeth. Public dental services for children are not comprehensive, and apart from the emergency service, which is available to all eligible children, access to routine dental assessment and treatment services is through the School Dental Service, which is limited to children in "target" primary school classes. Adolescents in secondary school may also be targeted, but this varies greatly across Ireland. Overall, there is considerable variation in the number and choice of school classes targeted. Available data on the dental attendance of Irish children show that only 19% of 5-year-olds[12] and 22% of 8-year-olds[4] normally attend privately, which suggests that the public dental service does not operate against a backdrop of regular private dental attendance. This highlights the vital role of the public dental service in caries prevention for children.

The fissure sealant programme, which is a core element of the School Dental Service, is the key caries-preventive strategy accounting for the greatest input of staff and resources. Yet, in spite of actively targeting the most vulnerable teeth – particularly the first permanent molar – 54% of all 12-year-olds and 72% of 15-year-olds have experienced decay on pit and fissure surfaces (North South survey, unpublished data). Among those with decay, pit and fissure caries accounts for over 80% of caries experience in 8-year-olds, and over 75% of caries experience in 12-year-olds.[4] A report on targeting and fissure sealants[19] commissioned by the Department of Health and Children concluded that: *"In view of the fact that targeting particular primary school classes was unlikely to result in the selection of appropriate at risk groups for dental services generally, including fissure sealing, an alternative method for selecting children for treatment is necessary".*

Preventive programmes for Irish preschool children are rare. Several reports for the Department of Health and Children have highlighted the need for preventive strategies for younger children[4,20], with one report stating: *"If prevention of oral disease is to be taken seriously in Ireland, it must be provided for this [preschool] age group"*.[20]

One of the key principles of the national health strategy in the Republic of Ireland is equity: that health inequalities are targeted and that people are treated fairly according to need.[21] The varying caries levels by age group, disadvantage status and geographic location suggest that current preventive strategies in Ireland need to be reviewed, and that guidance is required on effective strategies to achieve optimum outcomes. This guideline seeks to fill this gap.

2. Identifying high caries risk individuals

The approach taken by the Guideline Development Group was that all children are at risk of developing caries, but some children are at increased risk. These are the children that need to be identified as early as possible, ideally before caries develops or at a stage when the caries process is still reversible, thereby avoiding the need for restorative or surgical treatment. However, despite extensive research into methods of predicting caries, the predictive power of even the best measures currently available is modest.[22] A systematic review of 43 studies employing multivariate caries risk prediction models found that previous caries experience was an important predictor of caries risk in both the primary and the permanent dentition.[23] **2+**

2.1. Identification of high caries risk preschool children by non-dental health professionals

The current structure of public health services in Ireland means that the greatest potential for early identification of high caries risk preschool children lies with trained non-dental health personnel. Child health services offer developmental assessments to children at 7–9 months, 18–24 months and 3.5 years of age, and young children have contact with a range of health professionals, including public health nurses, general practitioners and practice nurses, long before they have contact with dental services. Such professionals are ideally placed to identify very young children who are at high risk of developing caries and who are likely to benefit from referral to dental services.

Three studies have tested the accuracy of trained non-dental health professionals (mostly paediatricians and nurses) at identifying caries in preschool children compared to a "gold standard" paediatric dentist. The percentages of children with and without caries that were correctly identified by the non-dental professionals (i.e. sensitivity and specificity) were 76% and 95% in a study with 11 paediatricians and one nurse practitioner, all of whom had received 2 hours training[24], 100% and 87% in a study of one paediatrician with 4 hours training[25], and 92.2% and 99.3% in a study of one nurse practitioner with 5 hours training.[26] **3**

Recommendation

➢ ***Public Health Nurses, practice nurses, General Practitioners and other primary care workers who have regular contact with young children should have training in the identification of high caries risk preschool children***	**D**
➢ ***An oral assessment should be incorporated into each child's developmental visit from age 8 months and recorded in the child's health record***	**D**
➢ ***Referral pathways should be developed to allow referral of high caries risk preschool children from primary, secondary and social care services into dental services***	**GPP**

2.2. Caries risk assessment by dentists

Currently, children access public dental services through the structured School Dental Service which is available to specific target classes, or through the emergency service which is available to all children under the age of 16. In many dental areas, the first school dental assessments start when children are in 1st or 2nd class (age 7 or 8 years) to coincide with the expected emergence of the first permanent molar teeth. Prospective studies of tooth emergence in children[27–31] have shown consistent average ages of emergence for first permanent molars (6.0–6.3 years for girls and 6.3–6.5 years for boys); however, the age range for first molar emergence is wide (from 5 to 8 years of age).[28–30] Irish cross sectional data show a similar wide age range for emergence of the first permanent molar.[19] Unpublished data from the North South survey of children's dental health show that 16% of 5-year-olds (Junior Infant class) had one or more of their first permanent molar teeth already present in the mouth, while at age 8 years (2nd class), just over 20% of children had already experienced caries in their permanent teeth.[4] **3**

These findings suggest that children are not being assessed early enough to prevent caries in the first permanent molar teeth. Assessment of children during their first year in primary school (Junior Infants class) allows an opportunity to identify early erupting first permanent molars, and to identify high caries risk children who may not have been identified through other health services.

Recommendation

- ***Children should be offered a dental assessment during their first year in primary school*** **D**

In recent years, there has been an increased emphasis on formal caries risk assessment to guide treatment planning decisions and recall intervals for individual patients, and various risk assessment tools and checklists have been developed for this purpose.[32-37] With formal caries risk assessment, the factors that contribute to a child having caries are identified, and modifiable risk factors can be addressed. The Caries Risk Assessment Checklist (CRAC) has been developed for the Irish public dental service to encourage a formal, risk-based approach to the management of caries in Irish school-children. The requirements of the checklist were that it would be simple and quick to apply in the dental surgery setting and that it would be appropriate to an Irish population. Given that the Guideline Development Group considered all children to be at risk of developing caries, it was decided at the outset that the checklist would only record high caries risk status (Figure 2.1).

Figure 2.1: Caries risk assessment checklist for children and adolescents

Risk Factors / Indicators **A "YES" in the shaded section indicates that the child is likely to be at high risk of or from caries**	Please circle the most appropriate answer	
• Age 0–3 with caries (cavitated or non-cavitated)	**Yes**	No
• Age 4–6 with dmft>2 or DMFT>0	**Yes**	No
• Age 7 and over with active smooth surface caries (cavitated or non-cavitated) on one or more permanent teeth	**Yes**	No
• New caries lesions in last 12 months	**Yes**	No
• Hypomineralised permanent molars	**Yes**	No
• Medical or other conditions where dental caries could put the patient's general health at increased risk	**Yes**	No
• Medical or other conditions that could increase the patient's risk of developing dental caries	**Yes**	No
• Medical or other conditions that may reduce the patient's ability to maintain their oral health, or that may complicate dental treatment	**Yes**	No
The following indicators should also be considered when assessing the child's risk of developing caries		
• Age 7–10 with dmft>3 or DMFT>0	**Yes**	No
• Age 11–13 with DMFT>2	**Yes**	No
• Age 14–15 with DMFT>4	**Yes**	No
• Deep pits and fissures in permanent teeth	**Yes**	No
• Full medical card	**Yes**	No
• Sweet snacks or drinks between meals more than twice a day	**Yes**	No
Protective Factors **A "NO" in this section indicates the absence of protective factors which may increase the child's risk of developing caries**		
• Fissure sealants	Yes	**No**
• Brushes twice a day or more	Yes	**No**
• Uses toothpaste containing 1000 ppm F or more	Yes	**No**
• Fluoridated water supply	Yes	**No / Don't know**

Is this child at high risk of or from caries?	**YES**	**NO**

The first shaded section of the checklist contains the factors/indicators that the Guideline Development Group considered most important in identifying high caries risk children, based on a review of the literature on risk factors for caries and their own clinical experience. The middle section contains other potential risk factors/indicators that should be considered when assessing an individual's caries risk status. Since the DMF index represents both past and current caries experience, the existence of a high DMF score in older children was not considered to be as reliable an indicator of current caries risk status as for younger children. The DMFT cut-offs for each age group in the checklist are based on the mean DMFT of the top one third of children with the highest caries levels from the North South survey.[4] The last section contains factors for which there is evidence from systematic reviews of a caries-preventive effect. The final assessment of caries risk status is based on the dentist's assessment of the balance between caries risk factors/indicators and

protective factors for the individual patient. Full notes on completing the Caries Risk Assessment Checklist can be found in Appendix 3. It is important to note that individual caries risk assessment is considered practical only in areas where the proportion of high caries risk individuals does not exceed 30% or 40% of the target population.[22,38]

2.2.1. School-based dental assessment (school screening)

School-based dental assessment is used by the public dental service as a pragmatic approach to providing dental services when faced with limited resources. The emphasis is on the identification of children with obvious needs – such as dental abscess, caries in permanent teeth or trauma – who can then be prioritised for dental treatment. A school-based dental assessment is, in essence, a caries risk assessment based on clinical data that can be observed under less than optimal examination conditions; it cannot assess children with the same diagnostic sensitivity as a clinic-based assessment and not all high caries risk children will be identified by this method.

Recommendation

➢ ***A formal caries risk assessment should be done for children attending the dental clinic for dental assessment or emergency care, using the Caries Risk Assessment Checklist***	**D**
➢ ***The Caries Risk Assessment Checklist should be integrated into the electronic patient record***	**GPP**

2.3. Re-assessment of caries risk

Caries risk assessment is a continuous process, as an individual's risk status can change over time. In the public dental service, intervals between dental assessments for most children are measured in years rather than months. A guideline on dental recall, which was developed for the NHS in the UK by the National Institute for Health and Clinical Excellence (NICE), recommended that the "*interval between oral health reviews should be determined specifically for each patient and tailored to meet his or her needs, on the basis of an assessment of disease levels and risk of or from dental disease*." The guideline also recommended that "*the longest interval between oral health reviews for patients younger than 18 years should be 12 months*" based on evidence that the rate of progression of dental caries can be more rapid in children and adolescents than in older people, and seems to be faster in primary teeth than in permanent teeth.[33] **4**

Recommendation

➢ ***Recall of high caries risk children should be based on the clinician's assessment of the child's caries risk status using the Caries Risk Assessment Checklist, and should not exceed 12 months***	**D**

3. Identifying high caries risk populations

National[4] and regional surveys[6–10] have shown that the prevalence and severity of caries varies considerably across Ireland, and that children living in non-fluoridated areas have significantly higher caries levels than children living in fluoridated areas. Thus, at national and regional level, non-fluoridated areas present an obvious target for preventive strategies. However, caries levels also vary at local level[11,12], and these small area variations are of particular relevance to those directly involved in planning and delivering services. The collection of oral health epidemiological data at small area level (e.g. the clinical catchment area of a dental clinic) is one way of identifying the dental health needs of a population to inform the planning and targeting of services. However, oral health surveys at small area level have rarely been conducted in Ireland.[11,12,41] In other countries, standardised data collection from school dental services has been used as an alternative way of monitoring oral health trends over time at national, regional and local levels.[42] **3**

The introduction of electronic patient records in the public dental service in Ireland will allow for the collection and analysis of data on oral health status at small area level. This should be exploited for further investigations of differences in caries risk across areas.

Recommendation

- ***An agreed set of oral health indicators for the planning, targeting and evaluation of dental services should be developed. Methods of measurement and reporting of these indicators need to be decided*** **GPP**
- ***Data should be collected at local level, but standardised and co-ordinated nationally*** **GPP**
- ***Electronic patient record systems should be designed to produce small area data on the agreed oral health indicators for children*** **GPP**

Public dental services for children are closely linked to schools, and the characteristics of Irish schools have been used as a means of identifying groups of children who are likely to be high caries risk. An Irish cross sectional study found that the prevalence and severity of dental caries was higher among 5-year-old children attending the most disadvantaged schools in the Dublin area compared to 5-year-olds attending schools that were less disadvantaged (mean dmft: 1.80 vs 1.11; prevalence: 51% vs 37%).[43] In another cross sectional survey, Irish children attending disadvantaged (DEIS) schools were found to be less likely to report positive health and more likely to consume sweets and soft drinks on a daily basis, compared to children in matched schools.[44] **3**

Because dental caries is strongly associated with deprivation, area based deprivation indices – which are based on census data – have been developed to categorise subgroups of the population which are likely to have greater health needs, and thereby lead to more appropriate allocation of resources.

Studies from the UK have shown that area based indices can generally predict areas with high caries levels[45,46] but there are limitations in their application. They do not appear to be reliable in rural areas[47], and although large differences in caries prevalence can be detected between deprived and affluent areas, the decline in caries prevalence from top to bottom of the ranking is gradual, with no obvious division between deprived and affluent areas.[48,49] This means that any area based targeting will inevitably include some children who are not high risk and will miss some who are.

An Irish deprivation index developed by the Small Area Health Research Unit (SAHRU) has been shown in two studies to have some potential for identifying sub-areas in Dublin with high caries levels.[50,51] Outside the Dublin area, deprivation was not well correlated with dental caries in primary or permanent teeth.[50] The authors of both studies concluded that further research was needed on the use of area based indices as a tool for targeting resources. **3**

Two relatively recent developments in the spatial presentation of health data are Health Atlas Ireland and the All Ireland Health and Well-being Data Set (AIHWDAS). Both systems use existing health information to map the distribution of health conditions (Health Atlas), or to allow comparison of indicators from different indicator sets to obtain more comprehensive profiles of a particular area (AIHWDAS). The use of these area based information systems to improve planning and targeting of dental services should be explored.

Recommendation

➢ ***The use of Health Atlas Ireland and the All Ireland Health and Well-being Data Set (AIHWDAS) should be explored as a means of using area based information and demographics to identify populations in small geographic areas who are likely to have high caries levels***	**GPP**

4. Preventive strategies

Summary of evidence

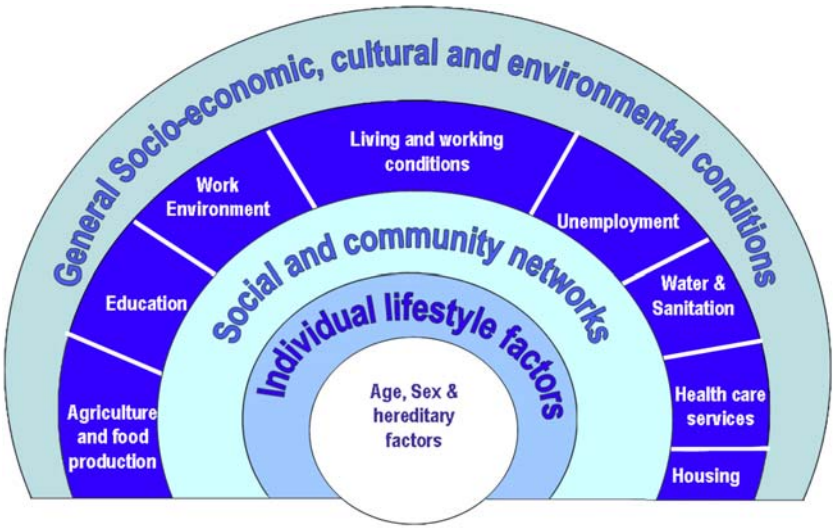
- We found no trials of dietary interventions, other than those involving sugar substitutes, that measured effect using caries as an outcome.
- Evidence for a caries-preventive effect of xylitol and sorbitol is inconclusive.[70,72–75]
- Trained non-dental personnel can effectively deliver oral health education.[57,115,116,117] **1+**
- The quality of evidence supporting the effectiveness of oral health education at preventing early childhood caries (ECC) is generally poor and the results are conflicting. However, there is a tendency for early and repeated contact with mothers, particularly in a non-clinic setting, and commencing before children are 2 years of age, to be an important element in educational programmes to prevent caries in young children.
- School-based oral health education alone has no impact on caries levels.[109,120,121] **2+**
- Topical fluorides are effective at preventing caries. A series of Cochrane systematic reviews found that topical fluorides (varnish, gel, mouthrinse and toothpaste), used either individually[77-80] or in combination[81], significantly reduced caries in children and adolescents compared to placebo or no treatment. No topical fluoride modality was found to be superior to another in head-to-head comparisons.[82] **1++**
- Fissure sealants are effective at preventing caries. A Cochrane systematic review of the caries-preventive effect of fissure sealants found that sealed permanent molar teeth had over 50% less caries than unsealed teeth after 4.5 years.[122] **1++**
- There is evidence to suggest that preventive programmes involving the use of fluoride or fissure sealants in combination with other interventions, are effective at preventing caries in children.[125,126,127] **1+**
- Evidence for a caries-preventive effect of chlorhexidine mouthrinse, gel or varnish is inconclusive.[125,129,130–132]
- Evidence for a caries-preventive effect of the remineralising product casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) is insufficient.

4.1. Introduction

Strategies to prevent dental caries can be targeted at the whole population, at subgroups of the population (e.g. geographic targeting or directed population targeting) or at specific individuals (e.g. those at high risk). In practice, a mixture of the three approaches is required to reduce caries, with individual care and geographic targeting built on a base of population preventive strategies.[52]

The principles of oral health promotion – defined as '*the process of enabling people to increase control over and to improve their health*' – should inform any preventive strategy that is implemented. Health promotion involves actions aimed at the determinants of health, many of which are outside the control of the individual (Figure 4.1). With the exception of water fluoridation, most caries preventive strategies operate at the individual lifestyle level. Despite increasing focus on the social and community level, initiatives relating to the use of legislative, fiscal and social measures as a means to improve oral health remain underutilised.

Figure 4.1 Determinants of Health. Taken from: Dalhgren and Whitehead, 1991[53]



4.1.1. The common risk factor approach

An overarching concept within health promotion is the common risk factor approach, which recognises that a range of chronic conditions and diseases have one or more risk factors or indicators in common.[54] Diet, the main risk factor for dental caries, is also a risk factor for obesity, heart disease, diabetes and some cancers. By directing action towards common risk factors and their underlying social determinants, improvements in a range of chronic conditions should be achieved more efficiently and effectively.[55,56] The common risk factor approach to managing and preventing oral disease is strongly advocated by the World Health Organisation as part of its Global Oral Health Programme.[56] **4**

As yet, there is only limited evidence that a common risk factor approach can reduce dental caries. A randomised trial from Brazil that was part of a larger study designed to assess the impact on children's feeding and general health of home visits to educate new mothers on breastfeeding and weaning, found that caries levels in the children at age 1 year were significantly lower in the intervention group compared to the control group.[57] **1+**

Recommendation

- ***Oral health messages should be incorporated into relevant general health promotion interventions for children and adolescents as part of a common risk factor approach to improving oral health*** **D**

4.2. Diet

The evidence that frequent consumption of food and drinks containing fermentable carbohydrates (sugars) is associated with dental caries is overwhelming.[58–63] However, the relationship between dietary factors and caries is far from straightforward, particularly in the current environment where fluoride exposure is widespread.[64]

Dietary guidelines in Ireland are currently based on the food pyramid, which is designed to help people to eat a balanced diet combining several different types of food in the correct amounts. A major concern in the Irish diet is the overconsumption of foods high in sugar and fats, which is a risk factor not just for caries but also for diabetes and heart disease. Irish adults consume more than twice the recommended daily intake of these types of food (7.3 servings/day compared to the current recommendation of less than 3 servings/day).[65] The increase in prevalence of obesity and diabetes in Irish children and adults clearly indicates that, from a general and oral health perspective, dietary habits need to be tackled at population level. The first National Nutrition Policy, which is due to be published in 2009, will be important in providing a framework for dietary change in Ireland. The National Nutrition Policy and healthy eating guidelines will be available on the website of the Department of Health and Children: www.dohc.ie.

Recommendation

➢ ***Oral health education to parents/carers, children and adolescents should encourage healthy eating, in line with national dietary guidelines***	**D**

Dietary habits are established early in life. A systematic review of risk factors for caries in children under the age of 6 identified 29 dietary factors, most of which related to the consumption of sugar – either its amount, frequency or timing of consumption – that were significantly associated with early childhood caries. **2+**

While there is still some uncertainty about the relative importance of frequency of intake of sugars versus total sugars consumption in contemporary populations[66], it seems likely that both factors are important for caries development[58], and therefore it is reasonable to encourage a reduction in both the frequency and total amount of sugars ingested for children of all ages.

Recommendation

➢ ***Parents/carers should be encouraged to limit their child's consumption of sugar-containing foods and drinks, and when possible, to confine their consumption to mealtimes***	**D**
➢ ***Children and adolescents should be encouraged to limit their consumption of sugar-containing foods and drinks, and when possible, to confine their consumption to mealtimes***	**D**

Cross sectional surveys from Ireland have identified a number of indicators related to baby bottle use that were significantly associated with increased caries levels at age 5 years. These include: taking a baby bottle to bed[67], drinking juice from a baby bottle[12] and weaning from the baby bottle after 2 years of age.[12] **3**

However, a systematic review found that the duration of bottle use was not significantly related to caries risk, but that the content of the bottle was important. Milk with sugar added, or juice given in the bottle increased the risk of caries.[62] **2+**

Recommendation

- ***Parents and carers of children who use a baby bottle should be advised never to put sweet drinks, including fruit juice, into the bottle*** **C**
- ***Parents and carers should be advised not to let their child sleep or nap with a baby bottle or feeder cup*** **GPP**

4.2.1. Sugar Substitutes

We found no experimental trials of dietary interventions, other than those involving sugar substitutes that used caries as an outcome.

Non-cariogenic sweeteners are increasingly used to replace sugar in foods, drinks and medicines. They can be divided into two categories: intense sweeteners, such as saccharin, acesulfame-K and aspartame; and bulk sweeteners, such as xylitol and sorbitol. They cannot be fermented by microorganisms to any great extent and so are considered non-cariogenic. It has been suggested that xylitol may have an anti-cariogenic effect by reducing the levels of mutans streptococci in the mouth.[68] However, the existence of an anti-cariogenic effect for xylitol remains controversial.[69]

One systematic review of dietary factors in the prevention of caries found that the evidence for a caries-preventive effect for xylitol and sorbitol was inconclusive due to the inconsistent findings of the best quality trials included in the review.[70] All five studies used chewing gum as the vehicle for the sugar substitute. In the one study that used a control chewing gum, the xylitol gum and the control gum produced similar reductions in caries (35% vs 33%), which indicated that the effect of chewing sugar free gum may be related to the chewing process itself rather than being an effect of the gum sweeteners or additives.[71] Based on the small number of studies and the inconsistent findings, the systematic review judged the evidence on the effectiveness of xylitol and sorbitol to be inconclusive.

Subsequent publications[72–75] are generally of poor quality and do not provide sufficient evidence to alter the conclusion of the systematic review.

The longterm use of sugar-containing medicines has been associated with increased caries levels.[76] Sugar free formulations of medicines have become more widely available in response to concern about the cariogenic potential of sugar-containing medicine.

The Guideline Development Group members recognised that sugar-free products were preferable to sugar-containing products for dental health, but were concerned that, given the high intake of sweet foods and drinks by Irish children, direct substitution of sugar-containing products for sugar-free products would do little to improve overall dietary habits. These concerns, coupled with the inconclusive evidence of a caries-preventive effect of xylitol and sorbitol, were considered by the Guideline Development Group in making its recommendation on the use of sugar substitutes.

Recommendation

- ***Parents/carers and children should be advised that foods and drinks containing sugar substitutes are available, but should be consumed in moderation*** **D**
- ***Sugar free medicines should be used, when available*** **D**

4.3. Topical Fluorides

Fluoride has been at the forefront of caries prevention for over 60 years. A series of Cochrane systematic reviews found that topical fluorides (varnish, gel, mouthrinse and toothpaste), used either individually[77-80] or in combination[81], significantly reduced caries in children and adolescents compared to placebo or no treatment. No topical fluoride modality was found to be superior to another in head-to-head comparisons.[82] **1++**

4.3.1. Fluoride toothpaste

Fluoride toothpaste is the most widely used form of topical fluoride throughout the world. In Ireland, 95% of toothpastes contain fluoride.[83] It has been suggested that toothbrushing with fluoride toothpaste is close to an ideal public health method in that its use is convenient, inexpensive, culturally approved and widespread.[52] However, as with all self-administered interventions, it requires compliance to achieve optimum results.

Systematic reviews of the effectiveness of fluoride toothpaste at preventing dental caries in children and adolescents have found that:

- Fluoride toothpaste is effective at preventing caries in children and adolescents.[80,84] **1++**
- Brushing twice a day is more effective than brushing once a day.[80] **1+**
- Toothpaste containing 1,500 ppm F is more effective than standard 1,000/1,100 ppm F toothpaste at preventing caries in permanent teeth.[84] **1+**
- Toothpaste containing 1,000 ppm F is more effective than toothpaste containing 250 ppm F at preventing caries in permanent teeth.[85,86] **1+**

Low fluoride toothpastes, containing less than 600 ppm F have been introduced specifically for young children who, because of their inability to spit, tend to swallow most of the toothpaste placed on the

brush.[87,88] Evidence of the effectiveness of low fluoride toothpaste (containing less than 600 ppm F) at preventing caries in primary teeth is insufficient, as it is limited to three randomised controlled trials which differ in quality, design, populations studied and results.[89-91]

Evidence that early use of fluoride toothpaste prevents caries is limited, and the definition of what constitutes "early" varies, making it difficult to draw any conclusions. Irish cross sectional studies have found that commencing tooth brushing before 12 months of age is significantly associated with lower caries levels in the primary teeth at age 5[12] and at age 8[4], after controlling for water fluoridation and medical card status. Creedon and O'Mullane[67] found that children who started brushing after 24 months had significantly higher levels of caries at age 5 than those who started brushing before that age. A cross sectional study of 4,468 7-year-old Flemish children showed a significant odds ratio of 1.22 (95% CI, 1.14–1.30) for an increased risk of caries when age at start of toothbrushing increased by one year. The probability of remaining caries free at age 7 for children who started brushing before the age of 3 was 46%, compared to 36% for children starting after the age of 3.[92] **3**

Rinsing with a large volume of water after brushing can reduce the caries-preventive effect of fluoride toothpaste. Two randomised trials found that children who rinsed with a large volume of water had higher caries increments than those using smaller volumes[93,94] **1+**

An Irish cross sectional study also found that caries levels were significantly higher for 15-year-olds who used a glass of water for rinsing after brushing compared to those who used another method for rinsing (p=0.006).[4] **3**

4.3.1.1. Fluoride toothpaste and fluorosis risk

Age of commencing toothbrushing

Fluorosis is a disturbance in enamel formation which occurs when excess fluoride is ingested during tooth development. The severity of fluorosis is related to the timing, duration of exposure and dose of fluoride ingested from all sources.[95] The use of fluoride toothpaste, particularly during the first 2 years of life has been associated with an increased risk of fluorosis.[96,97] **2+**

Fluoride concentration of toothpaste

The fluoride concentration of toothpaste has been associated with fluorosis. Follow-up of children in a non-fluoridated, high caries area of northwest England, who had participated in a randomised trial involving the postal distribution of toothpaste containing 440 ppm F or 1,450 ppm F from age 12 months to age 5–6 years, found that, overall, the prevalence of more severe fluorosis (TF≥2 and TF≥3) was significantly higher at age 9–10 among children who had received the 1,450 ppm F toothpaste compared to those who had received 440 ppm F toothpaste (7% vs 2% for TF≥2, and 2% vs 0.2% for TF≥3).[98] **2+**

Amount of toothpaste

There is limited evidence from observational studies that the amount of toothpaste used is a contributing factor to fluorosis risk with the use of toothpaste. A small observational study with 10 children found that salivary fluoride levels were significantly lower in children when they used 0.25 g of fluoride toothpaste compared with when they used 1 g of the same toothpaste. The researchers concluded that reducing the amount of toothpaste rather than the concentration of fluoride in the toothpaste might be the most efficient way to increase efficacy while decreasing the risk of fluorosis.[99] **3**

A “pea-size” amount of fluoride toothpaste is widely accepted as the recommended amount of toothpaste to be used by young children to reduce excessive ingestion. Figure 4.2 demonstrates a small pea-size amount of toothpaste (0.25g) on a child-size brush and a standard toothbrush. A “smear” of toothpaste has also been recommended for children under 2 or 3 years of age when brushing with toothpaste containing at least 1,000 ppm F.[100,101] **4**

Figure 4.2: Pea size amount of toothpaste (0.25g) on a child-size toothbrush and on a standard size brush

Supervision

It is accepted that young children (under the age of 7) should be supervised by an adult when brushing, to ensure that the correct amount of toothpaste is dispensed, to discourage the child from swallowing the toothpaste and also to ensure that the teeth are cleaned correctly. We found no studies that tested the effect of parental supervision of home brushing. Two systematic reviews found that supervised toothbrushing in a school setting is more effective than unsupervised toothbrushing at preventing caries[80,84], which suggests that the element of supervision ensures greater compliance. **1+**

It is reasonable to assume that supervising toothbrushing at home should have a similar effect.

4.3.1.2. Fluoride toothpaste and the risk/benefit balance

Assessment of the fluorosis/caries balance for a population must be based on that population's fluoride exposure profile, oral health status and socio-economic status. Most Irish children are exposed to two sources of fluoride: fluoridated water – which reaches 71% of the population[83] – and fluoride toothpaste. The prevalence of fluorosis in the permanent teeth of Irish children and adolescents has increased in both fluoridated and non-fluoridated areas between 1984 and 2002, while levels of caries have fallen in the same time period. The prevalence of fluorosis was significantly higher in fluoridated areas, which is not unexpected as a certain degree of fluorosis is an inevitable consequence of water fluoridation. Most of the fluorosis experienced was categorised as 'Questionable' or 'Very Mild'.[4]

In 2002, the Forum on Fluoridation recommended lowering of the fluoride level in water in Ireland from 0.8–1.0 ppm to 0.6–0.8 ppm as part of a strategy to bring about "*meaningful reductions in dental decay while reducing the risk of developing fluorosis*".[83] Levels of fluoride in the water were reduced in 2007.[102] Recommendations on the use of fluoride toothpaste were also issued, as an additional measure to minimise the risk of fluorosis. These recommendations were updated by the Expert Body on Fluorides and Health in 2008[103] and were considered by the Guideline Development Group.

After discussion of the risk/benefit balance of early use of fluoride toothpaste and the conflicting evidence on the effectiveness of low fluoride toothpaste at preventing caries in preschool children, the Guideline Development Group concluded that there is insufficient evidence to support the use of low fluoride toothpaste for caries prevention in young children and supported the recommendation of the Expert Body on Fluorides and Health that professional advice on the use of fluoride toothpaste should be considered when a child below 2 years of age is assessed as being at high caries risk.

The Guideline Development Group made slight modifications to the recommendations of the Expert Body, specifically regarding the timing of toothbrushing, and spitting out and not rinsing after brushing.

Recommendation

Under 2 years of age: At Risk children

- ***Parents/carers should be encouraged to brush their child's teeth as soon as the first tooth appears, using a soft toothbrush and water only*** **D**

Under 2 years of age: High Caries Risk children

- ***Parents/carers of children who are assessed as being at high caries risk should be encouraged to brush their child's teeth:***
  - ***with fluoride toothpaste containing at least 1,000 ppm F*** **A**
  - ***twice a day*** **B**
  - ***at bedtime and one other time during the day*** **GPP**
  - ***using a small pea size amount of toothpaste*** **D**

Age 2 years and over

➢ ***All children should be encouraged to brush their teeth:***	
➢ ***with fluoride toothpaste containing at least 1,000 ppm F***	**A**
➢ ***twice a day***	**B**
➢ ***at bedtime and one other time during the day***	**GPP**
➢ ***using a small pea size amount of toothpaste (up to age 7)****	**D**
➢ ***Children under the age of 7 should be supervised by an adult when brushing their teeth***	**B**
➢ ***Children should spit out toothpaste and not rinse after brushing***	**B**

***** *Over the age of 7, the risk of ingesting toothpaste is greatly reduced, and a pea size amount or more of toothpaste can be used.*

4.3.2. Professionally applied topical fluorides

A guideline on the use of topical fluorides for caries prevention in Irish children and adolescents has been developed for the public dental service and contains recommendations on the use of professionally applied topical fluorides (varnish, gel, foam, slow-release fluoride devices).[104] A summary of the evidence and the recommendations on the use of fluoride varnish and gel is presented here. The full list of recommendations on the use of professionally applied topical fluorides is reproduced in Appendix 1.

4.3.2.1. Fluoride varnish and gel

A Cochrane systematic review of seven trials of the effect of fluoride varnish at preventing caries reported an average reduction in caries increment of 46% (95% CI, 30–63%; p<0.0001) in permanent teeth and 33% (95% CI, 19–48%; p<0.0001) in primary teeth. This was based on a comparison of the use of varnish two or four times a year, compared to placebo or no treatment.[77] A subsequent systematic review[105] and a randomised trial[106], both of which looked at the effectiveness of fluoride varnish at preventing caries in preschool children, supported the efficacy of fluoride varnish at preventing caries in the primary dentition. **1++**

A Cochrane systematic review involving 14 placebo-controlled trials reported an average reduction in caries of 21% (95% CI 14-28%), p<0.0001) with the use of fluoride gel.[78] **1++**

Although the evidence of the comparative effectiveness of fluoride varnish and gel was inconclusive[82], two observational studies have reported that fluoride varnish is easier to apply, and has greater patient acceptability.[107,108] **3**

Recommendation

➢ ***Fluoride varnish should be used in preference to fluoride gel for caries prevention in children who are assessed as being at high caries risk***	**D**
Age 1– 7 years	
➢ ***Resin-based fluoride varnish application (22,600 ppm F) should be offered to children who are assessed as being at high caries risk, at intervals of 6 months or 3 months***	**A**
➢ ***Fluoride gel should not be used in children under the age of 7***	**GPP**
Age 7– 15 years	
➢ ***Fluoride varnish application (at least 22,600 ppm F) should be offered to children who are assessed as being at high caries risk, at intervals of 6 months or 3 months***	**A**
➢ ***Where operator or patient preference dictates the use of fluoride gel rather than fluoride varnish, gel application should be offered at 6 month intervals***	**A**

4.3.3. Use of topical fluorides in community-based programmes

The use of topical fluorides in community-based programmes is an example of a targeted population preventive strategy, which brings the caries-preventive benefits of fluoride to high caries risk groups or populations, such as those described in section 3. The topical fluoride guideline[104] covers community-based programmes involving the use of fluoride varnish, toothpaste and mouthrinse. A summary of recommendations can be found in Appendix 1. The full topical fluoride guideline can be accessed at http://ohsrc.ucc.ie .

4.4. Oral Health Education

Oral health education can operate at a community level or as part of individual patient care. The focus of oral health education is primarily to encourage a reduction in the consumption of sugars (fermentable carbohydrate) and to promote the effective use of fluoride toothpaste. Several systematic reviews have concluded that oral health education (OHE) is effective at increasing knowledge levels.[109–112] However increases in knowledge are short lived[111] and likely to fade over time.[112] There is disagreement as to whether changes in knowledge result in changes in behaviour. One systematic review[112] concluded that more innovative approaches to OHE have potential to lead to behaviour change, whereas another review[109] concluded that "*the balance of evidence is that the case for a causal relationship between knowledge and behaviour is 'not proven'*". However, the reviewers added that there was an ethical responsibility to disseminate scientific knowledge to the public. **2+**

4.4.1. Preschool children

Early intervention is crucial for caries prevention in young children. Dietary and oral hygiene habits are established early in life and, once established, can be difficult to change.[113] It is essential that all

parents receive accurate, consistent and age-appropriate information about promoting good oral health for their child during these crucial early years.

Evidence for the effectiveness of oral health education at a young age is generally of low quality, often due to weaknesses in the design of the studies, and the results are inconsistent. However, there is a tendency for early and repeated contact with mothers, particularly in a non-clinic setting, which commenced before children are 2 years of age, to be an important element in educational programmes aimed at preventing caries young children. Many of the studies used trained non-dental personnel to effectively deliver these programmes.

A randomised trial from a fluoridated, low income area of Brazil, used trained fieldworkers to give advice about healthy breastfeeding and weaning to new mothers at 10 home visits within the first year of their child's life. When the children were 1 year old, those whose mothers had received the intervention had significantly less decay compared to those in the control group (mean dt: 0.37 vs 0.63, p=0.03). The prevalence of caries was also lower in the intervention group (10% vs 18%).[57] **1+**

A controlled trial from Canada found that motivational interviewing delivered by trained South Asian women, with regular follow-up contact to encourage maintenance of good health practices, resulted in an average reduction in caries of 54% among children of South Asian mothers who had received the intervention, compared to those who received oral health education in the form of a pamphlet and video (mean dmfs 3.52 vs 7.59, p=0.001). Motivational interviewing is a patient-centred, personalised form of counselling and children in this group had, on average, more fluoride applications during the 2 years of the trial than the control group (mean no. of varnish applications 3.8 vs 0.25, p=0.001), which suggested that the intervention was effective at promoting dental attendance for varnish application.[115] **1+**

A controlled trial which used two trained oral health educators (one dental, one non-dental) to deliver different models of dental health education (DHE) to mothers, starting when the children were 8 months old and continuing at specified intervals for 3 years, found that the prevalence of caries among children in the intervention groups was substantially lower than that of the comparison group, which received no intervention (1% vs 33%). Caries levels were also significantly lower in the intervention groups (mean dmfs: 0.29 vs 1.75, p<0.001). No difference in effect was found between the groups who received 3-monthly visits and the group that received annual visits.[116] **2+**

A more recent randomised trial from the UK found no significant difference in caries levels at age 3 years in children whose mothers had received structured oral health education from a specially trained health visitor during the child's 8 month and 20 month developmental checks, compared to children whose mothers had received the usual level of advice from health visitors in the area (mean dmfs: 2.03 (95% CI 1.39–2.67) in the test group vs 2.19 (95% CI 1.41–2.97) in the control group). It was suggested that cross-contamination between the two groups might have obscured any true difference between the two strategies.[117] **1+**

A cluster randomised trial conducted in two matched Primary Care Trusts in Manchester[118] combined DHE delivered by health visitors or practice nurses, at the child's 8 month developmental check and their MMR vaccination at 12–15 months, with provision of a feeder cup (at 8 months) and a toothbrush

and fluoride toothpaste (1,450 ppm F) at age 12–15 months, and every 6 months thereafter up to age 32 months. When the children were 5 years old, the prevalence and severity of caries in children who had participated in the intervention in the test area was significantly less than "participants" in the control area (i.e. children that would have been eligible to participate, if the intervention had been available): prevalence: 54% vs 64%, p=0.03; mean dmft: 2.23 vs 3.72, p=0.0001; percentage with nursing caries: 20% vs 32%, p=0.002. However, a high level of population mobility in the test area meant that after 5 years, only 53% of the 5-year-olds in the test area had participated in the programme. The impact of non-participation in a deprived urban area with high levels of population mobility was sufficient to dilute the impact of the intervention such that few benefits were discernable at a population level.[118] **1-**

The Guideline Development Group considered that an intervention similar to that used in the Manchester trial, which timed DHE interactions to coincide with the child's 8 month developmental check and 15 month MMR vaccination[118] could potentially have a greater effect in an Irish setting, where population mobility is likely to be less than in the UK.

Recommendation

- ***Oral health education and diet advice should be incorporated into each child's developmental visits from age 8 months and at any appropriate opportunity that arises*** **D**

4.4.2. School aged children

Most oral health promotion interventions for school-aged children in Ireland tend to be school-based and educational.[119] These interventions may be targeted at certain disadvantaged or special needs groups, but most activity takes place in mainstream schools. Our situation analysis for this guideline found that over half of all dental areas provided school-based dental health education (DHE), involving over 40,000 children in 614 primary schools.

A systematic review found that there was no evidence of effectiveness of educative programmes aimed at reducing caries, if they did not involve the use of fluoride agents.[109] **2+**

We identified two studies, one from China[120] and one from Flanders[121], that assessed the effects of school-based oral health education on caries. Both studies found no significant effect of school-based oral health education on caries levels. **2+**

The Guideline Development Group considered that the public dental service had an ethical responsibility to provide oral health education to children, but that this could be effectively delivered by teachers as part of the Social and Personal Health Education (SPHE) programme of the school curriculum. This approach would allow oral health promotion personnel to work in partnership with other disciplines and in other settings to develop interventions with potentially greater impacts on oral health than purely educational oral health programmes.

Recommendation

- ***Oral health education should be incorporated into the Social and Personal Health Education (SPHE) programme of the school curriculum*** **D**

4.5. Fissure sealants

Fissure sealants are applied to the grooves and pits of teeth, usually molars, to create an impervious barrier between the tooth surface and the oral environment, thereby preventing dental caries. A Cochrane systematic review of 16 trials found that first permanent molar teeth sealed with resin-based sealant had 78% less caries on occlusal surfaces after 2 years and 60% less after 4–4.5 years compared to unsealed molars. Evidence of the caries-preventive effect of resin-based sealants versus other types of sealant (mainly glass ionomer) was inconclusive.[122] The authors of the review concluded that the effectiveness of sealants was obvious for children at high caries risk, but that information was lacking on the effectiveness of sealants at different levels of caries risk. **1++**

A systematic review on sealant effectiveness[123] found that the effect of sealants was affected by sealant replacement, with relatively high reductions in caries risk seen in studies in which a sealant replacement strategy had been used. **1+**

Sealant retention is critical to its effectiveness and sealant retention rather than caries has become the principal outcome measure of sealant effectiveness. The Cochrane systematic review reported widely varying complete sealant retention rates for the studies it included. These ranged from 79% to 92% at 12 months, 71% to 85% at 24 months, 61% to 80% at 36 months, 52% at 48 months, 72% at 54 months and 39% at 9 years.[122]

Recommendation

- ***Children who are assessed as being at high caries risk should have resin-based fissure sealant applied and maintained in vulnerable pits and fissures of permanent teeth*** **A**

4.6. Combinations of caries preventive interventions

A systematic review by Axelsson et al. concluded that there was moderate evidence that combinations of treatments involving fluoride had a caries preventive effect on children and adolescents, but were unable to draw any conclusions about the effect of combined treatments specifically in high caries risk children because the evidence was conflicting.[124] Another review of combined interventions to prevent caries in high risk children concluded that the evidence was insufficient, but suggestive of efficacy.[125]

A subsequent randomised trial which provided an intensive preventive regimen involving interactive counselling, intensive oral hygiene instruction, fluoride lozenges, xylitol lozenges, fluoride varnish, chlorhexidine varnish and distribution of toothpaste containing 1,500 ppm fluoride and 10% xylitol to high caries risk Finnish children aged 11–12 years, found a 44% reduction in caries after 3 years in

the intervention group compared to the comparison group, which received the standard available dental care. The DMFS increments for the test and comparison groups were 2.56 (95% CI 2.07–3.05) and 4.60 (95% CI 3.99–5.21), respectively (p<0.0001).[126] **1+**

A cluster randomised trial from Australia involving high caries risk children aged 12–13 years attending disadvantaged schools, found that a comprehensive school-based preventive dental programme which included a combination of fissure sealants and weekly 0.2% sodium fluoride mouthrinse, resulted in a significantly lower caries increment in the intervention group compared to the control group, which received an annual dental examination and an annual oral hygiene education programme.[127] **1+**

Studies involving combinations of preventive interventions differ in the precise combinations of interventions used and also in the extent to which the control group is exposed to preventive measures, which makes interpretation of the results of these studies difficult. There is a tendency for combination interventions involving either fluoride or fissure sealants or both, to show a benefit, particularly when the comparison group receives limited preventive services.

Recommendation

- ***Preventive programmes comprising combinations of interventions that include fluoride or fissure sealants should be considered for high caries risk children*** **A**

4.7. Chlorhexidine

Dental caries is an infectious disease of bacterial origin. Therefore, it seems rational to use an antimicrobial approach to prevent and control dental caries. Chlorhexidine is an antimicrobial agent that has been studied extensively over the last 30 years for its ability to suppress the levels of mutans streptococci in the mouth and for its potential to prevent and control dental caries. It is used in a variety of formulations and vehicles, such as varnish, gel, mouthrinse and toothpaste (Table 4.1). Chlorhexidine varnish was developed to prolong the contact of the chlorhexidine with the dentition to provide sustained release of the antimicrobial agent.[128]

Table 4.1: Product name and chlorhexidine (CHX) concentration of a selection of chlorhexidine vehicles

CHX Vehicle	Product name	CHX concentration
Varnish	EC40 (Biodent)	40%
	BioC (Biodent)	20%
	Chlorzoin (Oralife)	10%
	Cervitec Plus (Ivoclar-Vivadent)	1%
Gel	Cervitec	0.2%*
	Corsodyl (GSK)	1%w/w
Mouthrinse	Corsodyl (GSK)	0.2%w/v

*900 ppm F

There are several systematic reviews on the effectiveness of chlorhexidine mouthrinse, gel, toothpaste and varnish for caries prevention in permanent teeth[125,129–132], but their conclusions are inconsistent,

reflecting differences in the inclusion criteria used and the varying quality and conflicting results of the included trials.

Trials published after the most recent systematic review[132] failed to demonstrate a caries preventive effect for chlorhexidine varnish application in permanent teeth.[133,134] **1+**

Evidence for the effectiveness of chlorhexidine for caries prevention in preschool children is very limited. One high quality randomised trial from China[135] reported a 37.3% reduction in caries increment (p=0.036) in primary molars over two years, with biannual application of chlorhexidine varnish. However, the children had very low exposure to fluoride, which raises questions about the applicability of these findings for Irish children. **1+**

We identified three additional trials involving chlorhexidine varnish[136] or gel[137,138] for caries prevention in primary teeth, but these trials were of poor quality and had conflicting results.

- ***The use of chlorhexidine for caries prevention is not recommended*** **D**

4.8. Remineralising products

With the increasing focus on early detection and non-invasive management of caries, researchers have been testing new methods to enhance the remineralisation of enamel. Recent developments in the area of remineralisation include casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) nanocomplexes, which are derived from bovine milk protein, casein, and calcium and phosphate. The suggested mechanism of action for CPP-ACP is the localisation of calcium and phosphate ions in plaque, which provides a reservoir of soluble calcium phosphate ions to promote remineralisation.[139] An alkaline, stable and highly soluble CPP-ACP has been trademarked as Recaldent™. It has been commercialised in sugar-free gum and mints and in dental products (e.g. Tooth Mousse™).

Much of the research on the anti-cariogenic effect of CPP-ACP has been carried out using animal or laboratory-based studies or “in situ” trials using human volunteers, who wear removable appliances containing blocks of artificially demineralised enamel. These appliances are worn while the product under investigation is being used, and are usually removed and stored until the next exposure to the product. Thus the testing method does not replicate real life conditions. The enamel blocks are removed from the appliance at the end of the trial period and analysed for mineral content and remineralisation.

A systematic review of the clinical efficacy of casein derivatives, which included 10 trials relating to remineralisation (8 of which were “in situ”), concluded that there is insufficient good quality clinical evidence to make a recommendation regarding the long-term effectiveness of casein derivatives for preventing caries in vivo.[140]

A randomised trial published since the review tested the effect of two sugar-free gums – one containing CPP-ACP and the other containing sorbitol – on approximal caries progression in 1,820 low caries Australian adolescents.[141] Caries progression was measured radiographically. At the end of the trial, 5.4% of approximal surfaces had experienced caries progression in the CPP-ACP group compared to 6.5% in the sorbitol group. The absolute difference in the proportion of approximal surfaces experiencing caries progression was 1.1% and the prevented fraction was 17%. However, given the small absolute difference in approximal caries progression between the two groups and the absence of data on caries progression in other tooth surfaces, the clinical significance of the results of this trial are uncertain. **1+**

- ***There is insufficient evidence on which to base a recommendation on the use of remineralising products (CPP-ACP) for caries prevention***

5. Implementation and Audit

A new national oral health policy has been commissioned by the Minister for Health, and its publication is awaited. Many of the recommendations in this guideline address issues that the oral health policy planned to examine, such as the integration of oral health in the wider health care and education systems, and developing working partnerships within primary care to enhance oral health care for children. The guideline takes both a population and an individual approach to caries prevention, which is consistent with the Health Service Executive's (HSE) population health strategy.[142] Therefore, the implementation of the guideline should be supported at strategic and operational level.

The focus of the guideline is on the early identification of high caries risk children. This represents a major shift in focus for the public dental service, which up to now has concentrated on providing dental care for school-aged children. This reorientation towards younger target groups requires greater collaboration with members of the primary care team as well as development of oral health education resources that are concise, consistent and can be confidently delivered by non-dental primary health care professionals. Examples of such collaboration already exist in the HSE: The Child Health Information Service Project (CHISP) has incorporated age-appropriate oral health messages into its 3-part information pack for parents, and Shared Learning is a pilot project evaluating the effect of early assessment and referral of children with special care needs. The resources developed for these programmes could be adapted or updated for wider use.

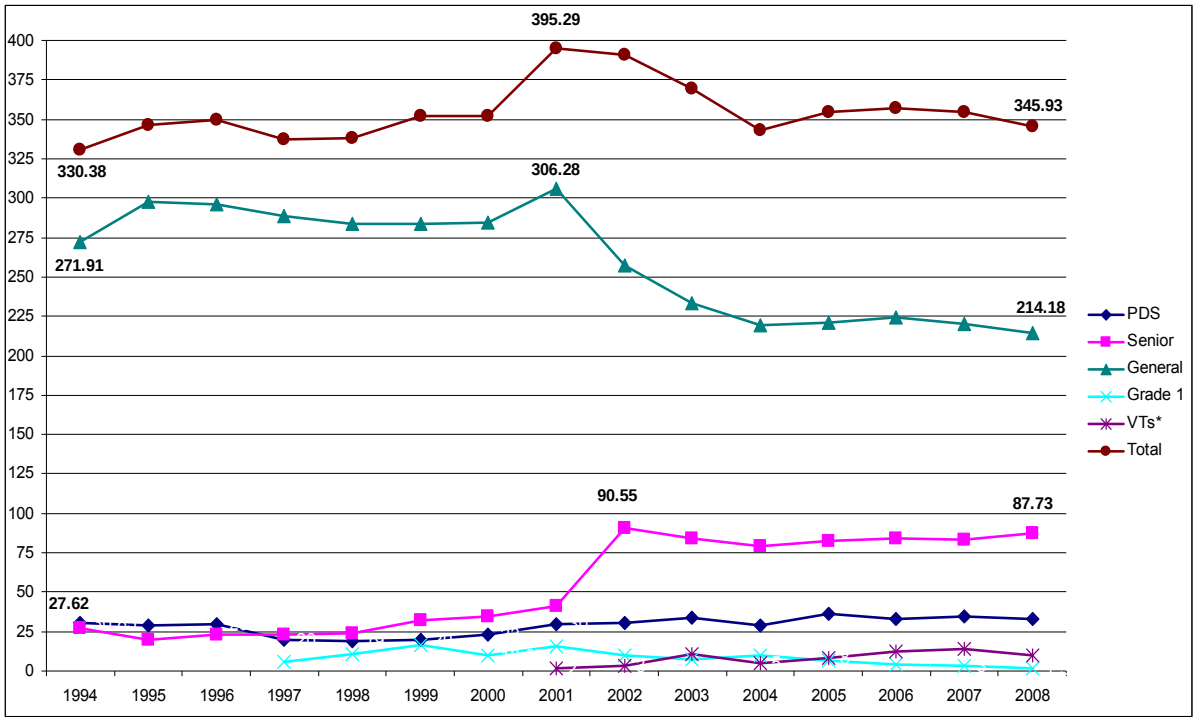
5.1. Resource implications and barriers to implementation

The introduction of employment ceilings to all service units within the HSE from 2006 onwards, and further restrictions on recruitment in 2009 represent the greatest organisational barrier to implementation of the guideline recommendations, as it affects not just dental services, but almost all primary care services that could be involved in the early identification of high caries risk children.

Employment statistics from the Department of Health and Children for 1994–2004[143,144] and from the National Employment Monitoring Unit of the HSE for 2005–2008 (personal communication) show that the number of whole time equivalent (WTE) dentists working in the public dental service has fallen from a peak of just over 395 WTEs in 2001 to 345.9 at the end of 2008, a decrease of 49.1 WTEs (Figure 5.1). Hygienist numbers have remained stable at between 50 and 60 WTEs since 2001. Resource limitations within the public dental service will specifically affect the capacity of the service to:

- Accept referrals of high caries risk preschool children
- Provide treatment services for high caries risk preschool children
- Maintain the School Dental Service and the emergency service while directing resources to the development of preventive strategies for high caries risk children.

Figure 5.1: Number of whole time equivalent (WTE) dentists in the public dental service, by grade, 1994–2008



Additional barriers that could delay the implementation of recommendations include:

- Willingness and capacity of non-dental health professionals to engage in oral health education
- Funding to develop an oral health promotion module for public health nurse graduate and post-graduate training
- The need to reorientate the public dental service away from the current culture of identifying children's oral health needs late rather than early, and to instil a focus on primary prevention rather than restoration.

5.2. Key points for Audit

The following data should be collected as part of the audit of the implementation of the guideline:

- Awareness of the guideline among dental and primary care team personnel
- Training of in-post Public Health Nurses (PHNs) in oral health assessment of preschool children
- Development of a national oral health training programme as part of PHN postgraduate training
- Number of dental areas who have developed referral pathways for high caries risk children from primary care services to dental services
- Number of dental areas providing dental assessment for high caries risk preschool children identified by primary care services

- Number of areas offering a dental assessment to children during their first year in primary school
- Proportion of public dental service dentists using the Caries Risk Assessment Checklist
- Average recall interval for children identified as being high caries risk using the Caries Risk Assessment Checklist
- Proportion of children assessed as high risk who receive:
    - Fissure sealants
    - Topical fluoride application
    - Oral Health Education
- Proportion of parents using toothpaste containing at least 1,000 ppm F for children > 2 years old
- Change in dmft/DMFT in children aged 5, 8 and 12 years in areas that have implemented the guideline.

5.3. Recommendations for future research

During the development of this Guideline, a number of gaps in the evidence base were identified. These need to be filled. Some of the necessary research is described below, using the EPICO structure to outline the design of specific studies.[145]

Research is needed to identify:

- Prevalence and severity of dental caries in Irish children aged between 2 and 3 years in the Republic of Ireland
- The accuracy of dental screening and referral carried out by trained Public Health Nurses in Ireland

Evidence	2 studies comparing the sensitivity and specificity of non-dental professionals (after appropriate training) at identifying caries in preschool children with that of a dentist (gold standard)[24,25]
Population	Children aged 12–24 months at high risk of caries
Intervention	Knee to knee dental examination using a flashlight and a tongue blade, following appropriate training
Comparison	Similar examination by a calibrated dentist
Outcomes	Identification of children with one or more cavitated carious lesions or dental sepsis (sensitivity and specificity) Acceptability of the process to Public Health Nurses and parents

- Compliance by Irish parents with current recommendations on toothpaste use
- Geographic distribution of dental caries using software that allows spatial presentation of oral health data e.g. Health Atlas Ireland

- Effects of chlorhexidine varnish for the prevention of caries in preschool children

Evidence	Randomised trials of chlorhexidine varnish[135,136]
Population	Children aged 12–24 months attending community preschools, early start programmes or crèches in high caries risk areas
Intervention	3 monthly application of 40% chlorhexidine varnish
Comparison	No chlorhexidine varnish application
Outcomes	dmfs (increment) at age 3–4 years (i.e. 2 years after the intervention) Acceptability Adverse effects

- Routine collection of relevant oral health data on Irish children to assist with planning and targeting of services.

Glossary of Terms

Approximal caries	Decay occurring on the surface of a tooth where it contacts the tooth beside it.
Caries	Tooth decay.
Caries increment	The amount of caries developing during a specific period of time, usually from the start of a study (baseline) to the end of the study.
Cohort study	An observational study in which a defined group of people (the cohort) is followed over time. The outcomes of people in subsets of this cohort are compared, to examine people who were exposed or not exposed (or exposed at different levels) to a particular intervention or other factor of interest.
Cross sectional study	A study measuring the distribution of some characteristic(s) in a population at a particular point in time. This type of study design is also known as a survey.
Demineralisation	Loss of minerals (usually calcium and phosphate) from the tooth surface caused by exposure to acid, from either bacteria or dietary sources.
dmft/DMFT	An index which is used to describe the level of dental caries in individuals or groups. It counts the number of teeth which are decayed, missing or filled. By convention, dmft in lower case letters refers to primary teeth and DMFT in capital letters denotes permanent teeth.
d_{3vc}mft/ D_{3vc}MFT	Caries recorded at the dentine level, with or without cavitation.
d_{3c}mft/ D_{3c}MFT	Caries recorded at cavitation level.
Fissure Sealant	A thin plastic coating that is applied to the grooves (pits and fissures) on the chewing surfaces of back teeth to prevent decay by creating a physical barrier against bacteria and food.
Fluorosis	Fluorosis is a specific disturbance in tooth formation that is caused when excess fluoride is ingested during tooth development and results in an altered appearance of the tooth, which ranges from almost imperceptible fine white lines to pitting or staining of the enamel.
Hypomineralised	Literally means “less mineralised”. It is a defect of enamel that occurs during tooth formation and results in a tooth surface that is more porous and therefore more prone to decay and wear than normal.
Meta-analysis	The use of statistical techniques in a systematic review to integrate the results of included studies.
ppm F	Parts per million fluoride. A commonly used measure of the concentration of fluoride in a product.
Prevented fraction	The difference in caries increment at the end of the study between the control and treatment group, divided by the caries increment in the control group. (Also called the percent caries reduction.)
Randomised controlled trial (RCT)	An experiment in which two or more interventions, possibly including a control intervention or no intervention, are compared by being randomly allocated to participants.
Remineralisation	The replacement of minerals lost from enamel due to the action of acids
Systematic review	A review of a clearly formulated question that uses systematic and explicit methods to identify, select, and critically appraise relevant research, and to collect and analyse data from the studies that are included in the review. Statistical methods (meta-analysis) may or may not be used to analyse and summarise the results of the included studies.
95% confidence interval (CI)	A measure of the uncertainty around the main finding of a statistical analysis. Estimates of unknown quantities, such as the odds ratio comparing an experimental intervention with a control, are usually presented as a point estimate and a 95% confidence interval. This means that if someone were to keep repeating a study in other samples from the same population, 95% of the confidence intervals from those studies would contain the true value of the unknown quantity. Alternatives to 95%, such as 90% and 99% confidence intervals, are sometimes used. Wider intervals indicate lower precision; narrow intervals, greater precision.

Appendix 1: Summary of Recommendations on the use of topical fluorides

Professionally Applied Topical Fluorides

The use of professionally applied topical fluorides for the prevention and control of dental caries in individual patients should be considered as part of an overall preventive programme for the patient, based on an assessment of the individual patient's risk for caries and their exposure to other sources of fluoride. A Caries Risk Assessment Checklist for Irish children has been developed for this purpose (Appendix 3).

FLUORIDATED AND NON-FLUORIDATED AREAS				
	Age 1– 7 years	**Grade of recommendation**	**Age 7–16 years**	**Grade of recommendation**
FLUORIDE VARNISH	Resin-based fluoride varnish application (22,600 ppm F) should be offered to children who are assessed as being at high caries risk	**A**	Fluoride varnish application (at least 22,600 ppm F) should be offered to children who are assessed as being at high caries risk	**A**
	Varnish should be applied at intervals of 6 months or 3 months	**A**	Varnish should be applied at intervals of 6 months or 3 months	**A**
	Because of its ease of application, the small amount used, and the precise application of the material to individual tooth surfaces, resin-based varnish (22,600 ppm F) can be used in very young children who are assessed as being at high caries risk	**GPP**		
	The introduction of a school-based fluoride varnish programme should be considered for children attending special schools			**GPP**
FLUORIDE GEL	Fluoride gel should not be used in children under the age of 7	**GPP**	Because of its ease of application and greater patient acceptability, fluoride varnish should be used in preference to fluoride gel for caries prevention in children who are assessed as being at high caries risk	**D**
			In situations where operator or patient preference dictates the use of fluoride gel rather than fluoride varnish, gel application should be offered at 6 month intervals	**A**
FLUORIDE VARNISH & GEL	Manufacturer's instructions regarding use of fluoride varnish and gel should be carefully followed, as these products have high concentrations of fluoride			**GPP**
	Every fluoride varnish or gel application should be recorded as a treatment item in the patient record and also in the day book, if used			**GPP**
FLUORIDE FOAM	There is insufficient evidence at this time on which to base a recommendation on the use of fluoride foam			
SLOW-RELEASE FLUORIDE DEVICES	There is insufficient evidence at this time on which to base a recommendation on the use of slow-release fluoride devices			

Community-Based Use of Fluoride Toothpaste

The use of topical fluorides for caries prevention should form part of an overall community-based preventive strategy, which should be population-specific and tailored to meet the needs and preferences of the population under consideration. The identification of high caries risk groups or populations in Ireland is currently based on local knowledge of disadvantaged schools or districts, special needs groups, geographic location (non-fluoridated areas) or, where available, on small area data on the distribution of caries.

FLUORIDATED AND NON-FLUORIDATED AREAS				
	Age < 2 years	**Grade of recommendation**	**From age 2 years**	**Grade of recommendation**
FLUORIDE TOOTHPASTE	Community-based programmes involving the use of fluoride toothpaste are not recommended for children under the age of 2 years	**GPP**	**Daily supervised toothbrushing programmes** should:	
			• Be considered for targeted populations of children who are at high risk of developing dental caries	**A**
			• Be undertaken in community settings such as	
			o crèches, nurseries, preschools	**B**
			o primary schools	**A**
			• Involve the use of toothpaste containing at least 1,000 ppm fluoride	**A**
			• Support home use of fluoride toothpaste through provision of toothpaste, toothbrush and instructions for home use during school holidays	**D**
			Programmes involving the distribution of fluoride toothpaste should**:**	
			• Be considered in targeted populations of children at high risk of caries *Toothpaste distribution has the advantage of being cheaper, but is less effective than supervised brushing.*	**A**
			• Involve the use of toothpaste containing at least 1,000 ppm fluoride	**A**
			• Distribute toothpaste at 3-month intervals, with instructions for home use	**GPP**
			• Distribute toothpaste directly to parents/guardians of children under the age of 7 years	**GPP**
			Any community-based preventive programme should be conducted as an RCT to establish both the effectiveness and cost of the programme in Ireland	**GPP**

Community-Based Use of Fluoride Mouthrinse

NON-FLUORIDATED AREAS ONLY				
	Age < 7 years	**Grade of recommendation**	**Age 7–16 years**	**Grade of recommendation**
FLUORIDE MOUTHRINSE	Children under the age of 7 years should not participate in a school-based fluoride mouthrinsing programme because of the increased risk of the rinse being swallowed by young children	**GPP**	Weekly fluoride mouthrinsing with 0.2% sodium fluoride rinse should be offered to children living in non-fluoridated areas (sub-analysis of review by Marinho et al)	**B**
			The target number of applications should be at least 30 per year	**GPP**
			Fortnightly mouthrinsing with 0.2% sodium fluoride rinse is effective at reducing caries, but appears to be less effective than weekly rinsing (sub-analysis of review by Marinho et al)	**B**
			Children participating in a school-based fluoride mouthrinsing programme should rinse for two minutes with 0.2% sodium fluoride rinse	**GPP**
			Rinsing times of less than 2 minutes should be considered for new participants in a mouthrinsing programme to avoid excessive ingestion of fluoride mouthrinse	**GPP**
			Children should wait for at least 20–30 minutes after rinsing before eating or drinking	**D**
			Staff responsible for administering the fluoride mouthrinse are an important part of the dental service and should be appropriately trained in the delivery of the fluoride mouthrinsing programme	**GPP**
			A standardised protocol should be developed for fluoride mouthrinsing programmes in Ireland, which should include an individual rinse record for each child, incident reporting, monitoring and evaluation of participation, and information for participants on the maintenance of good oral health when the programme ends	**GPP**

Appendix 2: Guideline Development Process

This guideline was developed in line with international best practice, as specified by the AGREE Collaboration and described in the AGREE Instrument.[2] A Guideline Development Group (GDG) was established which represented key stakeholders in the guideline. Stakeholder groups who were not represented within the GDG were invited to contribute comments when the scope of the guideline was being planned and to comment on the consultation draft of this guideline.

Stakeholder organisations

- Society of Chief & Principal Dental Surgeons
- Principal Dental Surgeon Group with regional responsibility for the planning and evaluation of Children's Dental Services
- Principal Dental Surgeon Group with regional responsibility for services for patients with special needs
- Health Service Executive (HSE)
- Irish Society for Disability and Oral Health
- Irish Society of Dentistry for Children
- Oral Health Managers' Society of Ireland
- Expert Body on Fluorides & Health
- Community Action Network
- Dental Health Foundation
- Irish Dental Association
- Cork Dental School and Hospital
- Dublin Dental School and Hospital
- Oral Health Promotion Research Group - Irish Link

The key questions to be addressed by the guideline were developed by the GDG and the two researchers. Searches were run in Pubmed, all databases of The Cochrane Library and Embase, from 1995 to 2008, to identify systematic reviews or randomised trials to answer the key questions relating to the effectiveness of individual preventive agents (i.e. antimicrobial agents, fissure sealants, remineralising products and sugar substitutes). Thirty nine systematic reviews were included in this guideline. Where a systematic review was identified, the search for additional randomised trials was conducted from the last search date of that review to the end of 2008.

A separate search was commissioned from the Cochrane Oral Health Group in Manchester, to identify randomised trials, quasi-randomised trials or longitudinal studies of any health promotion intervention which had caries as an outcome measure. This search strategy was developed by Sylvia Bickley, Trials Search Co-ordinator of the Cochrane Oral Health Group in Manchester, and was run from 1995 to 2007 in the Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE (Ovid), Embase and CINAHL. The search was updated by Anne Littlewood (Cochrane Oral Health Group) to August

2008 for MEDLINE and September 2008 for all other databases. The oral health promotion search generated 2,566 non-duplicate records, from which 60 full text articles not identified by other searches were obtained. Twenty three of these studies were used in the guideline. All searches were limited to the English language. The quality of all identified studies was appraised by two reviewers using the appropriate SIGN methodology checklists. The websites of key guideline organisations, dental professional organisations, and electronic guideline databases were also searched to identify relevant guidelines (see table below). The quality of relevant guidelines was appraised using the AGREE instrument.[2]

Websites searched for guidelines

	Web address
NHS Evidence Health Information Resources (formerly National Library for Health)	http://www.library.nhs.uk/
National Institute for Health and Clinical Excellence (NICE)	http://www.nice.org.uk/
Scottish Intercollegiate Guidelines Network (SIGN)	http://www.sign.ac.uk/
NZ Guideline Group	http://www.nzgg.org.nz/
Australian National Health and Medical Research Council	http://www.nhmrc.gov.au/publications/
National Guideline Clearinghouse	http://www.guideline.gov/
Centre for Disease Control (CDC)	http://www.cdc.gov/OralHealth/guidelines.htm
Guidelines International Network (G-I-N)	http://www.g-i-n.net/
TRIP database	http://www.tripdatabase.com/
FDI World Dental Federation	http://www.fdiworldental.org/home/home.html

A summary of the evidence to answer each of the key questions was presented to the Guideline Development Group. Recommendations were developed by informal consensus, and graded according to the level of evidence on which they were based using the SIGN criteria (page 3).

The full list of questions posed by the Guideline Development Group, and the oral health promotion search strategy can be found in the full guideline. This is available at: http://ohsrc.ucc.ie/ .

The development of this guideline was funded through a Strategic Health Research and Development Research Award from the Health Research Board (HRB). The content of this guideline was not influenced by the funding body. The guideline will be updated in 2011.

Appendix 3: Caries Risk Assessment Checklist and Notes

Dentist's name: _____ Date: _____

Child's name: _____ School: _____ First assessment Y / N

Risk Factors / Indicators **A "YES" in the shaded section indicates that the child is likely to be at high risk of or from caries**	Please circle the most appropriate answer	
• Age 0–3 with caries (cavitated or non-cavitated)	**Yes**	No
• Age 4–6 with dmft>2 or DMFT>0	**Yes**	No
• Age 7 and over with active smooth surface caries (cavitated or non-cavitated) on one or more permanent teeth	**Yes**	No
• New caries lesions in last 12 months	**Yes**	No
• Hypomineralised permanent molars	**Yes**	No
• Medical or other conditions where dental caries could put the patient's general health at increased risk	**Yes**	No
• Medical or other conditions that could increase the patient's risk of developing dental caries	**Yes**	No
• Medical or other conditions that may reduce the patient's ability to maintain their oral health, or that may complicate dental treatment	**Yes**	No
The following indicators should also be considered when assessing the child's risk of developing caries		
• Age 7–10 with dmft>3 or DMFT>0	**Yes**	No
• Age 11–13 with DMFT>2	**Yes**	No
• Age 14–15 with DMFT>4	**Yes**	No
• Deep pits and fissures in permanent teeth	**Yes**	No
• Full medical card	**Yes**	No
• Sweet snacks or drinks between meals more than twice a day	**Yes**	No
Protective Factors **A "NO" in this section indicates the absence of protective factors which may increase the child's risk of developing caries**		
• Fissure sealants	Yes	**No**
• Brushes twice a day or more	Yes	**No**
• Uses toothpaste containing 1000 ppm F or more	Yes	**No**
• Fluoridated water supply	Yes	**No / Don't know**

Is this child at high risk of or from caries?	**YES**	**NO**

Notes on the Caries Risk Assessment Checklist

Introduction

The approach taken during the development of this checklist was that all children are at risk of developing caries but some children are at high risk, and these are the ones we want to identify. The assessment of caries risk is something that every dentist does, usually informally or implicitly. The aim of the checklist is to encourage a formal, systematic approach to identifying individual children who may be at high risk of developing decay. Caries risk assessment should form the basis of a risk-based approach to patient treatment and recall, with repeat assessments indicating if the child's risk status is changing over time.

The checklist is divided into 2 main sections: risk factors/indicators and protective factors. The shaded part contains the risk factors/indicators that the Guideline Development Group considered most important for identifying high caries risk children. A score in the shaded part indicates that a child is likely to be at high risk of or from caries. Other indicators that should be taken into account when assessing the child's risk status complete this section. The second section contains protective factors that should also be considered. The checklist combines the two most consistent predictors of future caries: previous caries experience[23] and the dentist's own assessment.[146,147] The dentist makes the final decision about caries risk status, based on their overall assessment of the patient. The following notes give some pointers on filling in the checklist.

Risk Factors/Indicators

Age 0–3: Any child under the age of 4 who shows any evidence of caries – with or without cavitation – should be considered high risk, as the consequences of any caries for this age group can mean recourse to general anaesthesia for treatment.

Age 7 and over: Caries is a dynamic process that can progress or arrest. The concept of lesion activity is becoming increasingly important in assessing a patient's risk of developing future caries. There is currently no international consensus on the diagnosis of active lesions, and for the purposes of this checklist, we are suggesting a modified version of the criteria defined by Nyvad et al.[148] An active lesion is one which is likely to progress if nothing is done. It is more than just a "white spot" lesion. An active, non cavitated enamel lesion is characterised by a whitish/yellow opaque surface with loss of lustre and exhibiting a "chalky" appearance. Inactive lesions tend to be shiny and smooth.

New lesions: New caries in the last 12 months, or progression of non-cavitated lesions (clinical or radiographic) is a good indicator of high caries activity. It would be a key factor to assess, particularly on repeat caries risk assessments for children deemed to be high risk.

Smooth surface caries: At least 70% of caries in permanent teeth in Irish children occurs on pit and fissure surfaces.[4] The occurrence of caries on smooth surfaces, i.e. proximal, buccal or palatal (excluding the respective pits) or lingual surfaces, indicates a different pattern of disease and potentially a greater risk of developing further decay. The presence of approximal lesions on bitewing (if available) should also be considered when assessing smooth surface lesions (although it will not be possible to assess the activity of the lesion from radiographs taken at a single timepoint).

Hypomineralised molars: Molar hypomineralisation varies in severity, and some hypomineralised molars can disintegrate rapidly, making early detection and monitoring of these teeth essential. In more severe cases, hypomineralised molars present a restorative and long-term management challenge. Other developmental disorders of tooth formation, e.g. amelogenesis imperfecta, which can predispose to caries, should also be considered in this category.

Deep pits and fissures: The morphology of the occlusal surface has been shown to be a good predictor of caries risk.[147,149]

Medical or other conditions: This section considers factors from the medical history that you normally take for your patient, that may put the person at risk of or from caries. Some examples of conditions that could be included in each of the categories are shown below.

Medical or other conditions	**Examples**
Conditions where dental caries could put the patient's general health at increased risk	Cardiovascular disease Bleeding disorders Immunosuppression
Conditions that could increase the patient's risk of developing dental caries	Salivary hypofunction Medications that reduce saliva flow Long term use of sugar-containing medicine
Conditions that may reduce the patient's ability to maintain their oral health, or that may complicate dental treatment	Certain physical and intellectual disabilities, Cleft lip/palate Anxious*, nervous* or phobic conditions, Behavioural problems

**Over and above what would be considered "normal" anxiety or nervousness for children*

DMFT (Decayed/Missing/Filled Teeth): In calculating dmft/DMFT, only teeth that have been extracted due to caries should be counted as missing. Similarly, only fillings that have been placed due to caries should be counted. The DMFT cut-offs in the checklist are based on the mean DMFT of the top one third of children with the highest caries levels from the North South survey.[4] In the North South survey, caries was recorded without the use of (bitewing) radiographs; therefore caries detected on (bitewing) radiographs should not be included in the dmft/DMFT calculation.

Dietary habits: Diet is one of the main risk factors for dental caries, and it can be the most difficult and sensitive area on which to get accurate information. We are suggesting that the question could be phrased along the lines of the question on diet that was included in the North South survey.

Dietary habits	**Suggested question**
Sweet snacks or drinks between meals more than twice a day	How often does your child eat sweet food or drinks e.g. biscuits, cakes, sweets, fizzy drinks/squash, fruit drinks etc between normal meals?

Medical Card: There is fairly strong evidence of an inverse relationship between socio-economic status and oral health in children under 12 years of age.[62] Medical card status has been used in Irish studies as an indicator of disadvantage. Medical card status may be a particularly useful indicator of caries risk where children are too young for their risk to be based on caries history. Since the introduction of the GP Visit card, which has higher income thresholds for eligibility, it is necessary to establish if the patient has a Full medical card. Very often this data is collected as part of the medical history or patient details, and data from these sources can be used to complete the checklist.

Protective Factors

The effectiveness of the protective factors listed in the checklist at reducing caries has been established in various systematic reviews.[80,84,122,150] The absence of protective factors could increase a child's risk of developing caries.

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