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E Tipu e Rea



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**Brief Evidence Reviews for the Well Child
Tamariki Ora Programme**

Report submitted to MoH on 11 December 2019

***Whakapūpūtia mai ō mānuka,
kia kore ai e whati***

*Cluster the branches of the manuka,
so they will not break*

Foreword

The Ministry of Health is responsible for the development of policy advice on children's health and the future direction of the Well Child Tamariki Ora (WCTO) programme. The WCTO programme is the universal health service in New Zealand, which is responsible for protecting and improving the health and wellbeing of children from birth to 5 years of age. This is achieved through health and development screening and surveillance, whānau care and support, and health education.

The current programme is based on the evidence available at the time of the last programme update in 2007. Therefore, the Ministry of Health is reviewing the current WCTO Framework and associated Schedule (developed in 2002) to ensure that WCTO services meet the current needs of children and their whānau, and address the issues they face. The present review was initiated in 2019 and is the second review of the programme, as the first was carried out in 2006. In preparation for this review, the Ministry of Health has commissioned an evaluation of the recent literature on some of the new and emerging issues for preschool children, as well as possible ways to address them.

The purpose of this review includes ensuring that the programme is underpinned by the latest research and evidence. This is particularly pertinent to the current Schedule of Universal Contacts delivered, and one of the work-streams of the review is to consider the timing, content, and intensity of the Schedule, and associated additional contacts. This work stream will support the development of an integrated framework of universal wellbeing contacts for the pregnancy to 24 years of age life course.

The Ministry of Health require the brief evidence reviews (BERs) to synthesise relevant evidence about what works in key areas for children, including development, vision, hearing, emotional and mental health, and growth. The BERs adopted the He Awa Whiria – Braided Rivers approach and include consideration of what will work for Māori tamariki and whānau, and Pacific children and families within each domain. The BERs have helped to identify any knowledge gaps where further work and research may be needed, to inform further development of the WCTO programme.

The WCTO review is a key health contribution to the Government's Child and Youth Well-being Strategy. It forms part of the Ministry of Health's work programme to transform its approach to supporting maternal, child, and youth well-being.

The Ministry of Health have commissioned A Better Start: E Tipu E Rea National Science Challenge to undertake 11 health related BERs that will inform the WCTO review and decision making on the future core service schedule, and additional health and social services for children in New Zealand. The aim of the BERs is to ensure that decisions are grounded in, and informed by, up-to-date evidence. BERs are intended to synthesise available evidence and meet time constraints of health care decision makers. Internationally health technology agencies have embraced rapid reviews, with most agencies internationally offering these alongside standard reviews. These 11 BERs that we have conducted have been performed in a very short time which was a very challenging task.

A Better Start is a national research programme funded by the Ministry of Business Innovation and Employment (MBIE). The objective of A Better Start is to improve the potential for all young New Zealanders to lead a healthy and successful life. To achieve this, A Better Start is researching methods and tools to predict, prevent, and intervene so children have a healthy weight, are successful learners, and are emotionally and socially well-adjusted. A Better Start consists of more than 120 researchers across 8 institutions.

The BERs cover 11 domains critical to the WCTO programme, which are: neurodevelopment (#1); parent-child relationships (#2); social, emotional, and behavioural screening (#3); parental mental health problems during pregnancy and the postnatal period (#4); parental alcohol and drug use (#5); excessive weight gain and poor growth (#6); vision (#7); oral health (#8); adverse childhood experiences (#9); hearing (#10); and family violence (#11). The BERs have synthesised relevant evidence about what works in key areas for children across these domains, which were assessed with careful consideration of what will work for Māori tamariki and whānau and Pacific children and families. They have also identified knowledge gaps where further work and research may be needed to inform further development of the WCTO programme.

Within each domain, a series of 6–14 specific questions were drafted by the Ministry of Health, and subsequently refined with input from the large team of researchers assembled by A Better Start. A Better Start established discrete writing teams to undertake each BER. These teams largely consisted of a post-doctoral research fellow and specialty expert, often in consultation with other experts in the field. Subsequently, each BER was peer reviewed by at least two independent experts in the field, as well as two Māori and a Pacific senior researcher. In addition, senior clinical staff from the Ministry of Health have reviewed each BER. These were then revised to address all the feedback received, checked by the editors, and finalised for inclusion in this report.

Whilst each of these domains are reviewed as discrete entities, there is considerably inter-relatedness between them. In particular, neurodevelopmental problems can be impacted by parent-child relationships, parental mental health, and pre- and postnatal drug exposure. Similarly, children who have problems with growth, vision, or oral health may also have neurodevelopmental disorders.

Most of the evidence available for these BERs comes from international studies with limited data from New Zealand, in particular there is limited information about Māori, Pacific, and disadvantaged families. These are the tamariki and whānau in whom the WCTO Programme services are more scarce, yet could potentially offer the greatest benefit.

The criteria for screening include the requirement for an effective and accessible intervention; the corollary is that screening should not be offered if there is no benefit to the individual being screened. The essential issue is therefore to identify those infants and preschool children and their whānau who would have better outcomes following intervention; this includes better outcomes for the whānau.

The current WCTO programme has had a greater emphasis on surveillance rather than screening. Many of the questions in the BERs address screening. A change in the WCTO programme that further extends into screening will require substantial upskilling of many WCTO providers, as well as redirection of resources. Importantly, Māori and Pacific iwi and community views must be considered before any new screening programmes are to be included.

It should be noted that a shift towards screening rather than surveillance may prevent health and behavioural problems. The economic benefits of prevention and early intervention are well documented, with early interventions showing that for every dollar spent there are substantial savings to health, social services, police, and special education resources.



Professor Wayne Cutfield
Director of A Better Start National Science Challenge
On behalf of the editors, authors and reviewers of the brief evidence reviews

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8 Oral health promotion and early preventive interventions in a community setting

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Disclaimer

This brief evidence review was commissioned by A Better Start National Science Challenge (the Challenge) on behalf of the New Zealand Ministry of Health. It was prepared over a relatively short time based on the evidence available to the authors at the time of its preparation. The authors have made considerable efforts to perform a comprehensive and balanced evaluation of the existing evidence. However, this brief evidence review cannot be considered an exhaustive analysis of the existing peer-reviewed and grey literature on the topic, and it may not reflect the potentially conflicting views of all experts in the field. There could have been important omissions, and additional evidence might have also come to light since completion of this final draft. Thus, this brief evidence review should be considered with the appropriate caution. A previous version of this document was peer-reviewed by Māori and Pacific researchers and by independent experts in the field. Peer reviewers were anonymous, unless they have otherwise been identified by name. Please note that this brief evidence review does not represent the views of the Challenge or the Ministry of Health; rather, it reports the independent conclusions of the listed authors.

Conflicts of interest: The authors have no financial or non-financial conflicts of interest to declare that may be relevant to this work.

Abbreviations

ART	Atraumatic restorative technique
CAMBRA	Caries Management by Risk Assessment
Caries-free	Having no teeth affected by decay
COHS	Community Oral Health Service
dmft	Decayed, missing, and filled primary teeth
DMFT	Decayed, missing, and filled permanent teeth
ECC	Early childhood caries
ICCMS	International Caries Classification and Management System
ICDAS	International Caries Detection and Assessment System
PF	Prevented fraction
ppm	Parts per million
pufa	pulp, ulceration, fistula abscess
RCT	Randomised controlled trial
WCTO	Well Child Tamariki Ora programme

Definitions

dmft	The count of primary teeth with untreated caries, dental restorations, and missing due to dental caries
DMFT	The count of permanent teeth with untreated caries, dental restorations, and missing due to dental caries
ECC	Presence of ≥ 1 decayed, missing (due to caries), or filled tooth surfaces in any primary tooth ¹
Permanent teeth	Permanent teeth that replace the primary teeth
Primary teeth	Deciduous or 'baby' teeth that are lost when permanent teeth emerge
pufa	An index of tooth and soft tissue consequences of untreated caries

Executive summary

- The prevalence of dental caries among 5-year-old New Zealand children was 40% in 2018, and ECC remains a common condition.
- There are marked inequalities in oral health in New Zealand, with Māori and Pacific children at particularly high risk for dental caries.
- Though overall ECC prevalence has decreased in New Zealand, severe caries experience and hospital-based intervention have increased.
- Lift-the-lip is easy to perform by adults and should constitute the cornerstone of community screening. Identification of any visible sign or suspicion of ECC should result in prompt referral to dental services.
- Lift-the-lip should not replace comprehensive assessment by oral health practitioners but be used systematically and opportunistically during any health checks.
- Dental disease can only be ruled out with an examination by an oral health practitioner.
- Many risk factors for ECC are known, but no standardised screening tool for ECC risk has been validated or adopted in New Zealand.
- CAMBRA is an example of a caries risk assessment tool that has been taught in New Zealand dental training for a number of years, which could be adapted or abbreviated for use in screening for ECC risk in infants and preschool children in New Zealand.
- A toothbrushing programme should be implemented for infants and preschool children in New Zealand, involving provision of toothbrushes and toothpaste to young families, and introducing routine toothbrushing in preschools as well as demonstrations in Well Child visits.
- Fluoride varnish should be applied early (from age 12 months) and routinely (6 monthly) for children identified to have caries or at high risk of developing dental caries. This should be done by trained health practitioners (such as an oral health therapist) and may be applied in community or clinical settings.
- Treatment of established dental disease requires the involvement of oral health practitioners and cannot be performed in community settings.

- Treatment of dental decay is multifaceted and includes addressing patient factors such as oral health behaviours.
- Māori and Pacific children are at greater risk of dental disease, and so should be a priority for oral health screening, prevention, and treatment.
- Early access to care – detected early enough, dental caries can be arrested or reversed by sealing of affected tooth surfaces or use fluoride treatments, negating the need for costly restorative or surgical dental care. By detecting caries early through routinely ‘lifting the lip’ and ensuring children are referred and promptly seen for treatment, it may be possible to reduce New Zealand’s increasing rate of children requiring general anaesthetics for dental care.
- Increased investment in preventive care should be paired with healthy public policy – early childhood caries frequently occur very early in life, not long after the teeth have entered the mouth, and is directly attributable to an unhealthy or inappropriate diet.
- The Scottish Childsmile programme is a valuable model that is cost effective, reducing ECC, dental care spending, and inequalities in oral health; a similar strategy is likely feasible in New Zealand, but would require investment, including prioritisation and delivery of effective preventive dental care.
- It is unavoidable that we recommend regulation of marketing and sale of products known to cause dental caries.

8.1 Introduction

Early childhood caries (ECC), characterised by one or more tooth surfaces being affected by decay before the age of 6 years, is one of the most common diseases of childhood². A relatively good understanding of the risk factors and aetiology of ECC means that it is largely preventable^{3,4}. However, prevention efforts often do not reach those at highest risk, so that ECC has been described as a sensitive marker for economic and other stresses on individual households³.

Caries experience is often measured in epidemiological dentistry using the DMF index, referring to the number of **d**ecayed, **m**issing, or **f**illed teeth (dmft) or tooth surfaces (dmfs) as a result of decay^{5,6}. For those aged <30 years, teeth lost or restored due to traumatic injury are not typically included in the index⁵. Lowercase letters refer to the primary teeth (dmft or dmfs), while permanent teeth are represented by uppercase letters (DMFT or DMFS). A dmf index score ≥ 1 indicates the presence of ECC, while a child with a dmf of 0 is considered caries-free^{5,7}.

Despite the importance of oral health in the early years, children aged 2 to 4 years are less likely than older children to engage in recommended oral health behaviours, such as toothbrushing with fluoride toothpaste². This coincides with the age at which parents report the most difficulty engaging children in toothbrushing⁸. It seems that many parents also believe that caring for primary teeth (i.e. 'baby' teeth) is not a priority, because they do not feel that the health of primary teeth is related to health of permanent teeth⁹. This is an important misconception as caries on primary teeth are strong predictors of later decay in permanent teeth^{10,11}.

In New Zealand, Well Child Tamariki Ora (WCTO) is a programme that provides health assessments, referrals, and support services to children and their families from birth to age 5 years¹². As part of a review of this programme, the New Zealand Ministry of Health sought to review the oral health of children and infants in this age group, as well as the services available to them. Thus, this brief evidence review aimed at evaluating the most efficacious and cost-effective screening and intervention tools for dental caries in New Zealand, including those that are culturally appropriate. We also briefly examine the prevalence of dental caries among New Zealand children and the associated risk factors, as well as the potential adverse effects of screening and interventions.

8.2 Prevalence and distribution of dental disease in New Zealand infants and preschoolers

The main dental disease among New Zealand infants and pre-schoolers is ECC; other oral diseases include developmental defects of the teeth or other oral structures, as well as periodontal conditions or other soft tissue disorders. As ECC is by far the dominant disease in this population group, this review will focus on ECC.

Identifying ECC in the community is a challenge, as early decay may not be easily visualised on the tooth surface. While a comprehensive dental exam including bitewing radiographs will reliably detect caries^{10,13,14}, this is not practical in the context of large epidemiological studies or in community settings. In addition, bitewing radiographs only detect caries on the posterior teeth, and they involve exposure to ionising radiation (raising ethical issues for their use in research or screening among low-risk children). Therefore, prevalence estimates based on community-acquired data are likely to underestimate the actual number of children affected by ECC¹⁰.

ECC remains a considerable public health issue worldwide^{3,15,16}. There are marked differences in ECC prevalence between countries^{7,17}, with recent estimates among 5-year-olds ranging from 16.5% in Greece¹⁸, to 85% in China¹⁹ and 90% in Indonesia²⁰. According to Ministry of Health data, the prevalence of dental caries among 5-year-olds in New Zealand who accessed the Community Oral Health Service was 40% in 2018 (noting that in New Zealand this is reported inversely, i.e. as the proportion who were caries-free, in this case 60% with 0 dmft)²¹. There is some evidence that rates of ECC have decreased among preschoolers, with 52% of 5-year-olds reported to be caries-free in 2005 compared to 60% in 2018^{22,23} (Table 8.1). However, these data only represent children who were accessing care at this age, and approximately 30% of 5-year-olds were missing from the 2018 data set²¹.

Table 8.1. Proportion of 5-year-old New Zealand children (%) attending the Community Oral Health service who were caries-free (dmft=0) in 2005–2018

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total	52.0	52.9	51.4	57.0	55.6	57.2	59.6	58.9	57.5	58.7	59.5	59.6	60.6	59.7
Māori	30.2	31.1	28.7	36.2	34.6	38.3	41.1	39.2	37.4	39.7	39.2	41.1	42.1	40.8
Pacific	34.6	31.8	28.8	32.8	31.8	32.8	35.3	37.0	36.3	35.3	38.9	34.3	36.3	38.1
Other ethnicities	60.7	61.9	61.1	66.8	65.8	67.0	69.0	68.5	66.9	68.4	69.1	69.5	70.1	69.1

Data reproduced from Ministry of Health 2018²¹.

There is paucity of data on the oral health of very young children in New Zealand, as most of the reported data are on those aged ≥4 years. Nonetheless, the available data in children aged 4 to 5 years is still highly relevant for younger children/infants. Oral health conditions are chronic and cumulative, therefore the prevalence of caries or dmft count at ages 4 to 5 years represent the accumulation of the child's caries experience throughout their preschool years.

Data based on the quick visual ‘lift-the-lip’ examination from the B4 School Check data indicated that severe caries experience has increased in recent years, despite an overall reduction in ECC prevalence²². Further, the number of children receiving dental treatment under general anaesthesia increased markedly (+83%) over a similar period (from 4,646 in 2005 to 8,520 in 2013)^{24,25}, suggesting that rates of severe dental caries may be on the increase. Disease severity may not be the only reason for this increase; children’s behaviour and/or disability can contribute to a decision to refer for hospital treatment. A total of 8,758 children (18 years or younger) had dental treatment under anaesthetic in 2017/18, at a cost of \$22.4 million.

8.2.1 Oral health inequalities

Globally, there are well described inequalities in the prevalence of dental caries within individual localities, for example in association with socioeconomic status^{2,15,26,27}. Socioeconomic deprivation in particular is likely to be the most important factor underpinning the marked inequality in oral health among ethnic groups in New Zealand^{2,23}, reflected, for example, in the reported poor knowledge of basic oral hygiene among Pacific mothers and their children²⁸.

Over recent decades, improvements both in access to oral health services and prevalence of dental caries in some countries have been reported^{26,27}. Unfortunately, in New Zealand such improvements in access to oral health care have not been observed among adults at least². For New Zealand children, the reorientation of the School Dental Service to the Community Oral Health Service (COHS) was intended to lead to better access to care²⁹, but contemporary influences of workforce shortages in the

COHS may be leading to challenges in access to care³⁰. Dental care has a preventive focus, but access to preventive care is not necessarily proportionate to need, magnifying oral health inequalities among socioeconomic groups in some places²⁶.

While there have been improvements in child oral health across all ethnic groups, disparities in the prevalence of dental caries appear to remain largely unchanged³¹ (Table 8.1), and may have worsened for young Pacific children^{22,31}. In general, there is a higher prevalence of ECC among Māori and Pacific children and those living in areas of high socioeconomic deprivation^{21,32}. These groups are also overrepresented among the large number of children requiring dental treatment under general anaesthesia in New Zealand²⁵. Not surprisingly, there is evidence to indicate that Māori and Pacific children, and those living in the most deprived areas are also more likely to miss oral health checks^{2,23}.

Of note, the timing of tooth eruption is variable, and the primary first molar teeth may emerge from as early as 13 months of age³³. There is some evidence that the timing of tooth eruption varies with ethnicity³⁴ and sex³⁵. Data for New Zealand children are lacking, but one study of permanent teeth showed that these emerged earlier among Pacific children and Māori children³⁶. This would place their teeth at risk from a younger age compared to other ethnicities, so that they may require earlier attention.

8.2 Summary

- *The prevalence of dental caries among children aged 5 years in New Zealand was ~40% in 2018, and ECC remains a common condition.*
 - *There are marked inequalities in oral health in New Zealand, with Māori and Pacific children at particularly high risk for dental decay.*
 - *Though overall ECC prevalence has decreased in New Zealand, severe caries experience and resulting hospital-based intervention have increased.*
-

8.3 Screening for dental disease and dental disease risk

8.3.1 Clinical oral health settings

While screening within clinical dental practices is outside the scope of this review, it is important to briefly cover this area. In these clinical settings, detection of caries is primarily visual, involving inspection of all soft and hard tissues, as well as bitewing radiographs depending on caries risk³⁷. Examination of pits and fissures in the teeth with a sharp explorer probe is still performed by a majority of New Zealand dental practitioners³⁸, but the use of a probe is usually unnecessary, and is also undesirable as it frequently causes cavitation of incipient carious lesions³⁹. The International Caries Classification and Management System (ICCMS)⁴⁰ aids decision making by incorporating patient risk factors with the *International Caries Detection and Assessment System* (ICDAS) system of rating caries severity based on visual appearance of carious lesions³⁷. ICDAS and ICCMS are part of the dental curriculum and are currently taught to students in the training program for dentists at the University of Otago as well as the oral health therapy programmes at Auckland University of Technology and University of Otago, but its uptake among established practising clinicians is low^{41,42}.

Dental assessment from an oral health practitioner is the best way to reliably diagnose tooth decay. Therefore, in New Zealand and internationally, it is recommended that a child should first see an oral

health practitioner by 12 months of age or shortly after their first teeth come through^{10,43-45}. In practice, screening at WCTO checks and other health check-ups can prioritise dental referrals for children at high risk for dental decay. For example, bitewing radiographs are recommended from age 5 years for children with a low risk of dental decay³⁷, while those at high risk should have dental radiographs taken by an oral health practitioner at 3 years of age³⁷.

8.3.2 Community screening for dental disease

Outside of the oral health practitioner setting, a visual inspection is also the best way to identify signs of dental disease. Of all methods for screening ECC in community settings, the 'lift-the-lip' examination is by far the most widely adopted⁴⁶⁻⁴⁹. The lift-the-lip is a quick and simple examination (usually 2-3 minutes long) that in New Zealand is recommended to be carried out as part of the WCTO health checks, by primary healthcare providers alongside other health assessments^{22,45,48}, or even by a parent. The health practitioner or parent lifts the child's lip to check teeth for visual signs of decay. While these signs can be rated in comparison to reference photographs for severity of decay from 1 (no visible caries) to 6 (severe caries including posterior teeth), in practice any sign of decay should result in a referral to an oral health practitioner^{22,45}.

Surprisingly, while the lift-the-lip is frequently mentioned as the chosen method in a large number of studies, there is in fact very little description in both peer-reviewed and grey literature as to what it entails. For example, Wilson's 2017 report focused entirely on the lift-the-lip but made only a passing referencing to "visual assessment of the upper anterior teeth particularly", with no adequate description of this technique⁴⁸. In New Zealand, it seems that the report *Healthy Smile, Healthy Child* may be one of the very few documents describing that the lift-the-lip check should include all teeth "as decay can occur on any tooth surface" (p.20)⁴⁵. We recommend that the lift-the-lip involves all teeth if the opportunity arises, but inability to examine the back teeth should not constitute a reason not to perform it; i.e. any examination of a child's teeth is better than none at all. In light of the paucity of description in the existing literature, the key steps to perform the lift-the-lip examination are described in Table 8.2. Note that some guidelines suggest assessing the gingiva for colour and moisture; while gums should be moist, intact, pale, and pink, the colour of gingiva will vary with skin colour⁴³. Periodontal conditions are rare among preschool children, however, redness or bleeding of the gums (indicated gingivitis due to excess plaque) should be an indication to refer for dental care.

As the lift-the-lip is very easy to perform by any adult, it should constitute the cornerstone of community screening (i.e. without the involvement of trained oral health practitioners). Identification of any visible ECC or other tooth surface changes should result in prompt referral to an oral health therapist or dentist (Table 8.2). Nonetheless, it should be stressed that early signs of tooth decay may be easily missed by practitioners not qualified in oral health assessment²². Therefore, lift-the-lip should not replace comprehensive assessment by an oral health practitioner, but instead should be employed opportunistically at any health check to identify and prioritise referral for high-risk patients.

Beyond the lift-the-lip examination, severe decay can also be further classified based on ECC complications using the pufa index¹¹. This index refers to **p**ulpal involvement, **u**lceration due to tooth or root fragments, **f**istula, and **a**bscess, as a result of decay of primary teeth¹¹. However, in practice, the pufa index is of little relevance for community screening, as any evidence of tooth decay (irrespective of its level) requires referral to an oral health practitioner, where a proper clinical oral health evaluation will be carried out.

Table 8.2. Step-by-step instructions for the lift-the-lip.

EXAMINATION	
1. Lighting	Ensure good lighting or have a pen torch ready
2. Position child	<ul style="list-style-type: none"> • Infant or toddler: parent and practitioner sit knee-to-knee with child facing the parent on their lap. The child is lowered onto practitioner's lap • Preschool child: Lie on examination table or sit on or in front of parent's lap facing practitioner • Other positions may be used, but these positions maximise viewing access for the practitioner, while ensuring the child is likely to be comfortable
3. Lift-the-lip	<ul style="list-style-type: none"> • Practitioner uses gloved hand to lift upper lip, if possible • If parent or child prefers that parent lifts their lip, an infant or toddler should be positioned with their head in the parent's lap (gloves may be used but are not essential)
4. Inspect anterior teeth (anterior surface)	<ul style="list-style-type: none"> • Inspect the upper anterior teeth, looking for: <ul style="list-style-type: none"> –Whitish lines on the teeth along the gumline –Chalky, white spots or patches –Yellow or brownish discoloration –Clearly visible cavity • If any of the above are present, child should see an oral health practitioner for further assessment or intervention • The practitioner should also note any visible plaque or food debris, as their presence may indicate poor diet, poor oral hygiene, or poor brushing technique; thus, the child should see an oral health practitioner for a formal caries risk assessment
5. Inspect anterior teeth (posterior surface)	<ul style="list-style-type: none"> • Use a mouth mirror (if available) to visualise the back of the upper anterior teeth, looking for the same signs of decay
6. Inspect all teeth	<ul style="list-style-type: none"> • Examine all teeth that can be visualised, using a pen torch (or any torch such as that on a mobile phone) and mouth mirror (if available) to assist • A tongue depressor or toothbrush can also be used to move the tongue to better visualize teeth • Suggested sequence: <ol style="list-style-type: none"> a. Biting surfaces of the teeth (pits & fissures) b. Between the teeth (proximal surfaces) c. Sides of the teeth (inside the cheeks and beside the tongue)
7. Check tooth eruption	<ul style="list-style-type: none"> • Examine whether tooth eruption is proceeding as expected: <ul style="list-style-type: none"> –Incisors from ~6 months onwards, initially 4, later 8 teeth; –First molar from ~12 months, 4 teeth; –Canines (eye teeth) from ~18 months, 4 teeth; –Second molars from ~24 months, 4 teeth
POST-EXAMINATION	
A. Referral	If any decay is detected or suspected, refer child to a dental clinic
B. Education	For all parents, emphasise the importance of oral health practices (e.g. regular toothbrushing, fluoride toothpaste, diet) and regular dental check-ups
C. Parental guidance	Instruct parents to: <ul style="list-style-type: none"> • Assist their child with brushing twice daily • Perform the lift-the-lip and inspect child's teeth monthly • Make a dental appointment straight away if any signs of decay are visible (or suspected)

Guidelines based on the New Zealand Dental Association's "Healthy Smile, Healthy Child" report⁴⁵, the NSW Ministry of Health guidelines⁴³, and the University of Washington lift-the-lip guide⁴⁷.

Importantly, aside from identifying need for prompt referral to dental services, lift-the-lip is an opportunity for oral health education for parents and children⁴⁸. It should involve an individualised conversation about diet, sugar, toothbrushing technique (Table 8.2), and the importance of attending oral health services⁴⁸. Parents should also be taught and encouraged to regularly look at their child's teeth for signs of decay at home using the lift-the-lip⁴⁵ (Table 8.2).

8.3.3 Community screening for dental disease risk

Assessment of risk for ECC should be done at the same time as a visual examination of the teeth. However, if it is not possible to view a child's teeth (e.g. due to behaviour), it can be possible to assess risk through a parent interview alone. This should take place as early in life as possible, as teeth are at risk of dental caries as soon as they emerge into the mouth. This may be particularly important in the first year of life, when risk identification may occur before the eruption of any teeth. It is also important to consider the past experiences of family members. Among families with at least two children, dental caries experience is strongly correlated between siblings⁵⁰ and children who require general anaesthetic for dental care frequently have siblings who require the same treatment in future⁵¹.

In 2008, the New Zealand Ministry of Health recommended that a standardised dental caries risk assessment form be developed for use in *WCTO* checks for infants aged 9-12 months of age⁵². However, to date no such tool has yet been developed for New Zealand⁴⁵, and *WCTO* checks do not commonly involve lifting of the lip or discussing oral health, except at the B4 School Check at age 4 to 5 years. To assess a child's risk for dental decay, the New Zealand Dental Association recommend asking about dietary habits, fluoridated water supply, toothpaste used, oral hygiene, and child and family oral health history⁴⁵. Factors indicating high risk include: regular intake of sugary foods and drinks; visible plaque, food, or debris in the mouth; not brushing or brushing infrequently; and current or previous dental decay in the child or family members⁴⁵.

Some systems used internationally also take into account the patient's socio-economic status and any existing barriers to access health services⁴⁰. For example, the Caries Management by Risk Assessment (CAMBRA) developed by the California Dental Association has been adapted for use from birth to age 5 years (Appendix I), and is taught to students in the Bachelor of Dental Surgery at the University of Otago, as well as to students in the Oral Health Therapy training programmes at both Auckland University of Technology (AUT) and the University of Otago. Certain elements of the full assessment (e.g. bacteriological evaluation) may be omitted when CAMBRA is applied as a screening tool. An adapted version for preschool children involves a short interview with the caregiver to rate the child's risk of caries development as low, moderate, or high based on risk factors, protective factors, and clinical findings^{53,54}.

This risk assessment tool had a reported sensitivity of 83.7% and specificity 62.9% for predicting oral health 12 months after assessment for 3-year-olds in Hong Kong⁵⁵. To our knowledge, this version of the CAMBRA has not been validated for use with children younger than 3 years of age or in New Zealand, and its potential for use in *WCTO* settings is unclear. However, dental caries is the same condition at any age, and when applied as a screening tool, the single-page assessment tool is the most systematic screening tool we were able to identify that is, at least, partially validated for use among preschool children. The risk assessment tool recommended by the American Academy of Pediatric Dentistry assesses caries risk based on similar risk factors to the CAMBRA, but includes a question about night-time bottle feeding⁵⁶. This could improve its sensitivity for detecting caries risk in very young children, but validity of the screening tool has not been assessed.

8.3 Summary

- *The lift-the-lip is very easy to perform by any adult and should constitute the cornerstone of community screening.*
 - *Identification of any visible sign or suspicion of ECC should result in prompt referral to dental services.*
 - *The lift-the-lip should not replace comprehensive assessment by oral health practitioners, but used opportunistically during any health checks.*
 - *Dental disease can only be ruled out with an examination by an oral health practitioner.*
 - *Many risk factors for ECC are known, but no standardised screening tool for ECC risk has been validated or adopted in New Zealand.*
 - *The single page CAMBRA screening form could be adapted and applied for use in screening for caries risk.*
-

8.4 Interventions for prevention of dental disease

New Zealand's Oral Health Clinical Advisory Network (OHCAN)³⁷ describe the four cornerstones of prevention:

- brushing twice a day with fluoride toothpaste
- fissure sealants
- dietary advice for food and drink intake
- other fluoride vehicles

Note that a summary of the available evidence from meta-analyses of randomised controlled trials is provided in Appendix II. While we focused on the evidence for primary teeth, it is important to note that the evidence on permanent teeth is still relevant; although the enamel of primary teeth is thinner, both teeth are of very similar composition (i.e. calcium apatite crystals)⁵⁷.

Early intervention is important for preventing dental caries in childhood and maintaining good oral health into adulthood⁵⁸. Accordingly, New Zealand's COHS has a strong focus on maintaining good oral health in early childhood through prevention and early treatment of dental disease²⁹. Untreated ECC has a number of adverse effects on child well-being that can have long-term consequences. Children with caries can experience pain that results in difficulty eating and sleeping, and may face self-esteem issues due to the appearance of their teeth^{10,24}. ECC requiring dental work predict further problems with dental disease, including increased risk of decay in permanent teeth^{10,11}. Severe ECC may require hospitalisation for tooth extraction and can lead to infectious complications^{11,24}.

8.4.1 Toothbrushing and fluoride toothpaste

Toothbrushing is an effective means for preventing dental caries primarily as a delivery mechanism for fluoride. Fluoride cannot reach tooth surfaces that are covered with thick plaque³⁷, and brushing with fluoride toothpaste removes surface plaque, improving delivery of fluoride to the tooth surfaces and reducing the bacterial load, thus reducing caries risk^{2,37,59}. It is not recommended to rinse after brushing as this can neutralise the benefits of brushing with a fluoride toothpaste⁶⁰. Unfortunately, according to the 2009 Oral Health Survey, only 15.3% of 2-4 year olds in New Zealand brushed daily with fluoride

toothpaste², despite brushing with fluoride toothpaste being associated with lower dmft among children^{59,61}.

Using fluoride toothpaste of at least 1000 ppm concentration reduces the development of dental caries in comparison to non-fluoride toothpaste⁶¹ (Table 8.3). Importantly, there is no robust evidence to show that lower fluoride toothpastes (≤ 550 ppm) have any benefit over placebo for ECC⁶¹ (Table 8.3) or for caries prevention on permanent teeth⁶¹ (Appendix II), despite being marketed as child-friendly and believed by many parents to be an optimal choice⁸. In New Zealand, mainstream toothpaste companies have recently withdrawn low fluoride concentration toothpastes from the market, but numerous non-fluoride toothpastes have recently been introduced by smaller companies. Conversely, there is some evidence that higher fluoride concentrations (above 1250 ppm) may have more beneficial effects for both children and adults^{61,62} (Table 8.3), and toothpastes with high fluoride concentrations (2800ppm) are sometimes prescribed for older children at high risk for caries¹⁰. However, based on the available evidence, in New Zealand it is recommended that toothpaste with 1000 ppm fluoride be used for children of all ages, although infants and children should use only a smear of toothpaste⁶³. While evidence-based, this guidance differs from other countries such as Australia and the UK. Nonetheless, this means that it is important that a small amount of toothpaste (a smear) be used for infants and young children and that any swallowing is minimized¹⁰. For this reason, and to ensure that proper brushing technique is used, young children should be supervised while brushing¹⁰. Of note, there is some evidence that powered toothbrushes are more effective in reducing plaque and improving gingivitis scores than manual toothbrushes in older children and adults⁵⁹, with very limited evidence for children aged 5 years or younger⁶⁴ (Table 8.3). Thus, it is still unclear whether there is any additional benefit from powered toothbrushes among young children, particularly if there is parental supervision of toothbrushing.

While toothbrushing frequency may vary between children, school programmes can reach a large number of children to encourage effective brushing. For example, a recent study in New Zealand found a toothbrushing programme to be effective at improving oral health-related quality of life among Northland children⁶⁵. Overseas, Childsmile is an evidence-based oral health programme (including community interventions) that was introduced in Scotland in 2006, aiming at reducing inequalities in oral health^{66,67}. It provides evidence that a preschool-based toothbrushing programme can be feasible, efficacious, and cost effective. Childsmile developed out of a programme that involved provision of free toothbrushes and toothpaste to all Scottish children under the age of 6 years since 2001. In addition, this programme includes free supervised daily toothbrushing for every 3- to 4-year-old who attends preschool, and for first- and second-year students at primary schools in the highest quintile for deprivation (the equivalent of decile 1 and 2 schools in New Zealand)^{67,68}. A cost-benefit analysis indicated that while the program cost just under £1.8 million per year to implement, the number of 5-year-olds with filled, decayed, or missing teeth halved between 2000 and 2010⁶⁸. This resulted in savings of £2 million in dental care spending within three years of implementation, and in 2009/2010, the estimated savings of the program were £4.7 million⁶⁸. Importantly, the greatest savings were due to a reduction in extractions among children from the most deprived neighbourhoods⁶⁸.

8.4.2 Fissure sealants

Fissure sealants are effective for preventing caries in the pits and fissures of children's teeth. Most available evidence focused on the permanent teeth, showing marked reduction in dental caries⁶⁹, with larger effect sizes reported when sealants and varnish was used together in comparison to fluoride varnish alone⁷⁰ (Table 8.3). Fissure sealants have long been used for prevention of pit and fissure caries in New Zealand⁷¹.

Table 8.3. Evidence for oral health interventions from meta-analyses.

Data focuses on evidence for primary teeth, but evidence on permanent teeth is provided if deemed appropriate.

Intervention	Type †	Source	Comparison	Study characteristics	Finding	Quality/ Certainty of evidence	Conclusions/Recommendations
Chlorhexidine	OHP	Walsh 2015 ⁷²	Chlorhexidine 0.12% gel vs no T _x	Meta-analysis 2 RCTs Follow-up 2 years n=487; aged 0–2 years at baseline Outcome new caries on primary teeth	RR 1.00 (0.36, 2.77)	Very low	No evidence of benefit
				Meta-analysis 2 RCTs Follow-up 2 years n=490; aged 0–2 years at baseline Outcome Streptococcus mutans	RR 1.26 (0.95, 1.66)	Very low	No evidence of benefit
Fissure sealants	OHP	Ahovuo-Saloranta 2017 ⁶⁹	Resin-based sealant versus no sealant	Meta-analysis of 7 RCTs 4-year follow-up n=1,322; aged 5–10 years at baseline Outcome: caries in permanent molars	OR 0.12 (0.08, 0.19)	Moderate	Benefits of resin-sealants were maintained throughout the 4-year follow-up
Fluoride gels	OHP	Marinho 2015 ⁷³	FG vs placebo/no T _x	Meta-analysis of 25 RCTs 1-5 years follow-up n=8,479 Outcome: D(M)FS	PF# 28% (19%, 36%)	Moderate	Large reduction in tooth decay in permanent teeth from moderate quality evidence
				Meta-analysis of 10 RCTs 1-5 years follow-up n=3,198 Outcome: D(M)FT	PF 32% (29%, 57%)	Moderate	Large reduction in tooth decay in permanent teeth from moderate quality evidence
				Meta-analysis of 3 RCTs 1- to 5-year follow-up n=1,254 Outcome: d(e/m)fs	PF 20% (1%, 38%)	Low	Large reduction in tooth decay in primary teeth from low quality evidence (few studies)
Fluoride in milk	Home/ PopW	Yeung 2015 ⁷⁴	180–200ml milk ~0.5ppm F ⁻ vs non-fluoridated milk	1 RCT Follow-up 3 years n=166; aged 3 years at baseline Outcome dmft	-0.13 (-0.24, -0.02) PF 76% (2%, 100%)	Very Low	Number of issues: very wide CI for PF; unpublished data; parents were unblinded; high baseline level of caries; and low fluoride levels in drinking water (0.18–0.20ppm F).
Fluoride supplementation (pregnant women)	Home	Takahashi 2017 ⁷⁵ on Leverett 1997 ⁷⁶	2.2mg NaF tablet (1mg F) daily vs placebo (from 4 th mo until delivery)	1 RCT ⁷⁶ Follow-up at 3 and 5 years n=938 and 798, respectively Outcome dfs	3yr RR 1.46 (0.75, 2.85) 5yr RR 0.84 (0.53, 1.33)	Very low	Only one RCT met inclusion criteria, and there was no evidence that maternal fluoride supplementation during pregnancy help prevent decay in primary teeth in the offspring.

Intervention	Type †	Source	Comparison	Study characteristics	Finding	Quality/ Certainty of evidence	Conclusions/Recommendations
Fluoride supplementation (children)	Home	Tubert-Jeannin 2011 ⁷⁷ on Lin 2000 ⁷⁸	NAF tablets/drops (0.25-0.50mg F) daily vs no T _x	1 RCT ⁷⁸ Follow-up 2-3 years n=115; aged 22–26 months at baseline Outcome d(m)fs	PF 73% (46%, 99%)	Very low	Evidence of very low quality from one relatively small study that showed a marked reduction in caries in primary teeth with fluoride supplementation. Population were children cleft lip and/or palate.
		Tubert-Jeannin 2011 ⁷⁷	NaF or APF tablets/drops (0.25-1mg F) daily vs no T _x	Meta-analysis 2 RCT Follow-up 2-3 years n=696; aged 22–26 months and 5.3 years at baseline Outcome d(m)ft	PF 46% (8%, 83%)	Very low	Two studies with high heterogeneity, results with a very wide confidence interval. Study populations unclear.
			NaF tablets (0.25 or 1mg F) vs topical F	Meta-analysis 2 RCTs Follow-up 2-3 years n=1,051; aged 3 and 6 years at baseline Outcome d(m)fs	PF 13% (-7%, 33%)	Moderate	Topical fluorides consisted of varnishes, toothpastes, and mouthwashes. There was no effect of fluoride supplementation, with this observation apparently unaffected by the type of topical treatment.
Fluoride toothpaste	Home	Walsh 2019 ⁶¹ on Fan 2008 ⁷⁹	1500ppm vs fluoride-free TP	1 RCT ⁷⁹ n=998 Outcome: dfs *	-1.86 (-2.51, -1.21)	Moderate	1500ppm toothpaste reduces tooth caries increment compared to fluoride-free toothpaste, from moderate-quality evidence (one study).
		Walsh 2019 ⁶¹	1055ppm vs 550ppm TP	Meta-analysis 2 RCTs n=1,958 Outcome: dmfs *	-0.05 (-0.38, 0.28)	Moderate	No difference in efficacy for 1055ppm TP vs 550ppm TP from moderate-quality evidence (two studies)
		Walsh 2019 ⁶¹ on Davies 2002 ⁸⁰	1450ppm vs 440ppm TP	1 RCT ⁸⁰ n=2,362 Outcome=dmft *	-0.34 (-0.59, -0.09)	Moderate	1450ppm TP led to slight reduction in caries increment compared to 440ppm, with moderate-quality evidence (one large study)
Fluoride varnishes	OHP	Marinho 2013 ⁸¹	FV 2 to 4x per year vs placebo/no T _x	Meta-analysis of 10 RCTs 1- to 2.5-year follow-up n=3,804 Outcome: d(e/m)fs	PF 37% (24%, 51%)	Moderate	ditto
				Meta-analysis of 2 RCTs Follow-up 'closest to 3 years' n=322 Outcome: d(e/m)ft	PF 65% (48%, 82%)	Moderate	ditto
Fluoride varnishes + Pit & fissure sealants	OHP	Ahovuo-Saloranta 2016 ⁷⁰	RBPfseal vs FV	Meta-analysis of 2 RCTs 2-year follow-up Outcome: permanent molar caries n=358; age 6–10 years	OR 0.69 (95%CI 0.50, 0.94) Decay 9.5% vs 13.2%	Low	Low-quality evidence suggestive: RBPfseal > FV alone at 2yr

Intervention	Type †	Source	Comparison	Study characteristics	Finding	Quality/ Certainty of evidence	Conclusions/Recommendations
		Ahovuo-Saloranta 2016 ⁷⁰ on Splieth 2001 ⁸²	RBPfseal+FV vs FV	1 RCT ⁸² 2-year follow-up n=92; age 5–8 years Outcome: caries in permanent teeth	Decay at 2yr: OR 0.30 (95%CI 0.17, 0.55); 7.9% vs 22.3%;	Low	Low-quality evidence suggestive: RBPfseal+FV > FV alone at 2yr
Silver diamine fluoride	OHP	Oliveira 2018 ⁸³	T _x : 38% SDF onto carious surfaces Control: placebo or no T _x (onto carious surfaces)	Meta-analysis 2 RCTs ^{84,85} Follow-up 2.5–3 years n=496 Outcome: dmft/dmfs	PF 77% (68%, 87%)	Moderate	Silver diamine fluoride effective in the prevention of dental caries in primary teeth.
		Oliveira 2018 ⁸³ on Chu 2002 ⁸⁴	T _x : 38% SDF Control: 5% NaF varnish (onto carious surfaces)	1 RCT ⁸⁴ Follow-up 2.5 years n=123 Outcome: dmft/dmfs	PF 54% (27%, 73%)	Low	Single study, but it was deemed to have mostly low risk of bias.
Toothbrush type	Home	Yaacob 2014 ⁵⁹ on Silverman 2004 ⁶⁴ Δ	Powered vs manual TBr	1 RCT ⁶⁴ Follow-up 6 weeks n=38; aged 4–5 years at baseline Outcome plaque & gingivitis scores	Plaque reduction -13% (-32%, 5%) Gingivitis reduction -55% (-4%, -100%)	Very low	Only RCT in children aged ≤5 years reported in Yaacob 2014 ⁵⁹ . Showed no effect on plaque, but a significant reduction in gingivitis scores at 6 weeks. However, very low quality evidence from a single very small trial.
Xylitol	Home	Riley 2015 ⁸⁶ on Milgron 2009 ⁸⁷	Xylitol syrup (8 g/day) vs Xylitol syrup (2.7 g/day)	1 RCT ⁸⁷ Follow-up 1 year n=94; aged 9–15 months at baseline Outcome no. decayed primary teeth	-1.10 (-2.03, -0.18) PF 58% (7%, 78%)	Low	A single RCT provided evidence of a 58% reduction in decayed primary teeth after 1 year with xylitol syrup at 8 g/day. RCT deemed at low-risk of bias, but evidence low quality due to small sample size (and wide confidence interval).
		Riley 2015 ⁸⁶ on Oscarson 2006	Xylitol tablets (0.5–1 g/day) vs no T _x	1 RCT ⁸⁸ Follow-up 2 years n=118; aged 2 years at baseline Outcomes d(m)fs; caries increment vs none/no change	-0.42 (-1.12, 0.28) [d(m)fs] PF 53% (35%, 80%) RR 0.72 (0.35, 1.45)	Very low	One RCT reporting no evidence of benefit on primary dentition with xylitol tablets. However, if the effect on caries increment was assessed as PF, there was indication of a 53% reduction with the treatment. Thus, the evidence is deemed to be very low quality.
		Riley 2015 ⁸⁶ on Taipale 2013 ⁸⁹	Xylitol tablets (200-600 mg/day) vs control (sorbitol) tablets [tablets delivered through pacifiers or spoons]	1 RCT ⁸⁹ Follow-up 4 years n=62; aged 1–2 months at baseline Outcome caries increment vs none/no change	RR 3.08 (0.69, 13.7)	Very low	No evidence of an effect, from very-low-quality evidence (low risk of bias but high attrition rate – 43% loss to follow-up).

Intervention	Type †	Source	Comparison	Study characteristics	Finding	Quality/ Certainty of evidence	Conclusions/Recommendations
		Riley 2015 ⁸⁶ on Zhan 2012 ⁹⁰	Xylitol wipes 3x/day (4.2 g/day) vs control wipes	1 RCT ⁹⁰ Follow-up 1 year n=44; aged 0.5–3 years at baseline Outcome d(m)fs caries increment vs none/no change ⁸⁶ ; Proportion with new d(m)fs ⁹⁰	RR 0.14 (0.02, 1.07) ⁸⁶ DiffProp -0.27 (-0.49, - 0.06) ⁹⁰	Very low	Riley 2015 ⁸⁶ reported no effect based on RR. However, Zhan 2012 reported in the original study a beneficial effect of xylitol wipes based on a Fisher's exact test (incidence of children with new d(m)fs). Nonetheless, the evidence derived from a very small sample size (22 per group).
Primary school-based behavioural interventions	Pre- school	Cooper 2013 ⁹¹ on Zanin 2007 ⁹²	T _x : intensive individual training on TBr technique and structured educational oral health programme (3-monthly) Control: Supervised group training on TBr technique once yearly.	1 RCT ⁹² Follow-up 15 months n=60; aged 4 to 7 years at baseline Outcome DMFS; plaque index	PF 65% (12%, 100%) DMFS [¶] PF 37% plaque index ⁹²	Low	Provided evidence of markedly improved oral health after the education programme. No information on data variability was provided, so it is not possible to assess the level of accuracy of results on plaque. Study also on a small population of children deemed high-risk, but it was deemed low risk of all biases (except allocation concealment that was assessed as unclear).
		Cooper 2013 ⁹¹	T _x : school-based education Control: no T _x	2 RCT ^{93,94} Follow-up 3 months n=419 at 3–4 months; aged 9–10 years at baseline Outcome: plaque index	-0.51 (-0.80, -0.21) PF 38% (15%, 59%) [¶]	Low	Substantial heterogeneity. One of the studies included (Saied-Moallemi 2009 ⁹³) showed best outcomes when parents were involved at home.

Population-wide interventions such as fluoridation of water⁹⁵ have been excluded.

Data on findings are means and respective 95% confidence intervals. Studies on adults were not included.

APF, acidulated phosphate fluoride; CI, confidence interval; d(e/m)fs, decayed (extraction indicated/missing) or filled primary surfaces; d(e/m)ft, decayed (extraction indicated/missing) or filled primary teeth; dfs, decayed or filled primary tooth surface; DFS, decayed or filled permanent tooth surface; OHP, oral health practitioner; D(M)FS, decayed (missing) or filled permanent surfaces; D(M)FT, decayed (missing) or filled permanent teeth; F, fluoride; FV, fluoride varnish; NaF, sodium fluoride; OR, odds ratio; PF, prevented fraction; PopW, population-wide intervention; RBPfseal, resin-based pit and fissure sealant; RR, relative risk/risk ratio; SDF, silver diamine fluoride; TBr, toothbrush(es)(ing); TP, toothpaste; Tx, treatment.

PF, prevented fraction is derived as [(mean caries increment in controls – mean caries increment in treated group) / (mean caries increment in controls)], where the caries increment is calculated as, for example, (final DMFS – baseline DMFS).

† Type refers to the setting in which a given treatment would be applied in the real world.

* Differences were expressed as caries increment, i.e. surface index d3fs or d3(m)fs or D3(M)FT adjusted for baseline value.

‡ Data provided as mg/L, and 1 mg/L = 1 ppm.

Δ Effect size calculated here using a two-sample t-test.

¶ The PF upper limit was corrected to 100%, as original PF provided by Cooper 2013⁹¹ was erroneous for including an upper limit >1, i.e. there were fewer caries on permanent dentition than children started with. This would be theoretically possible if the children had lost permanent teeth without accruing new caries on the permanent dentition, which is very unlikely to occur across of group of young children deemed to be high-risk.

8.4.3 Fluoride mouthwashes

Fluoride mouthwashes are largely unsuitable to target ECC in most children aged <5 years who would likely swallow them, putting these children at risk of fluorosis. Thus, there is a paucity of evidence on the efficacy of fluoride mouthwashes for primary teeth. However, a large meta-analysis of 35 RCTs on 15,305 children aged 6–14 years provided moderate quality evidence showing a prevented fractionⁱ of 27% (95% CI 23%, 30%) in DMFS, with findings largely unaffected by caries severity, background exposure to fluorides (e.g. water), fluoride concentration, or rinsing frequency⁹⁶. Thus, supervised fluoride mouthwashes may help prevent ECCs in those children old enough not to swallow them

8.4.4 Fluoride supplementation

Fluoride supplementation in the form of tablets, drops, or lozenges has been shown to have positive effects on child oral health outcomes in a small number of studies⁷⁷ (Table 8.3). However, the World Health Organization recommends that water, salt, or milk be the primary source of fluoride supplementation, as all have good evidence to support their use and have the potential to reach most if not all of a population^{97,98}. In New Zealand, universally fluoridated water would likely be the most cost effective way to pursue adequate fluoride supplementation in all communities⁹⁹.

8.4.5 Dietary advice and oral health education

Dietary habits play a key role in caries risk through exposure of the teeth to fermentable carbohydrates, especially monosaccharides (i.e. simple sugars). Consumption of carbohydrates leads to rapid reduction in the pH of biofilm on teeth (known as dental plaque), altering the tooth microbiome, and contributing to demineralisation of the tooth enamel^{2,4,37}. Bacteria or plaque dysbiosis alone will not lead to tooth decay, but free sugars in particular promote an environment of increased risk^{4,100,101}. Saliva protects teeth by diluting acids at the tooth surface, and normally contains calcium and phosphate (essential for remineralisation of tooth surfaces) and bicarbonate (essential for buffering oral acids). Saliva may also contain fluoride from toothpaste or dietary sources^{37,102}, which can prevent and reverse early caries¹⁰³.

A commonly cited review suggests that dental health education interventions can have a significant but temporary positive effect on oral hygiene, and that while educating parents may improve child oral health, there is little evidence that school-based programmes are effective¹⁰⁴. However, this review is more than 20 years out of date, and the evidence base has changed. Currently, there is moderate evidence that education and behavioural interventions based in primary schools (which may or may not include a ‘homework’ component involving parents) can reduce children’s plaque levels⁹¹. Cooper et al.’s Cochrane review from 2013 included one study that suggested an effect of preventing caries, and another that reported improved oral health knowledge among participating children⁹¹. One school-based oral health intervention in Iran reported that parental involvement was critical for the success of their programme⁹³.

Family engagement is especially important for oral health, as parents and caregivers can affect children’s oral health both directly and indirectly through their behaviours, knowledge, and attitudes^{9,105,106}, which can have an effect throughout life¹⁰⁷. Young mothers in general may have poor knowledge about disease prevention and the consequences of poor oral health¹⁰⁸. Motivational

ⁱ Calculated using the formulae:

$$\text{Caries increment} = \text{final dmfs} - \text{baseline dmfs}$$

$$\text{Prevented fraction} = \frac{\text{mean caries increment in controls} - \text{mean caries increment in treated group}}{\text{mean caries increment in controls}}$$

interviewing or education one-on-one in a dental setting may be effective for improving diets¹⁰⁹, and while such evidence is not child-specific, the composition of infant/child diets are determined by adult caregivers. Further, motivational interviewing has been successfully incorporated into a culturally-informed intervention for Australian Aboriginal children¹¹⁰, and has been adapted for use with Māori caregivers in an oral health setting¹¹¹.

Oral health changes during pregnancy (e.g. pregnancy gingivitis)¹¹² and education during this critical period can help establish the idea of good oral health as important for general health and wellbeing¹⁰. Further, dental care during pregnancy is a good time for anticipatory advice for infant and child oral health¹⁰, which has been demonstrated to improve expectant mothers' oral health knowledge and potentially child outcomes^{113,114}. Although it seems there are no data for New Zealand, provision of anticipatory guidance during pregnancy was associated with a reduction in the prevalence of severe ECC in young Australian children¹¹⁵, and oral health education for new mothers has been associated with improved child oral health internationally¹¹⁶. Conversely, there is likely to be no benefit of maternal fluoride supplementation during pregnancy on ECC risk in primary teeth among the offspring, and this has been verified through research^{75,76}.

Media campaigns have the potential to reach a wide audience, making them suitable for preventive education. The Baby Teeth Matter campaign aimed to promote oral health awareness, particularly among Māori, Pacific, or low income families of pre-schoolers, using a re-imagined Māori tooth fairy in TV, radio, social media, and other online advertisements¹¹⁷. The promotion was remembered by the majority of participants in an evaluation study. A third of those who saw the campaign had made changes to their child's dental care, most commonly by ensuring their child's teeth were brushed twice daily¹¹⁷.

It is important that health education interventions intended to result in behaviour modification are supported by regulation and health public policy. Children in New Zealand are regularly exposed to marketing of sugary drinks, fast food, confectionary, and snacks in home, school, and public settings¹¹⁸. Unhealthy food television advertisements are most frequent during peak times for child viewing¹¹⁹, and have an impact on children's food requests¹²⁰. In this context, an infrequent and perhaps rushed educational interaction with an oral health professional once every six months is likely to be undermined by parents and their children being frequently exposed to advertising for unhealthy products.

8.4.6 Childsmile and fluoride varnish

As well as the toothbrushing programme, Childsmile comprises several components, all of which include oral health education alongside other interventions⁶⁷. Childsmile begins with universal screening of infants at their 6-8 week health check to identify those who are at increased risk for developing dental caries⁶⁶. Families of these infants are encouraged to visit a dental service when their child is around six months of age, and to have six monthly checks thereafter. These visits provide opportunities to educate about diet and toothbrushing, and to administer appropriate clinical interventions based on the child's needs (e.g. fillings, fissure seals, fluoride varnish)⁶⁷. It is of note that no elements of Childsmile are 'new', and all elements are used in New Zealand to some extent. Childsmile simply takes well-established caries preventive and management strategies, but actually implements them on a wide scale, ensuring that staff are available, trained, and funded to reach out to communities.

Another key component of the Childsmile program is a targeted oral health intervention for children aged three years or older attending schools or preschools in the highest quintile for deprivation. All

children attending these schools regardless of individual risk are offered fluoride varnish to be applied to their teeth twice-yearly by mobile teams of specially trained dental nurses⁶⁷. Parental consent and a brief medical history are sought then revised by a dentist, who gives an individual prescription for the varnish unless it is contraindicated. The success of this intervention is thought to rely largely on parental consent⁶⁷. Consent varies considerably between educational establishments and may depend on the school/preschool's commitment to the program and ability to chase up parents who have not completed the consent form⁶⁷. The fluoride varnish programme has not yet been fully evaluated, but the number of children receiving fluoride varnish has increased since its implementation¹²¹. The proportion of three-and-four-year-old children receiving two applications in the 2013/14 school year was highest in those from the most deprived quintile¹²¹. However, only 40-50% of these children received the recommended applications¹²¹. In 2011 the fluoride varnish programme was extended by offering remuneration to all dental practitioners who apply varnish to children aged two to five years, but this had only a modest effect on practice for the majority of practitioners¹²².

Evidence from Sweden supports a targeted approach to fluoride varnish application. A three-year randomised controlled trial demonstrated no significant benefit of fluoride varnish application for children determined to have low risk for caries, while among high-risk children, twice-yearly application was associated with a 69% reduction in caries incidence¹²³. These children were aged 13 years at the beginning of the study, so the results may underestimate the potential of early intervention approaches. In New Zealand, targeting those who are likely to benefit most from fluoride varnish may be challenging as there is no standardised and validated screening tool available. The Childsmile approach of targeting those who live or go to school in the areas of highest deprivation may reach the majority of those who are at highest risk for ECC.

8.4.7 The New Zealand context

Dental caries is the same disease the world over, and at any age, and international experience can inform what happens in New Zealand. The key to reducing dental caries prevalence and severity is investment in prevention. There is ample evidence that strategies such as toothbrushing programmes, clinical preventive care and health policy measures can be effective. Historically, caries rates fell markedly among New Zealand children following the reorientation of New Zealand's School Dental Service in the 1970s at which time a greater focus on preventive care was introduced. School dental nurses were discouraged from doing as many fillings as they had been placing and were instead encouraged to provide preventive-only appointments. The number of restorations placed per child dropped from 5 restorations per year in 1965 to 1.5 restorations in 1981¹²⁴. Count of decayed, missing and filled teeth at age 5 years dropped rapidly reducing from 3.7 teeth in 1977 to 2.6 teeth in 1982¹²⁵. These improvements have been sustained, and advances in dental care mean dmft scores among five-year-old children has reduced further. However, the rate of improvement has largely stagnated, with only a modest improvement in mean dmft at age 5 over the past decade (from 2.0 in 2009 to 1.8 in 2009). Limitations of the dental service mean that clinicians must deal with problems that occur before a child ever reaches a dental clinic; this underlines the key role that WCTO could play in the front line of prevention of dental caries

8.4 Summary

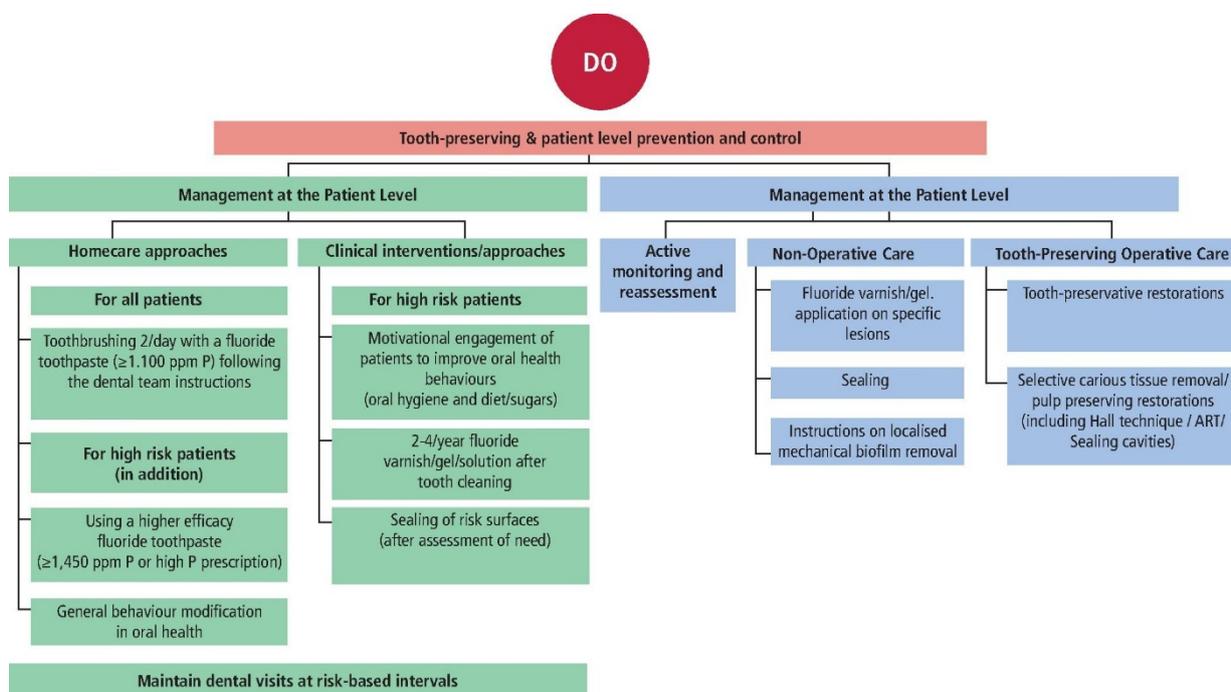
- *Key preventive measures for ECC are behavioural: toothbrushing twice daily with 1000 ppm toothpaste and reducing intake of sugary drinks and food.*
- *Interventions focussing on these behaviours can be successfully implemented in pre- and primary schools, especially when caregivers are involved.*

- *Universal water fluoridation is recommended.*
- *The Childsmile programme is a valuable model that has shown to be cost effective, leading to reductions in ECC, dental care spending, and inequalities in oral health among Scottish children.*
- *A similar strategy to Childsmile is likely to be achievable in New Zealand, but would require investment, including prioritisation and delivery of effective preventive dental care.*

8.5 Effective interventions following early detection of dental disease

Because of the preventive focus of dental care, there is considerable overlap between preventive strategies and ‘treatment’ interventions. Thus, almost invariably every effective preventive measure for dental disease would also be part of the management following detection of actual ECC. However, while preventive approaches can be administered at a community level, treatment of existing dental disease must be carried out by an oral health practitioner and is therefore beyond the scope of this review. Nonetheless, in general, the aim of dental treatment for decay is to restore decayed teeth and prevent further progression of the disease. The exact treatment plan depends on the practitioner’s clinical judgement, taking into account the child’s age and cooperation. The CariesCare practice guide, written by an international group of experts on dental caries has outlined how treatment and prevention may combine in patient care (Figure 8.1)¹³. The figure further demonstrates that motivational engagement to change patients’ health behaviours is an important part of dental care¹³. For children, family engagement using principles of motivational can improve both oral health knowledge and actual health behaviours¹⁰⁵.

Figure 8.1. Flowchart reproduced with permission from Martignon 2019¹³ showing tooth-preserving and patient level prevention and control.



Note: this figure is an illustration, not a specific prescription.

Population level interventions are beyond the scope of this review, but they have the potential to effect significant changes on behavioural risk factors for dental disease, such as dietary choices. Although it is recommended that sweetened beverages and juices should be avoided entirely by young children¹⁰ (or not be supplied to them), New Zealanders are among the top consumers of sugar worldwide, and in 2007 this country's annual per-capita consumption of sugar exceeded those in the USA, UK, Canada, and Australia¹²⁶. In this context, the World Dental Federation recommend higher taxation on sugar-rich foods and sugar-sweetened beverages¹²⁷. Health taxes have demonstrated positive effects on consumer behaviour¹²⁸, including a reduction in purchasing of sugar-sweetened beverages in Mexico and a restaurant chain in the UK after the introduction of a levy on these products¹²⁹. New Zealand data suggest that changes to packaging and prices of sugar-sweetened beverages are likely to affect purchasing decisions¹³⁰. A recent cost-benefit analysis suggested that a 20% tax on sugar-sweetened beverages in Australia could result in savings of at least \$666 million over 10 years due to reduced dental decay and subsequent dental treatment¹³¹.

8.5 Summary

- *Treatment of established dental disease requires the involvement of oral health practitioners and cannot be performed in community settings; however, ongoing preventive care should still be provided.*
 - *If there is a lesion, oral health practitioners can consider silver diamine fluoride (even for very young children), which would delay the time to the first restorative intervention and minimise the risk that the child will require general anaesthetic for dental treatment.*
 - *As dental disease such as caries is cumulative, it is important that children identified to have dental disease (or for whom a sibling experiences dental disease) should be classified as high risk and remain a target for preventive interventions.*
 - *Treatment of dental decay is multifaceted and includes management of patient factors such as oral health self-care and diet.*
-

8.6 Potential harms from screening and/or early intervention

8.6.1 Screening

Due to the difficulty of visually identifying tooth decay in a primary care setting, it is likely that the lift-the-lip will lead to false negatives cases⁴⁸. Conversely, if early caries are missed by the assessor during the lift-the-lip, some parents may believe that their child is free of tooth decay and do not take their child to see an oral health practitioner as appropriate. Therefore, it should be clearly communicated to parents that the lift-the-lip examination is not a replacement for a comprehensive dental exam by a qualified oral health practitioner⁴⁸.

8.6.2 Fear of treatment

Many children and adults experience fear of dental procedures or dental practitioners; this may lead to avoidance behaviour and consequently to delayed diagnosis of tooth decay, requiring more extensive and more costly treatment^{8,10,132,133}. This is especially true for children who have previously suffered from toothache or had a painful experienced during dental treatment, or children whose parents who fear the dentist¹³².

It has been theorised that positive, early exposure to an oral health clinic environment before any treatment is necessary could reduce the likelihood of children developing such fears, as well as providing an opportunity for anticipatory guidance to help prevent oral health problems^{8,10}. Of note, techniques such as the Atraumatic Restorative Technique (ART) do not use electrical tools (i.e. 'drills'), and may be used to minimise the risk of young children having unfavourable experiences of dental care, although ART restorations last poorly relative to conventional dental treatment¹³⁴.

8.6.3 Fluoride

Excessive exposure to fluoride can result in fluorosis as permanent teeth develop during the first eight years of life⁹⁹. In its common mild form fluorosis may be observed as opaque white areas in the tooth enamel, which are of purely cosmetic significance. Moderate fluorosis involves mottling and discolouration on all teeth, while severe fluorosis may additionally cause pitting or a 'corroded' appearance of enamel. Severe fluorosis is rare in New Zealand⁹⁹, but it may be observed among individuals who immigrate from regions of the world where fluorosis is endemic. Developmental defects of enamel in permanent teeth are more likely if the primary tooth was carious¹³⁵. These are not associated with fluoride exposure, but may be misdiagnosed as fluorosis¹³⁶.

To minimise risk of dental fluorosis, it is recommended that excess fluoride toothpaste is not swallowed, and that children should use smaller amounts than adults^{10,63,137}. Children should also be observed while brushing their teeth to ensure that excess toothpaste is not swallowed. Acute fluoride poisoning is possible if a small child swallows a large amount of toothpaste (around 50 g depending on the child's weight), but in most cases symptoms will resolve quickly with no apparent long-term effects¹³⁸. Existing New Zealand guidance is that toothpastes of 1000 parts per million fluoride should be used by children of all ages⁶³.

There is a clear consensus in the scientific literature that fluoridated water is safe and effective for improving oral health at concentrations used in New Zealand⁹⁹. Some studies have reported high levels of fluoride to be associated with lower IQ scores, but the evidence that fluoride has effects on neurodevelopment at levels recommended for community water fluoridation is lacking^{99,139}. A recent Canadian study suggested that there may be sex-specific effects of maternal fluoride intake during pregnancy on offspring IQ score¹⁴⁰, but other studies have had contradictory findings^{139,141}.

Community water fluoridation has the potential to provide greater benefit at lower cost than other interventions due to its wide reach, but only half of New Zealanders receive fluoridated water^{99,142} (Appendix III). Although community water fluoridation is less cost-effective in some areas than others, uptake of a Ministry of Health subsidy for fluoridation was low, suggesting that when the barrier of cost is addressed there is still reluctance to implement this public health measure¹⁴².

Anti-fluoride groups are a barrier to community water fluoridation, as local government is currently responsible for both decision-making on this issue and legal fees if challenged by anti-fluoride activists^{142,143}. A bill currently awaiting its second reading in the New Zealand Parliament proposes transferring water fluoridation decision-making to District Health Boards as a reflection of its importance as a wider public health measure rather than a matter for local government. Minimal fluorosis has been reported in New Zealand in areas receiving fluoridated water supplies. Those at highest risk are infants who consume formula constituted with fluoridated water and therefore may have exceeded recommended limits⁹⁹ until their revision¹⁴⁴. However, even in this higher risk group, fluorosis causing cosmetic concern is rare, and benefits for oral health are thought to far outweigh this risk⁹⁹.

8.6.4 Other interventions

The majority of intervention studies for dental disease do not report whether or not participants experienced adverse outcomes. Studies that report on adverse events are summarised in .

Table 8.4, noting that studies on infants and preschoolers that report adverse events are rare. Further, even though some studies included in the table reported adverse events, most did not provide detail such as the proportion of participants who experienced them. Importantly, no serious adverse events have been reported (Table 8.4).

Table 8.4. Recorded adverse events in association with oral health interventions*

Intervention	Study	Study characteristics	Adverse events	Comments
Chlorhexidine varnish	Walsh 2015 ⁷²	4 RCTs n= 1146 Age: 0-5 years, 1 study mean 13.2 years	Nil	No adverse events reported
Fluoride gels	Marinho 2015 ⁷³	3 RCT or quasi-RCTs n= 609 Age: 6-15 years	Nausea, vomiting	Very low quality evidence, proportion affected unclear
Fluoride mouthwashes	Marinho 2016 ⁹⁶	6 RCT or quasi-RCTs n= 3325 Age: ~7-13 years (some reported only mean age)	Tooth staining	Data incompletely reported; majority reported no adverse side effects.
Fluoride tablets	Tubert-Jeannin 2011 ⁷⁷	1 RCT n= 640 Age: mean 6.6 years	Fluorosis	One child had moderate fluorosis and fewer than 1% had mild fluorosis. No severe fluorosis reported.
Fluoride toothpaste	Walsh 2010 ⁶²	14 RTs n= 16364 Age: 4-13 years	Tooth staining	Majority of studies reported no adverse events. Tooth staining was only reported in data collected before 1975.
Fluoride varnish	Marinho 2013 ⁸¹	3 RCT or quasi-RCTs n= 200 aged 1-4 years, 758 aged 13-16 years, 16 aged 22-30 years	Nil	No adverse events reported
	Ahovuo-Saloranta 2016 ⁷⁰	3 RCT n=1180 Age: ~6-10 years	Nil	Note: same studies as above (resin-based and resin-modified glass ionomer fissure sealant)
Powered and manual toothbrushes	Yaacob 2014 ⁵⁹	40 RCTs n=? Age: mostly adults	Soft tissue damage	Absent in most studies, no apparent difference in risk of soft tissue damage between manual vs powered toothbrush use.
Resin-based fissure sealants	Ahovuo-Saloranta 2016 ⁷⁰ & 2017 ⁶⁹	2 RCTs n=853 Age: 6-10 years	Nil	No adverse events reported
Resin-modified glass ionomer fissure sealant	Ahovuo-Saloranta 2016 ⁷⁰ & 2017 ⁶⁹	1 RCT n=327 Age: mean 7 years	Nil	No adverse events reported
Silver diamine fluoride	Seifo 2019 ¹⁴⁵	8 systematic reviews n=? Age: primarily adults	Black staining of carious lesions White painful lesions in oral mucosa	The proportion of patients affected by staining is not clear. Staining was not of concern to the majority of participants. Lesions were due to accidental contact of mucosa with silver diamine fluoride, proportion affected unclear.
Topical fluoride	Wong 2010 ¹⁴⁶	2 RCTs, 1 cohort study, 6 case-control studies, 16 cross-sectional surveys n= 27,868 Age: 12 months to 17 years	Fluorosis	Only toothpaste evaluated. Brushing with fluoride toothpaste before 12/14 months associated with increased fluorosis risk, no evaluation of severity.

Intervention	Study	Study characteristics	Adverse events	Comments
Xylitol candy	Riley 2015 ⁸⁶	1 RCT n= 252 Age: mean 8 years	Nil	No adverse events reported
Xylitol fluoride toothpaste	Riley 2015 ⁸⁶	2 RCTs n= 4214 Age: 7-12 years	Nil	No adverse events reported
Xylitol syrup	Riley 2015 ⁸⁶	1 RCT n= 94 Age: 9-15 months	Loose stools and diarrhoea. Nil serious adverse events	Similar rates of loose stools and diarrhoea between different dose groups.
Xylitol wipes	Riley 2015 ⁸⁶	1 RCT n= 44 Age: 6-35 months	Nil	No adverse events reported

* Note that in light of the paucity of published data on adverse events in young children, we have listed some evidence reported for older children and in some cases adults.

8.6 Summary

- *The use of fluoride toothpaste is safe and effective, but young children require supervision to minimize any swallowing.*
- *The quantity of toothpaste placed on a brush should be limited to a smear, owing to the high fluoride concentration in toothpastes recommended for use among children in New Zealand.*
- *Minimally invasive treatments may reduce fear associated with dental treatment.*
- *While some adverse events have been associated with specific oral health interventions, most were rare and/or of minor concern.*

8.7 Māori and Pacific knowledge about screening and intervention for dental disease

The prevalence of ECC among non-Māori and non-Pacific New Zealanders is similar to rates reported in other high-income countries, but prevalence among Māori and Pacific children is consistently reported to be twice as high^{2,32,143}.

Many complex social and political factors contribute to poor oral health experienced by Māori and Pacific children^{3,143}. Poverty creates an environment of high risk for poor oral health, and disproportionately affects Māori and Pacific families in New Zealand¹⁴³. During early life, when children are dependent on others for their health needs, oral health is strongly related to both the knowledge and beliefs of parents and their economic circumstances⁹. Poor oral health literacy has been reported among Māori and Pacific parents and those from neighbourhoods with high deprivation^{8,28}. Māori and Pacific children consume much more sugary drinks than children from other ethnic backgrounds¹⁴⁷, and qualitative data from two studies suggest that convenience and affordability are key factors in food choices for Māori caregivers^{111,148}.

Pacific Islanders living in New Zealand are a diverse group with different cultures, languages, and traditions, but overlapping social circumstances¹⁴⁹. Ethnic subgroups within Pacific ethnicity are associated with oral health practices^{28,149}. In particular, Tongan children are less likely to brush their

teeth as recommended, less likely to be supervised while brushing, and more likely to snack immediately before bed compared to other Pacific children^{28,149}.

The extent to which Pacific mothers feel aligned with Pacific Island or New Zealand culture also predicts oral health behaviours¹⁵⁰. Children whose mothers identify strongly with Pacific but not New Zealand culture were less likely to be enrolled in the school dentist service, or to brush their teeth regularly compared to those with other cultural orientations¹⁵⁰. This association between oral health and cultural orientation was not as strong as other individual and societal influences on oral health, but highlights the importance of oral health services and education that are culturally acceptable to those they target. Data from a qualitative study suggests that cultural connectedness and tradition are important in decision making around oral health for Māori women¹¹¹. Many felt that oral health was important for avoiding the pain and cost associated with dental problems in adulthood, but that attempts to provide healthy food for their children could be easily undermined by whānau giving young children sweet treats, and the cost and inconvenience of preparing healthy meals. They saw the value of education efforts that came from within their own communities, and felt that it was important to have access to Māori oral health providers¹¹¹.

Although the number of Māori oral health practitioners appears to be slowly increasing, they still comprise a small proportion of the workforce in comparison to the general population¹⁵¹. Furthermore, Māori oral health providers were consulted during the reorientation of the COHS, but many felt that their input was largely disregarded³⁰. They saw the reorientation project as an opportunity to bring oral health services more in line with the values of community and whānau ora. Instead, the changes made to mainstream services (e.g. mobile clinics) were systems that were already in use by Māori oral health providers in some areas and had failed to address widening inequalities for Māori children³⁰.

Research informed by kaupapa Māori principles that empowers whānau to find solutions within their own communities, and better access to culturally competent care will likely help to improve oral health for Māori children¹¹¹. However, interventions that ignore the root causes of health inequality for Māori and Pacific families (i.e. poverty) are unlikely to close the oral health gap between Māori and Pacific children and other New Zealanders^{111,148}.

When screening or treating patients of any ethnicity, it is important to be sensitive to their cultural beliefs and practices. The Dental Council of New Zealand provides a statement on best-practice for providing care to Māori, which was produced in consultation with Te Ao Marama (the Māori Dental Association). These guidelines provide specific advice for supporting Māori patients in dental setting. For example, Māori consider the head to be tapu, and dental screening and treatment involve touching of the head, so permission of a child's parent/caregiver should be asked before doing so. In more general terms, as whānau are extremely important in Māori culture, it is important that clinicians consider whether a patient may wish for whānau members to be present in an oral health setting; clinicians should not exclude family members against the wishes of their patient.

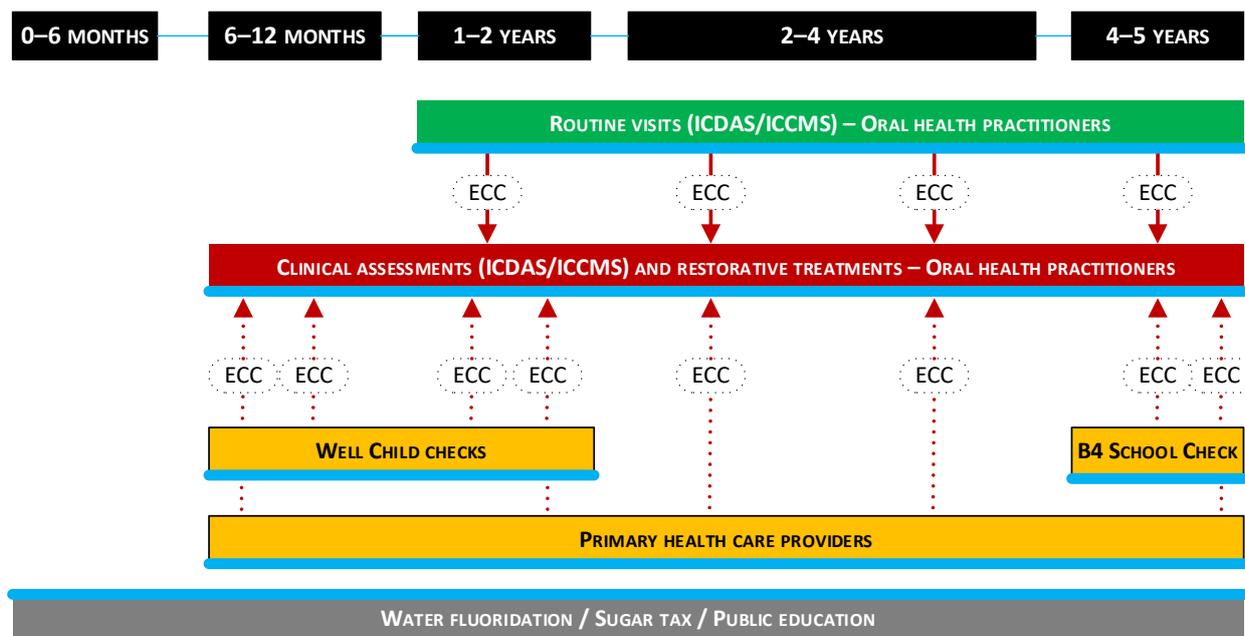
8.7 Summary

- *Māori and Pacific children are at greater risk of dental disease, and should be a priority for oral health screening, prevention, and treatment.*
 - *It is important to develop Māori and Pacific oral health workforce.*
 - *Screening and treatment should be sensitive to Māori and Pacific cultural beliefs and practices.*
-

8.8 Conclusion

Adequate oral health screening and intervention requires a multifaceted approach. Such an approach for New Zealand is summarized in Figure 8.2.

Figure 8.2. – Proposed oral health care system for New Zealand children aged 0–5 years.



- Grey box – recommended population-wide measures that are outside the scope of this study, but which are nonetheless represented as important parts of a national oral health care system.
- Orange boxes – instances where the lift-the-lip screening tool should be performed. If any there is any evidence or suspicion of early childhood caries (ECC), the child should be referred (dotted red lines) to an oral health practitioner for proper assessment and, if necessary, restorative treatment. It must be emphasized that the settings illustrated by the orange boxes are not sufficiently diagnostic of ECC, which must be done by oral health practitioners.
- Blue lines – opportunities where oral health education should be provided to caregivers and/or their children.
- Green box – routine visits to oral health practitioners that should occur at least once-yearly after child completes 1-year of age; if any ECC is identified during an assessment, the child should be referred (solid red arrows) for treatment (red box).
- Red box – restorative treatment administered by oral health practitioners, with more serious cases requiring referral to specialist dental surgeons.

Both assessments and preventive and restorative work by oral health practitioners should be guided by best practice, i.e. the ICDAS (International Caries Detection and Assessment System) and ICCMS (International Caries Classification and Management System). While these are outside the scope of this review, these are important parts of an effective system that requires adequate funding to support best practice.

8.9 Recommendations for further action

Policy and practice

- Deployment of a caries risk assessment tool. The existing CAMBRA tool, known to newly-graduated oral health practitioners in New Zealand could be a starting point for a screening tool to be adapted and applied for use in WCTO screenings for caries risk.
- Incorporation of the lift-the-lip as part of any health screening, by any health practitioner; this tool would serve to better integrate oral health care with general health care services, which will foster conversations with parents about healthy diets, oral self-care, and routine use of dental services.
- Increased investment in preventive dental care – dental caries is a preventable disease and there are many effective strategies. One of the most effective means of preventing dental caries is the brushing of the teeth with fluoride toothpaste. A programme should be implemented to ensure these products are made available to young families at no cost. Dental caries rates can be greatly decreased by application of fissure sealants and fluoride varnish to the teeth of at-risk children. Childsmile provides an example of increasing the reach of fluoride varnish through application in a community setting.
- Early access to care – detected early enough, dental caries can be arrested or reversed, negating the need for costly restorative or surgical dental care. By detecting caries early through routinely ‘lifting the lip’ and ensuring children are referred and promptly seen for treatment, it may be possible to reduce New Zealand’s increasing rate of children requiring general anaesthetics for dental care.
- Increased investment in preventive care should be paired with healthy public policy – early childhood caries frequently occur very early in life, not long after the teeth have entered the mouth, and is directly attributable to an unhealthy or inappropriate diet.
- The Scottish Childsmile programme is a valuable model that is cost effective, reducing ECC, dental care spending, and inequalities in oral health; a similar strategy is likely feasible in New Zealand, but would require investment, including prioritisation and delivery of effective preventive dental care.
- It is unavoidable that we recommend regulation of marketing and sale of products known to cause dental caries, in particular sugary drinks.
- Māori and Pacific children are at greater risk of dental disease, and so should be a priority for oral health screening, prevention, and treatment.

Further research

- Evaluation, including analyses of cost savings, should be incorporated into any changes to the New Zealand oral health system.

8.10 Graded evaluations

Table 8.5. Graded evaluation of screening tools and associated recommendations for policy and practice.

Screening tool	Grade	Estimated net benefit	Level of certainty	Recommendation
Lift-the-lip	B	Moderate	Moderate	This screening tool should be provided to all children.
CAMBRA – preschool	B	Moderate	Moderate	This screening tool should be provided to all children.

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty](#).

Table 8.6. Graded evaluation of interventions and associated recommendations for policy and practice.

Intervention	Grade	Estimated net benefit	Level of certainty	Recommendation
Community toothbrushing programme – community setting	A	Substantial	High	This intervention should be provided to all children attending community childcare settings.
Fluoride varnish programme – community and clinical settings	A	Substantial	High	This intervention should be provided to all children identified in screening to be at high risk for dental caries.
Fissure sealants – clinical setting	B	Substantial	High	This intervention should be provided to all children identified in screening to be at high risk for dental caries.
Fluoride mouthwashes – clinical setting	C	Insufficient evidence	Low	This screening intervention should be provided for selected patients depending on individual circumstances.

Grade: A, B, C, D, or I.

Estimated net benefit: substantial, moderate, small, nil or harmful, or insufficient (evidence).

Level of certainty: high, moderate, or low.

For more detailed explanation see [Supplementary Information - Grade definitions and levels of certainty](#).

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Appendix I – CAMBRA caries risk assessment tool

Updated CAMBRA*** Caries Risk Assessment Form for Patients Aged 0 to 5 (January 2019) (Available in its original form as a patient download at cda.org/CAMBRA4 and on page 40.)			
Caries risk component	Column 1	Column 2	Column 3
Biological or environmental risk factors*		Check if Yes**	
Frequent snacking (more than three times daily)			
Uses bottle/nonspill cup containing liquids other than water or milk			
Mother/primary caregiver or sibling has current decay or a recent history of decay (see high-risk description below)			
Family has low socioeconomic/health literacy status			
Medications that induce hyposalivation			
Protective factors**			Check if Yes**
Lives in a fluoridated drinking water area			
Drinks fluoridated water			
Uses fluoride-containing toothpaste at least two times daily – a smear for ages 0–2 years and pea sized for ages 3–6 years			
Has had fluoride varnish applied in the last six months			
Biological risk factors – clinical exam*		Check if Yes**	
Cariogenic bacteria quantity – Not currently available			
Heavy plaque on the teeth			
Disease indicators – clinical exam	Check if Yes**		
Evident tooth decay or white spots			
Recent restorations in last two years (new patient) or the last year (patient of record)			
Final Score:	Column 1 total	Column 2 total	Column 3 total
Yes in Column 1: Indicates high risk Yes in columns 2 and 3: Consider the caries balance			
Final overall caries risk assessment category	High <input type="checkbox"/>	Moderate <input type="checkbox"/>	Low <input type="checkbox"/>

*Biological and environmental risk factors are split into a) question items, b) clinical exam.

**Check the “yes” answers in the appropriate column. Shading indicates which column to place the appropriate “yes.”

Determining the caries risk as high, moderate or low

1. High risk. If there is a “yes” in column 1 (one or both disease indicators), the patient is at high risk. Even if there are no “yes” disease indicators the patient can still be at high risk if the risk factors definitively outweigh the protective factors. Mother or caregiver with current or recent dental decay most likely indicates high caries risk for the child. Use the “yes” checks for each of the risk factor and protective factor columns to visualize the caries balance as illustrated below. The balance clearly to the left indicates high caries risk, whereas clearly to the right the risk level is low.

2. Moderate risk. If there are no disease indicators and the risk factors and protective factors appear to be balanced, then a moderate caries risk determination is appropriate. If in doubt, move the moderate to a high classification.

3. Low risk. If there are no disease indicators, very few or no risk factors and the protective factors prevail, the patient is at low risk.

Any items checked “yes” may also be used as topics to modify behavior or determine additional therapy. Use the following modified caries balance to visualize the overall result and determine the risk level:

Additional caries-related components for caregiver/patient counseling

- Frequency of use of fluoride toothpaste and amount
- Use of silver diamine fluoride in appropriate cases
- Dietary counseling to reduce frequency and amount of fermentable carbohydrates, especially sucrose, fructose (high-fructose corn syrup) and continual fruit juice (e.g., apple juice)
- Bottle used continually; bottle used in bed or nursing on demand
- Child has developmental problems/child has special care needs (CHSCN)
- Inadequate saliva flow and related medications, medical conditions or illnesses

Self-management goals (discussed and agreed with parent/caregiver)

1. _____

2. _____

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Appendix II – Fluoride toothpaste for permanent teeth

Meta-analyses reported by Walsh 2019^[1] on the efficacy of fluoride toothpaste at various concentrations for caries prevention in permanent teeth. All results below are reported with a follow-up "closest to 3 years".

Comparison	Number of RCTs	n	Outcome	Finding	Quality of evidence
250 ppm vs fluoride-free	3	1,738	DMFS	-0.15 (-0.25, -0.05)	Low
440–550 ppm vs fluoride-free	2	1,092	DMFS	-0.12 (-0.31, 0.07)	Low
440–550 ppm vs fluoride-free	2	1,092	DMFS	-0.18 (-0.41, 0.04)	Low
1000–1250 ppm vs fluoride-free	55	38,666	DMFS	-0.28 (-0.32, -0.25)	High
1000–1250 ppm vs fluoride-free	41	25,953	DMFT	-0.26 (-0.31, -0.21)	High
1450–1500 ppm vs fluoride-free	4	4,600	DMFS	-0.36 (-0.43, -0.29)	Moderate
1450–1500 ppm vs fluoride-free	4	4,600	DMFT	-0.39 (-0.49, -0.28)	Moderate
2400–2800 ppm vs fluoride-free	3	2,026	DMFS	-0.41 (-0.49, -0.33)	Low
2400–2800 ppm vs fluoride-free	2	1,244	DMFT	-0.39 (-0.52, -0.25)	Low
1000–1250 ppm vs 250 ppm	7	4,039	DMFS	-0.14 (-0.24, -0.04)	Low
1000–1250 ppm vs 250 ppm	3	1,769	DMFT	-0.15 (-0.31, 0.00)	Low
1450–1500 ppm vs 1000–1250 ppm	10	15,626	DMFS	-0.08 (-0.14, -0.01)	Moderate
1450–1500 ppm vs 1000–1250 ppm	4	8,137	DMFT	-0.13 (-0.23, -0.02)	Low
1700–2200 ppm vs 1000–1250 ppm	5	12,731	DMFS	-0.03 (-0.12, 0.06)	Low
2400–2800 ppm vs 1000–1250 ppm	6	12,990	DMFS	-0.12 (-0.25, 0.01)	Low
2400–2800 ppm vs 1450–1500 ppm	2	7,082	DMFS	-0.05 (-0.14, 0.05)	Moderate

Findings are expressed as caries increment, adjusted for baseline value, with data provided as means and respective 95% confidence intervals. Statistically significant effects are shown in bold.

DMFS, decayed (missing) or filled permanent surfaces; DMFT, decayed (missing) or filled permanent teeth; RCTs, randomized controlled trials.

[1] Walsh et al. Fluoride toothpastes of different concentrations for preventing dental caries. *Cochrane Database Syst Rev* 2019;(3):CD007868.

Appendix III – Proportion of New Zealand's population exposed to fluoridated water.

According to ESR data, currently 61.4% of the 4,094,680 people in New Zealand that are on networked or specified self-supplies receive fluoridated water^[1].

Thus, 61.4% of 4,094,680 = 2,514,134 people.

Stats New Zealand estimated the country's population at 4,957,400 in March 2019^[2].

As a result, 2,514,134 people or 50.7% of 4,957,400 people had access to fluoridated drinking water supplies.

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Supplementary Information - Grade definitions and levels of certainty

Table S1. Grade definitions for screening tools and interventions

Adapted with permission from the U.S. Preventive Services Task Force 2012.ⁱⁱ

Grade	Definition	Recommendation for policy and practice
A	<ul style="list-style-type: none"> The authors recommend this screening tool/intervention. There is high certainty that the net benefit is substantial. 	<ul style="list-style-type: none"> This screening tool/intervention should be offered or provided.
B	<ul style="list-style-type: none"> The authors recommend the screening tool/intervention. There is high certainty that the net benefit is moderate, or there is moderate certainty that the net benefit is moderate to substantial. 	<ul style="list-style-type: none"> This screening tool/intervention should be offered or provided.
C	<ul style="list-style-type: none"> The authors recommend selectively offering or providing this screening tool/intervention to patients based on professional judgment and patient preferences. There is at least moderate certainty that the net benefit is small. 	<ul style="list-style-type: none"> This screening tool/intervention should be provided for selected patients depending on individual circumstances.
D	<ul style="list-style-type: none"> The authors recommend against this screening tool/intervention. There is moderate or high certainty that the screening tool/intervention has no net benefit or that the harms outweigh the benefits. 	<ul style="list-style-type: none"> The authors discourage the use of this screening tool/intervention.
I	<ul style="list-style-type: none"> The authors conclude that the current evidence is insufficient to assess the balance of benefits and harms of the screening tool/intervention. Evidence is lacking, of poor quality, or conflicting, and the balance of benefits and harms cannot be determined. 	<ul style="list-style-type: none"> If the screening tool/intervention is offered, patients should understand the uncertainty about the balance of benefits and harms.

Table S2. Levels of certainty regarding net benefit

Adapted with permission from the U.S. Preventive Services Task Force 2012.¹

Level Of Certainty	Description
High	<ul style="list-style-type: none"> The available evidence usually includes consistent results from well-designed, well-conducted studies in representative populations. These studies assess the effects of the preventive service on health outcomes. This conclusion is therefore unlikely to be strongly affected by the results of future studies.
Moderate	<ul style="list-style-type: none"> The available evidence is sufficient to determine the effects of the preventive service on health outcomes, but confidence in the estimate is constrained by such factors as: <ul style="list-style-type: none"> the number, size, or quality of individual studies; inconsistency of findings across studies; limited generalizability of findings to routine practice; lack of coherence in the chain of evidence. As more information becomes available, the magnitude or direction of the observed effect could change, and this change may be large enough to alter the conclusion(s).
Low	<ul style="list-style-type: none"> The available evidence is insufficient to assess effects on health outcomes, because of: <ul style="list-style-type: none"> the limited number and/or size of studies; important flaws in study design and/or methods; inconsistency of findings across individual studies; gaps in the chain of evidence; findings not generalizable to routine practice; lack of information on important health outcomes. More information may allow estimation of effects on health outcomes.

ⁱⁱ <https://www.uspreventiveservicestaskforce.org/Page/Name/grade-definitions>