



Ending childhood dental caries

WHO implementation manual

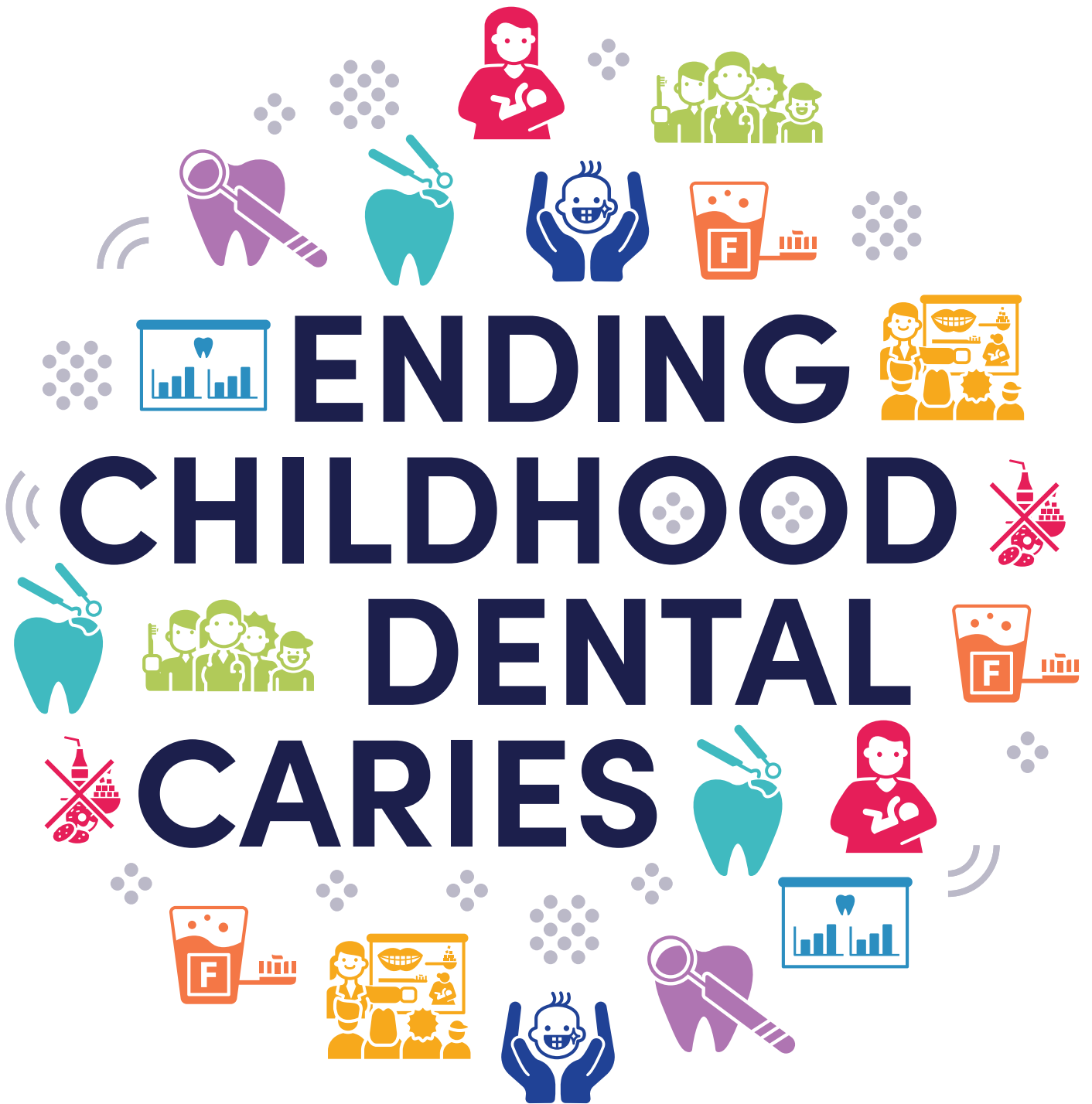
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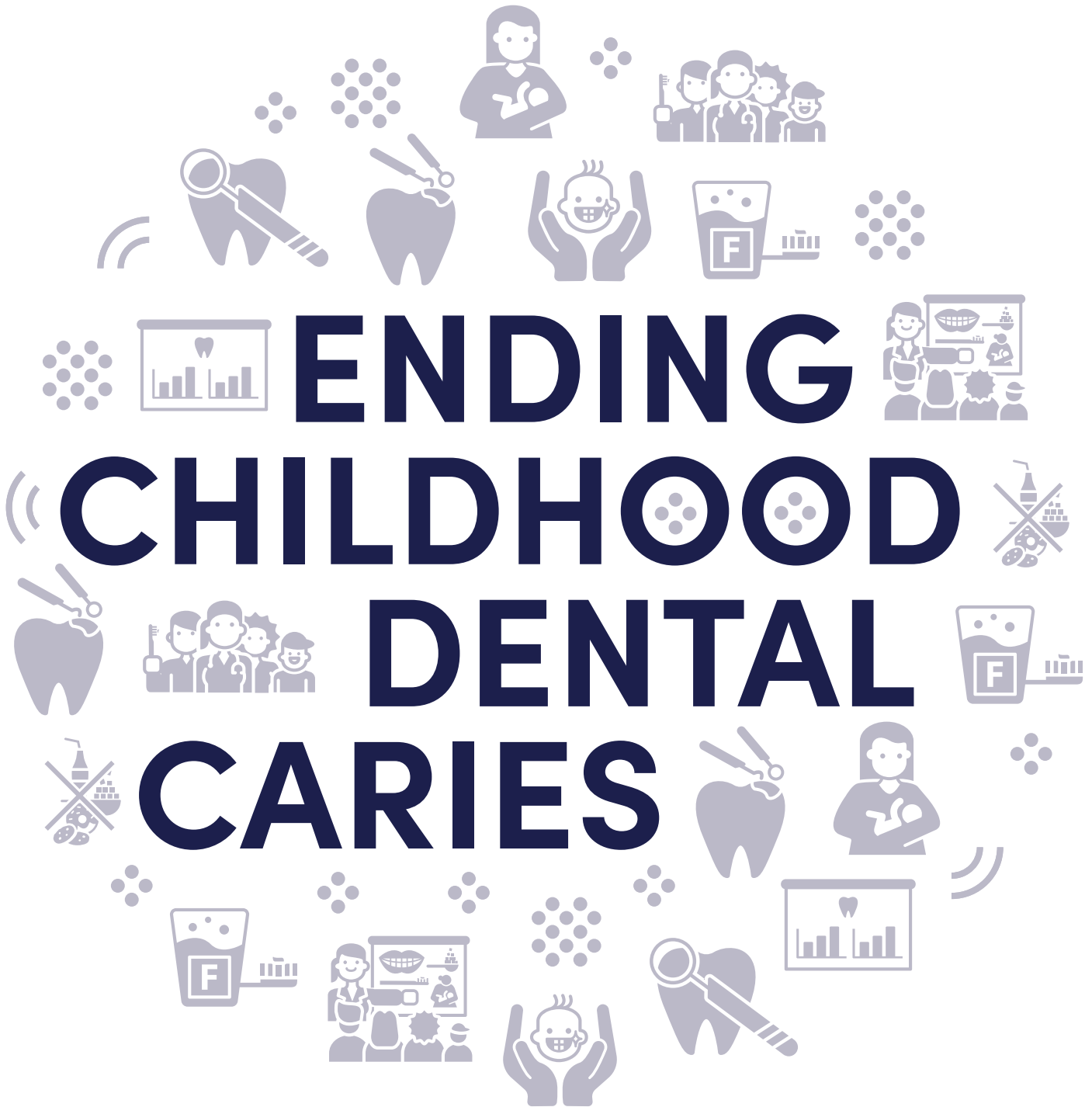
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ENDING CHILDHOOD DENTAL CARIES

WHO Implementation manual

Oral Health Programme, Prevention of Noncommunicable Diseases
WHO Headquarters



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Contents

Acknowledgements	iv
Glossary	v
Abbreviations	vii
Preface	viii
1. Background	1
1.1 Early childhood caries is a highly prevalent global disease of public health importance.....	1
1.2 Risk factors are known: they are diverse and, like most noncommunicable diseases, related to social determinants of health.....	1
1.3 The primary care team is a key actor in prevention and control of early childhood caries.....	4
2. Introduction	5
3. Definition of early childhood caries	7
4. Tackling early childhood caries	9
4.1 Early diagnosis.....	10
4.2 Control of risk factors: infant feeding and diet in young children.....	14
4.3 Control of risk factors: population-based fluoride exposure.....	18
4.4 Arresting carious lesions through application of sealants, fluoride varnish and minimally invasive techniques for restoration.....	22
4.5 Health education and community engagement for prevention of early childhood caries.....	28
4.6 Involvement of primary care teams, including community health workers, in prevention and control of early childhood caries.....	32
4.7 Monitoring and evaluation.....	36
4.8 Building a supportive framework for integration of early childhood caries prevention and control in overall health initiatives.....	40
Annex 1	44
Review questions related to prevention of early childhood caries.....	44
Annex 2	45
Key interventions for preventing and controlling early childhood caries.....	45
Annex 3	51
Useful materials.....	51
References	53

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Glossary

Atraumatic restorative treatment (ART) This is a minimally invasive technique to treat existing dental decay and prevent further decay. ART can be used with patients of all ages (e.g. children, adolescent, adults and elderly people). It consists of two activities: The first is a procedure to treat decayed tooth cavities by removing the decay using hand instruments; this is followed by filling the cavities and any adjacent pits and fissures on biting surfaces of the teeth with an adhesive material containing fluoride (glass-ionomer cement). The provision of ART is not limited to dental clinics since it does not require a dental chair, drill, piped water or electricity. Moreover, pain is rare during ART, virtually eliminating the need for anaesthetic. Although ART is ideally delivered by an oral health professional or auxiliary, trained primary care workers are also able to deliver ART effectively with the appropriate instruments and consumables.

Caries prevalence Proportion of population affected by dental caries.

Caries severity Mean number of teeth affected by caries per person in the population.

Community health workers People who provide health education, referral and follow-up, case management, basic preventive health care, and home visiting services to specific communities. Community health workers provide support and assistance to individuals and families in navigating health and social services systems. Community health workers are known by many different names in different countries, but in almost all cases they come from the communities they serve.

Complementary foods Foods that should be added to a child's diet when breast milk is no longer enough to meet the child's nutritional needs. The transition from exclusive breastfeeding to family foods, referred to as complementary feeding, typically covers the period from age 6 months to 18–24 months.¹

Dental caries Dental decay. Destruction of teeth results when microbial biofilm (plaque) formed on the tooth surface converts the sugars contained in foods and drinks into acids, which dissolve tooth enamel and dentine over time.

Early childhood caries Caries characterized by the presence of one or more teeth affected by carious lesions or with white spot lesions in primary teeth, loss of teeth due to caries, or filled tooth surfaces in affected teeth of a child aged under six years. Children with early childhood caries have been shown to have a high number of teeth affected by progressive disease.

Healthy foods Foods that contribute to a healthy diet if consumed in appropriate amounts.²

Impact of early childhood caries Sequelae caused by early childhood caries for the infant or child, family and community.

Infant A child aged under 12 months.

¹ Complementary feeding. Geneva: World Health Organization (https://www.who.int/nutrition/topics/complementary_feeding/en/).

² Healthy diet. Fact sheet 394. Geneva: World Health Organization; 2015 (https://www.who.int/nutrition/publications/nutrientrequirements/healthydiet_factsheet394.pdf).

Primary care A key process in the health system: first-contact, accessible, continued, comprehensive and coordinated care. First-contact care is accessible at the time of need; ongoing care focuses on the long-term health of a person rather than the short duration of the disease; comprehensive care is a range of services appropriate to the common problems in the respective population; coordination is the role by which primary care acts to coordinate other specialists that the person may need. Primary care is a subset of primary health care.³

Primary health care A whole-of-society approach to health and well-being centred on the needs and preferences of individuals, families and communities. It addresses the broader determinants of health and focuses on the comprehensive and interrelated aspects of physical, mental and social health and well-being. It provides whole-person care for health needs throughout the lifespan rather than treating only a set of specific diseases. Primary health care ensures people receive comprehensive care – ranging from promotion and prevention to treatment, rehabilitation and palliative care – as close as feasible to people’s everyday environment.⁴

Systemic fluoride Fluoride ingested and absorbed into the body.

Topical fluoride Fluoride applied directly on to teeth.

Unhealthy foods Energy-dense, nutrient-poor foods such as foods high in saturated fats, trans-fatty acids, free sugars or salt.⁵

Universal health coverage Universal health coverage means that all individuals and communities receive the health services they need without financial hardship. It includes the full spectrum of essential good-quality health services, from health promotion to prevention, treatment, rehabilitation and palliative care. Universal health coverage enables everyone to access the services that address the most significant causes of disease and death, and ensures the quality of those services is good enough to improve the health of the people who receive them.⁶

³ Main terminology. Geneva: World Health Organization (<http://www.euro.who.int/en/health-topics/Health-systems/primary-health-care/main-terminology>).

⁴ Primary health care. Geneva: World Health Organization; 2019 (<https://www.who.int/news-room/fact-sheets/detail/primary-health-care>)

⁵ Report of the Commission on Ending Childhood Obesity: implementation plan – executive summary. Geneva: World Health Organization; 2017 (<http://apps.who.int/iris/bitstream/handle/10665/259349/WHO-NMH-PND-ECHO-17.1-eng.pdf;jsessionid=9653E50F444A16983630CFE740689D72?sequence=1>).

⁶ Universal health coverage. Geneva: World Health Organization; 2019 ([https://www.who.int/en/news-room/fact-sheets/detail/universal-health-coverage-\(uhc\)](https://www.who.int/en/news-room/fact-sheets/detail/universal-health-coverage-(uhc))).

Abbreviations

ART	Atraumatic Restorative Treatment
DHIS	District Health Information System
ECC	early childhood caries
NCD	noncommunicable diseases
SDF	silver diamine fluoride
WHO	World Health Organization

Preface

Early childhood caries (ECC) affects teeth of children aged under six years. According to the Global Burden of Disease Study in 2017, more than 530 million children globally have dental caries of the primary teeth. However, as primary teeth are exfoliated due to growth of the child, ECC has previously not been considered important.

ECC has significant influence on individuals, families and societies. The disease affects primary teeth and permanent teeth and influences general health and quality of life across the entire life course. ECC links with other frequent diseases of childhood, primarily due to risk factors shared with other noncommunicable diseases (NCDs) such as high sugar intake, and the disease relates to other health conditions such as obesity. Dental caries can lead to abscesses and cause toothache, which may compromise ability to eat and sleep and restrict life activity of children. Severe dental caries is associated with poor growth. Moreover, ECC is an economic burden to the family and society; treatment of ECC under general anaesthesia for extensive dental repair is especially costly.

Prevalence of ECC is increasing rapidly in low- and middle-income countries, and dental caries is particularly frequent or severe among children living in deprived communities. In many countries, access to dental care is not equitable, leaving poor children and families underserved.

Fortunately, ECC is preventable, with almost all risk factors modifiable. ECC differs from dental caries in older children and adults in its rapid development, its diversity of risk factors, and in the control of disease. As with most NCDs, both cause and prevention are strongly determined by sociobehavioural, economic, environmental and societal factors, known as the social determinants of health. ECC is influenced strongly by health behaviours and practices of children, families and caregivers.

ECC prevention and control approaches range from changing personal behaviour, to working with families and caregivers, to public health solutions such as building health policies, creating supportive environments, and health promotion and orientation of health services towards universal health coverage. Building supportive environments for integration of ECC prevention and control into general health activities is essential. In addition, primary care teams, including community health workers, are key to successful programmes.

The Ending Childhood Dental Caries: WHO Implementation Manual has been developed to serve different stakeholders in their work for better health of children; these stakeholders include community agencies, ministries of health, academia, and nongovernmental and professional organizations.

The manual is based on evidence from systematic reviews and WHO recommendations, especially on nutrition, including breastfeeding, and primary care workers' programmes.

The current manual focus on tackling ECC in its global context defines the disease and outlines known risk factors and approaches to prevention and treatment. It is intended to inform and support:

- policy-makers on actions and rationales for ECC interventions;
- chief dental officers, ministry of health focal points and public health administrators in the development and implementation of plans for ECC prevention and control, using the primary health-care approach.

The manual may also be used in training activities to help primary care teams:

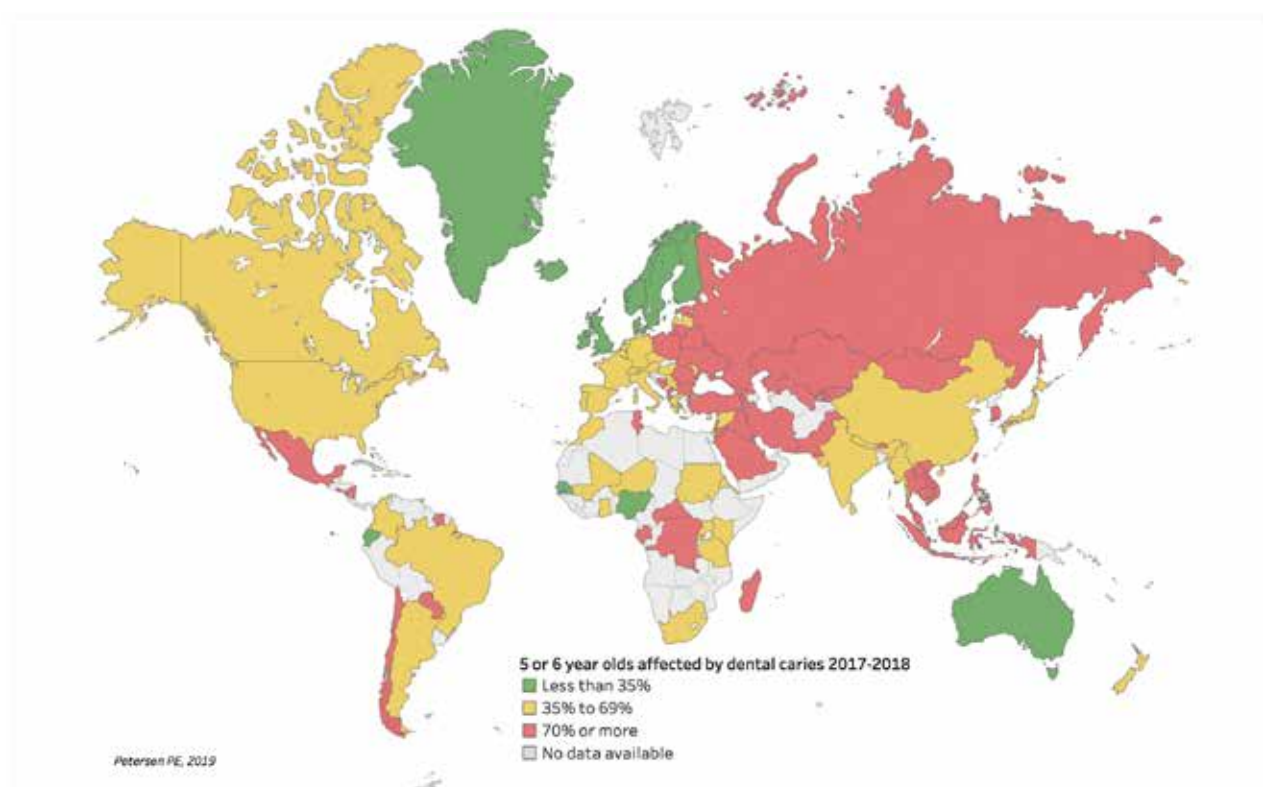
- understand ECC as a public health problem;
- recognize the essential risk factors for ECC, especially lack of exclusive breastfeeding, consumption of free sugars, and inadequate exposure to fluoride in prevention of dental caries;
- identify opportunities for intervention against ECC and its causes.

1. Background

1.1 Early childhood caries is a highly prevalent global disease of public health importance

The first primary teeth erupt in infancy, at about age 6 months, and the primary dentition of 20 teeth is complete by about age 30 months. In many children, these teeth stay sound, contributing to the child's health and well-being. But for an unacceptably large percentage of children, these teeth do not stay sound but are ravaged and sometimes totally destroyed by dental caries (dental decay). This is a preventable, global, noncommunicable disease (NCD) of medical, social and economic importance. Early childhood caries (ECC) differs from dental caries in older children and adults in its rapid development, its diversity of risk factors and its control. As with most NCDs, the aetiology and prevention of ECC are strongly determined by sociobehavioural, economic, environmental and societal factors, known as the social determinants of health (1). Societal and economic pressures often influence health behaviours and practices of children and families – particularly the main caregivers – and typically lead to poor oral health. The prevalence of ECC is increasing rapidly in low- and middle-income countries (2,3).

Figure 1 Percentages of children aged 5 and 6 years affected by dental caries in 2017–2018



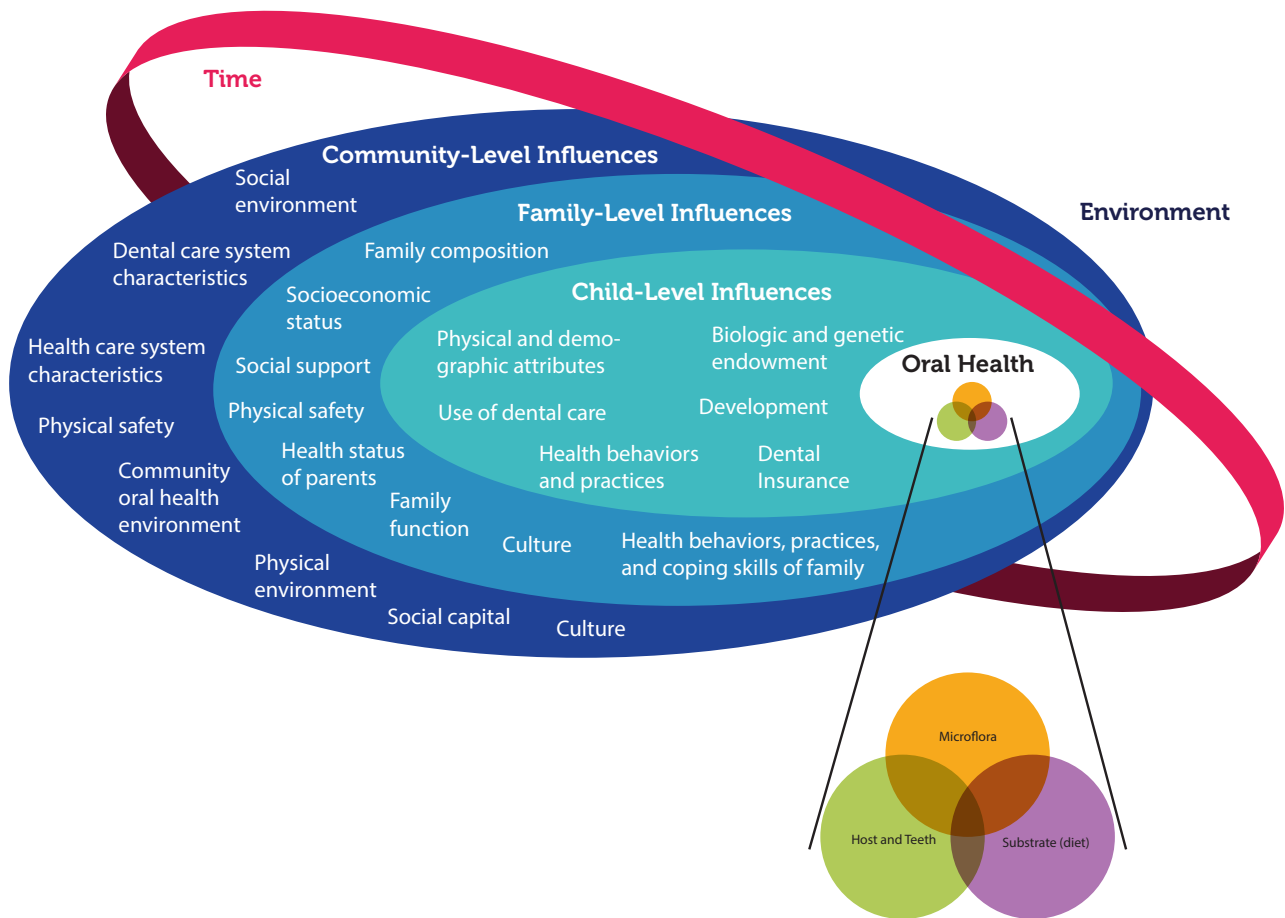
Source: Petersen PE. WHO Collaborating Centre for Community Oral Health Programme and Research, University of Copenhagen 2019.

Traditionally the prevalence and severity of dental caries are presented as the percentages of people with dental caries and the mean number of teeth affected by dental caries per person. Information collected by the World Health Organization (WHO) Collaborating Centre for Community Oral Health Programme and Research, University of Copenhagen is given in Figure 1, which indicates that the burden of dental caries affects significant numbers of children in all WHO regions. More recently, some surveys have recorded sequelae of disease by recording gross infection caused by severe caries involving pain and abscesses (4–7). Infection causes toothache, which can result in the child being unable to eat and compromise sleep for the child and their family. Severe dental caries is associated with poor growth (8).

1.2 Risk factors are known: they are diverse and, like most noncommunicable diseases, related to social determinants of health

Almost all risk factors for ECC are modifiable. They can be grouped into children, family and community influences (Figure 2) (9). The relevant factors will be considered elsewhere in detail. This is particularly the case with the importance of the parents' health (including nutritional status and oral health); family beliefs and behaviours, such as infant feeding and choice of complementary foods and drinks; and the ability, knowledge and will to purchase and provide a healthy diet for the child. As with the causal factors of childhood obesity, an appreciation of the effects of excessive and frequent consumption of free sugars is essential in the understanding of the aetiology and control of ECC. The importance of establishing good eating habits in childhood to minimize the risk of ECC and obesity can not be overestimated. Since eating patterns track from childhood to adulthood, establishing appropriate habits in the early years is a major target.

Figure 2 Concept of childhood caries – child, family and community influences on oral health outcomes of children



Source: adapted from Fisher-Owens SA, Gansky SA, Platt LJ, Weintraub JA, Soobader MJ, Bramlett MD, Newacheck PW. Influences on children's oral health: a conceptual model. *Pediatrics*. 2007;120:e510–20.

1.3 The primary care team is a key actor in prevention and control of early childhood caries

Difficulties in tackling prevention and control of ECC include:

- identifying a key platform to deliver oral health promotion and ECC prevention;
- identifying risk factors, including individual risk behaviours, culture and environment.

For example, many countries have introduced effective school-based programmes to improve the oral health of children (10,11). These programmes usually involve toothbrushing with a fluoride-containing toothpaste. Although such programmes are effective at developing healthy life skills, it is realized that most problems of ECC occur before the child attends school and therefore can not be impacted by these programmes.

ECC prevention and control interventions should be integrated into existing primary care such as child and maternal health programmes alongside vaccinations and general medical check-ups. This could lead to a continuing programme of interventions that provide reassurance to parents and caregivers and boost their knowledge of the need to attend health appointments (12).

Social context and cultural pressures within societies also influence ECC by influencing families' behaviours. Creating supporting environments for families is an important element of oral health promotion.

Globally, there are relatively few trained oral health professionals, and therefore it is unrealistic to rely on workforce models that require oral health professionals to deliver prevention and treatment of ECC. Fortunately, the majority of interventions related to ECC are proven, affordable and feasible in the places where people normally live and can be carried out by non-oral health professionals in the community or primary care facilities.

Therefore, primary care teams including nurses, midwives and community health workers, who have worked in the community and primary care facilities and advised and cared for families and communities, can contribute to preventing and controlling ECC.

To this end, all sectors of the community should use primary care teams to promote healthy behaviours at local and national levels.

2. Introduction

The Ending Childhood Dental Caries: WHO Implementation Manual has been developed following the request by different stakeholders, including countries, academia, and nongovernmental and professional organizations, involved in the prevention and management of ECC.

The development process was initiated in January 2016 in Bangkok at the WHO Expert Consultation on Public Health Intervention against Early Childhood Caries. The WHO Collaborating Centre for Oral Health Education and Research at Mahidol University organized this consultation in collaboration with the WHO Oral Health Programme, to agree on a set of key messages and interventions for a future action plan (13).

The expert consultation discussed a number of research questions relevant to the continuing work in the prevention of ECC, and the need for a new systematic review on action programmes was recognized. Subsequently, the WHO Collaborating Centre for Nutrition and Oral Health at Newcastle University conducted a systematic review on the effect of modifiable risk factors for ECC, focusing on 12 key questions (see Annex 1) (14).

This manual is based on updated evidence from systematic reviews and WHO recommendations, especially on nutrition, including breastfeeding, and community health workers' programmes.

After the manual was drafted, the contents were reviewed by experts in the fields of oral health and nutrition, including a specialist in breastfeeding. Experts assessed whether the manual is applicable for different resource settings (high-, middle- and low-resource settings), practitioners, policy-makers and academia staff from different countries.

The manual intends to inform and support policy-makers on actions and rationales for ECC interventions. Oral health focal points in ministries of health (e.g. chief dental officers) and public health administrators are considered important in the development and implementation of plans for ECC prevention and control using the primary health-care approach. The manual includes the following elements:

- definition of ECC;
- tackling ECC:
 - early diagnosis;
 - control of risk factors: infant feeding and diet in young children;
 - control of risk factors: population-based fluoride exposure;
 - arresting carious lesions through application of sealants, fluoride varnish and minimally invasive techniques for restoration such as Atraumatic Restorative Treatment (ART);
 - health education and community engagement for prevention of ECC;
 - involving primary care teams, including community health workers, in prevention and control of ECC;
 - monitoring and evaluation;
 - building a supportive framework for integration of ECC prevention and control in overall health initiatives.

The manual may also be useful in training activities for primary care teams to help them understand ECC as a public health problem, recognize the essential risk factors for ECC, and identify opportunities for intervention against ECC and its sequelae.

Box 1

Key points

- ECC is a highly prevalent global disease.
- ECC is a noncommunicable disease of medical, social and economic importance.
- ECC risk factors are linked to family lifestyle and community norms.
- Prevention and control of ECC require a primary health-care approach.
- Building supportive environments for integration of ECC prevention and control into other public health activities is crucial.
- Primary care teams, including community health workers, are key to successful programmes to prevent ECC.
- Countries should develop and deliver strategies for prevention and control of ECC.

Box 2

The misfortune of dental general anaesthetics for infants and young children

Extraction of infected carious teeth is often the only option – a traumatic experience for both child and family. If facilities exist, these extractions are often carried out under general anaesthesia in a safe environment, but this is expensive. It is of considerable concern that in several high-income countries, dental extractions are among the most common reasons for hospital admission in infants and children.

In 2016–2017, a total of 30 238 children aged 0–9 years were admitted to hospital for extraction of decayed teeth in England (population 53 million). This figure excludes extractions under general anaesthetic in young children carried out by community dental services and private hospitals. Tooth extraction was the most common reason for hospital admission for children aged five to nine years. The average cost of admitting a child aged 5 years or under for tooth extraction is £800–900 (15–17).

Similarly high numbers of hospital admissions for dental extractions in young children have been reported in Australia (18), the United States of America (19), Israel (20) and New Zealand (3).

3. Definition of early childhood caries

Dental caries (tooth decay) is a disease that may affect the teeth of people of all ages, including young children. It is the most common NCD among children around the globe. The disease affects primary teeth (milk teeth) and permanent teeth.

Cavitation occurs due to loss of tooth substance (enamel and dentine) by acids formed by bacteria in dental plaque, which accumulates on the tooth surface. This process is due to the bacterial metabolism of sugars derived from dietary sugars.

Tooth decay is the destruction of the tooth, which is made from calcified tissue. Under normal circumstances, the loss of calcium (demineralization) is compensated by the uptake of calcium (remineralization) from the tooth's microenvironment. This dynamic process of demineralization and remineralization takes place more or less continually and equally in a favourable environment of the mouth. In an unfavourable environment, the remineralization rate does not sufficiently neutralize the rate of demineralization, and caries occurs.

Early stages of dental caries are often without symptoms, while advanced stages of dental caries may lead to pain, infections and abscesses, or even sepsis. Advanced stages often result in tooth extraction (the tooth is pulled out). The development of caries is influenced by the susceptibility of the tooth, bacterial profile, quantity and quality of the saliva, level of fluoride, and amount and frequency of intake of sugars.

Dental caries influences general health and quality of life. Dental caries links with several frequent diseases of childhood, primarily due to common risk factors. For instance, dental caries can co-occur with obesity, as both diseases are related to diet and nutrition. Moreover, nutritional status affects teeth pre-eruptively, although this is less important than the post-eruptive local effect of diet. Undernutrition coupled with a high intake of sugars may exacerbate caries.

Across the world, dental caries is particularly frequent or severe among underprivileged and disadvantaged groups of children. Socioeconomic factors also play a crucial role in the scope of services covered by primary oral health care. In many countries, poor children are underserved by dental care since access to dental care is not equitable.

ECC is characterized by the presence of one or more teeth affected by carious lesions or with white spot lesions in primary teeth, loss of teeth due to caries, or filled tooth surfaces in affected teeth of a child aged under six years. Those children with ECC often have been shown to have a high number of teeth affected by progressive disease. Consequences of ECC include a higher risk of pain or discomfort, abscesses, carious lesions in both the primary and permanent dentitions, risk for delayed physical growth and development, increased days with restricted activity, and diminished oral health-related quality of life. The aetiology is frequently linked with a high-frequent consumption of sugared drinks or food, lack of breastfeeding, and/or poor oral hygiene. Additionally, the disease often manifests in children from poor families or living in poor environmental settings (21).

Figure 3 Image of early childhood caries



Photo credit: Petersen PE.



Photo credit: Petersen PE.



4. Tackling early childhood caries



4.1

Early diagnosis

Background information

Because caries lesions progress faster in primary dentition than in permanent teeth (22,23), the early detection of carious lesions is key to managing ECC and preventing adverse problems associated with its occurrence; it is also likely to be painless and less expensive.

Especially for children under six years of age, main caregivers assisted by health professionals are the important entry point to detecting early caries lesions.

An oral health professional (dentist, dental therapist or nurse, dental hygienist) will be able to diagnose ECC according to the WHO clinical criteria (24). In addition, suspicious white spot lesions that may indicate the early process of caries in teeth should be detected carefully. Primary care teams, if trained appropriately, can also detect early caries lesions (25). A mouth mirror and satisfactory lighting of the mouth cavity are required for careful examination of all teeth present. Images of tooth conditions may help the identification of lesions.

The images included in this section are intended to complement established criteria for determining whether a child has existing or has had ECC (24).



Key message

- Detect early caries lesions for early intervention.



Rationale for implementation of key interventions



Action	Rationale
Early detection of carious lesions is key to managing ECC. Main caregivers assisted by health professionals are the important entry point to detecting early caries lesions.	Caries lesions progress faster in primary dentition than in permanent teeth.
Integrate oral health check-ups into primary care, including community-based health interventions, to encourage early diagnosis of ECC.	Children may be seen for vaccinations or consultation for systemic health problems. Children aged under six years may be seen frequently by primary care staff or general health-care providers and less often by oral health professionals. Early detection of ECC and immediate intervention offer the opportunity to manage ECC and prevent associated problems.

Figure 4 Visual inspection of teeth



Photo credit: Feldens CA.

(a) Sound teeth in both jaws (primary teeth)



Photo credit: Phantumvanit P.

(e) Tooth decay in front teeth of upper jaw (primary teeth)



Photo credit: Feldens CA.

(b) Sound teeth in upper jaw (primary teeth)



Photo credit: Feldens CA.

(f) Deep carious lesions in both jaws (primary teeth)



Photo credit: Feldens CA.

(c) Sound teeth in lower jaw (primary teeth)



Photo credit: Feldens CA.

(g) Deep carious lesions in upper jaw (primary teeth)



Photo credit: Feldens CA.

(d) Suspicious white spot lesions, which may indicate early process of caries in teeth of upper jaw (primary teeth)

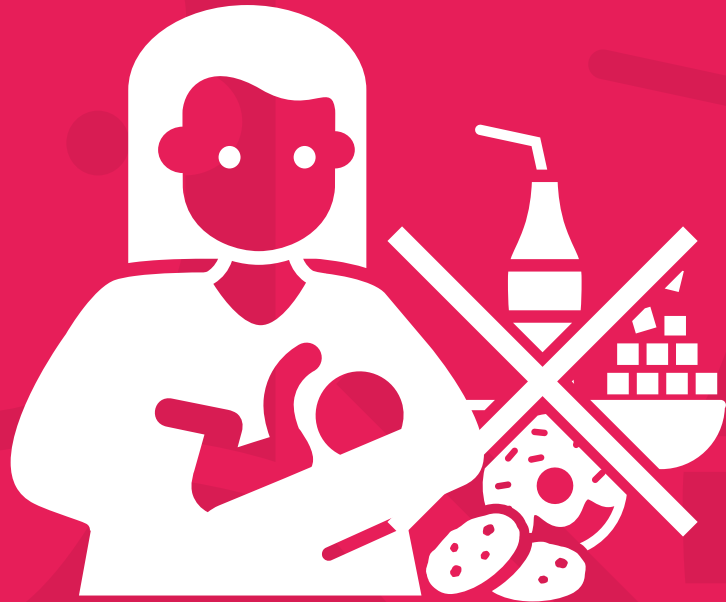


Photo credit: Feldens CA.

(h) Deep carious lesions in lower jaw (primary teeth)



4.2



Control of risk factors: infant feeding and diet in young children

Background information

Infant feeding practices, complementary feeding practices and diet in young children have immediate and long-lasting effects on child oral and general health.

WHO recommends that infants are exclusively breastfed up to six months of age, after which breastfeeding should continue alongside complementary feeding up to two years of age or beyond because of the many health benefits of breastfeeding for both mother and infant, including oral health (26). The WHO Global Guidance on Ending the Inappropriate Promotion of Foods for Infants and Young Children states explicitly that commercial complementary foods should not be advertised for infants aged under six months (27).

Evidence suggests that infants who are breastfed in the first year of life have lower levels of dental caries than those fed infant formula (28). Breast milk has a relatively higher concentration of lactose and a relatively lower content of protective factors such as calcium and phosphorus compared with cow's milk and other milks that form complementary drinks (29). This has raised concerns among the oral health profession about the risk breastfeeding poses to dental caries. One systematic review suggested a higher risk of ECC when breastfeeding extends beyond one year of age, but the data analysis did not control adequately for important confounders such as intake of sugars from other sources (30). A systematic review including more recent data has shown that infants who are breastfed two years of age do not have a greater risk of ECC than those breastfed up to one year of age (14).

Complementary feeding practices and dietary habits in the early years of life may modify the risk posed by exposure to dietary free sugars. It is well established that the amount of dietary free sugars consumed is the primary causative factor for dental caries (31), and the amount of free sugars should be no more than 5% of energy intake (32). Free sugars include all mono- and disaccharides added to foods and drinks by manufacturers, cooks or consumers, plus the sugars that are naturally present in honey, syrups, fruit juice and fruit-juice concentrates. Free sugars do not include sugars naturally present in milk and milk products or in whole fresh fruits and vegetables (32).

A systematic review has indicated that consumption of drinks containing free sugars increases the risk of ECC, although the observational studies on which this was based failed to control adequately for confounding factors (14). Studies show that consumption of liquids containing free sugars from an infant feeding bottle is independently associated with risk of ECC (14,33). Adding free sugars to complementary foods is also associated with a higher risk of ECC, although the data are limited (14,33).

Additionally, it is reported that some commercially produced complementary foods include free sugars, leading to children exceeding the WHO recommendation for sugar intake (34,35).

Children should be encouraged to eat a combination of different foods to help them obtain the right amounts of essential nutrients and avoid a diet high in free sugars. A good combination of different foods includes:

- staple foods, such as cereals (e.g. wheat, barley, rye, maize, rice) and starchy tubers or roots (e.g. potato, yam, taro, cassava);
- legumes (e.g. lentils, beans);
- vegetables and fruits;
- foods from animal sources (e.g. meat, fish, eggs, milk) (36).



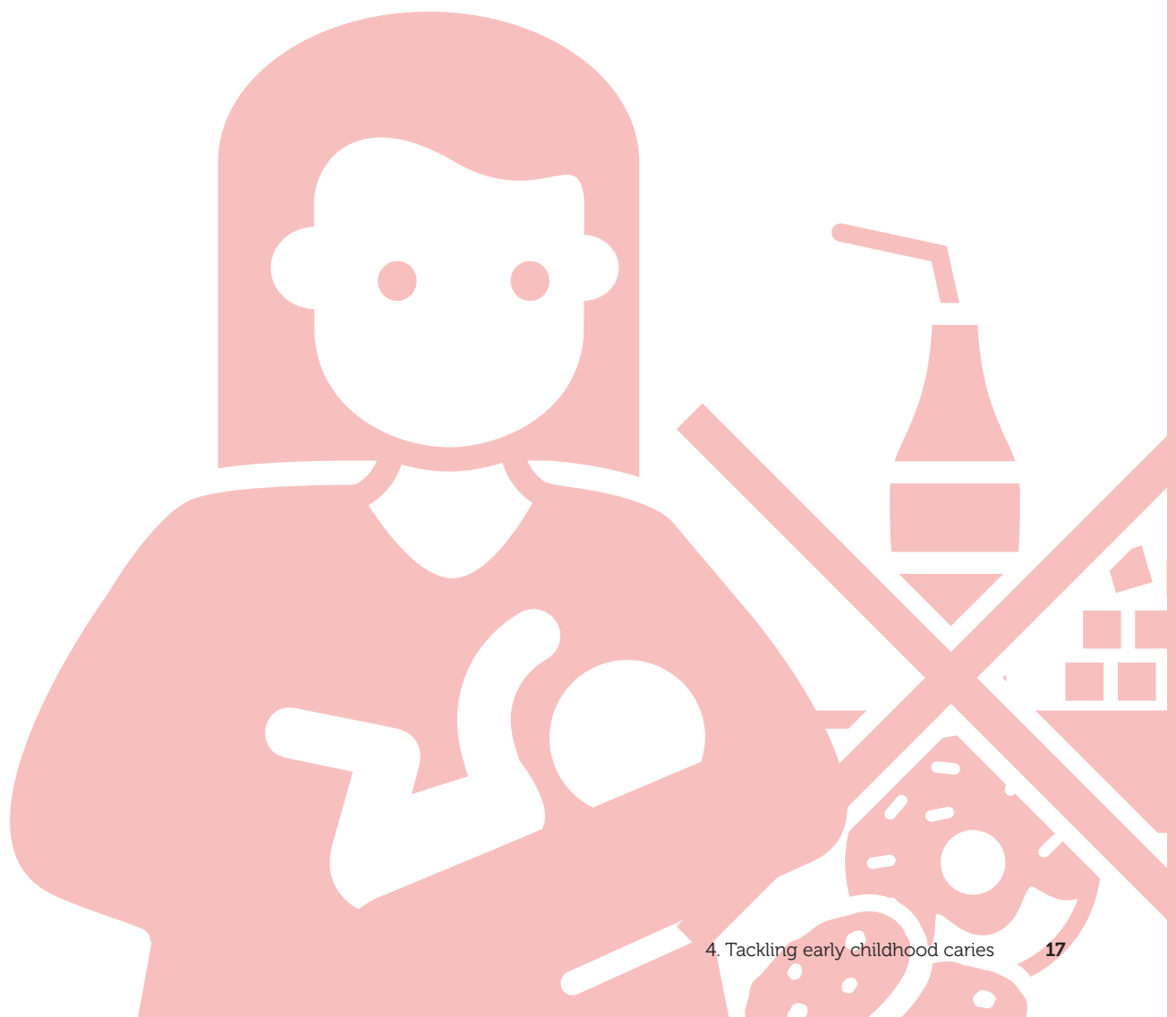
Key messages

- Promote, protect and support exclusive breastfeeding up to age six months, and introduction of nutritionally adequate and safe complementary (solid) foods at age six months together with continued breastfeeding up to two years of age or beyond.
- Prevent the intake of free sugars from drinks and foods, and promote a healthy balanced diet for young children.

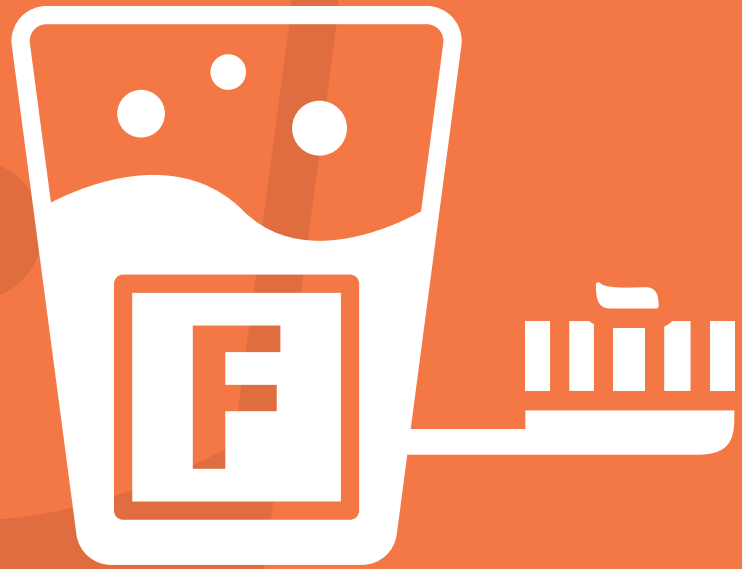
Rationale for implementation of key interventions



Action	Rationale
<p>Promote, protect and support exclusive breastfeeding up to age six months and introduction of nutritionally adequate and safe complementary (solid) foods at age six months together with continued breastfeeding up to two years of age or beyond.</p>	<p>Breastfeeding is associated with better general health and a lower risk of ECC in infants and children (14).</p>
<p>Limit consumption of liquids containing free sugars, including natural unsweetened juices.</p>	<p>Consumption of free sugars increases risk of dental caries, including ECC. Consumption of free sugars in drinks, including from feeder bottles, increases risk of ECC (14).</p>
<p>Limit consumption of complementary foods that contain free sugars.</p>	<p>Consumption of free sugars increases risk of dental caries, including ECC. Consumption of complementary foods high in sugars increases risk of ECC (14).</p>
<p>Encourage a combination of different foods that is high in fruits, vegetables and low in free sugars for young children.</p>	<p>A combination of different foods that is high in fruits and vegetables is associated with reduced risk of NCD including dental caries. (14,36).</p>



4.3



Control of risk
factors: population-
based fluoride
exposure

Background information

Fluoride is a key agent in reducing the prevalence and severity of dental caries (37). Effective use of fluoride is strongly supported by WHO (38–40).

There are two ways to use population-based fluoride to prevent dental caries: systemic exposure and topical exposure.

For systemic exposure, fluoridation of drinking water is an effective, safe and economically beneficial public health measure that is listed among the 10 greatest public health achievements of the twentieth century. Fluoridated drinking water reaches about 350 million people worldwide (41–45). A systematic review of the best available evidence pertaining to water fluoridation from cohort studies showed consistent evidence of a protective effect (14). Lack of piped drinking water precludes installation of water fluoridation in many communities globally, but when possible it has great advantages of reaching everyone without their effort, and being of low cost to the community. A distinct advantage of fluoridation is that it benefits the people who are most difficult to reach with other preventive programmes, and very often the people with the greatest health burden (37,41–43).

The enrichment of dietary salt with iodine has provided an effective way of preventing goitre. In parallel, adding fluoride to salt has been successful in preventing dental caries in many countries, with an estimated 300 million users of fluoridated salt worldwide (14,37). Where salt is used as a vehicle for fluoride, the WHO guideline on sodium intake must be considered (46). Salt intake at the country level should be monitored so that adjustments to the levels of fluoride in salt can be made if required to ensure the population is receiving optimum levels of fluoride exposure.

A third way of providing fluoride to communities is milk fluoridation. This can be cost-effective if the community has a well-developed milk distribution system, such as an existing school milk programme (14,47–51).

For topical exposure, toothbrushing twice a day with a fluoride-containing toothpaste is the most effective preventive measure for ECC. Toothpastes containing 1000–1500 µg/g (ppm) fluoride are effective in preventing dental caries. Parents and caregivers should brush their young children's teeth twice a day (52). In several communities around the world, children are taught to brush daily in nursery or school with an appropriate fluoride-containing toothpaste (11). Since toothpaste is not intended to be swallowed, such programmes can coexist with fluoridation of water, salt or milk, bringing substantial added benefit (37,53).

For both systemic and topical fluoridation, the risk of adverse effects of fluoridation, such as mild enamel fluorosis, is very low when the correct dose of fluoride for caries prevention is considered carefully. The population exposure to fluoride should be measured before programme implementation. An adequate surveillance system through periodic urinary fluoride monitoring in the child population should be considered. Assessment of enamel fluorosis and the level of dental caries in the child population should be undertaken regularly (54).

Although exposure to fluoride reduces the development of dental caries and delays the onset of the cavitation process, it does not completely prevent dental caries if implemented as an isolated action. Addressing the cause (free sugars) is therefore essential in preventing and reducing dental caries (55).



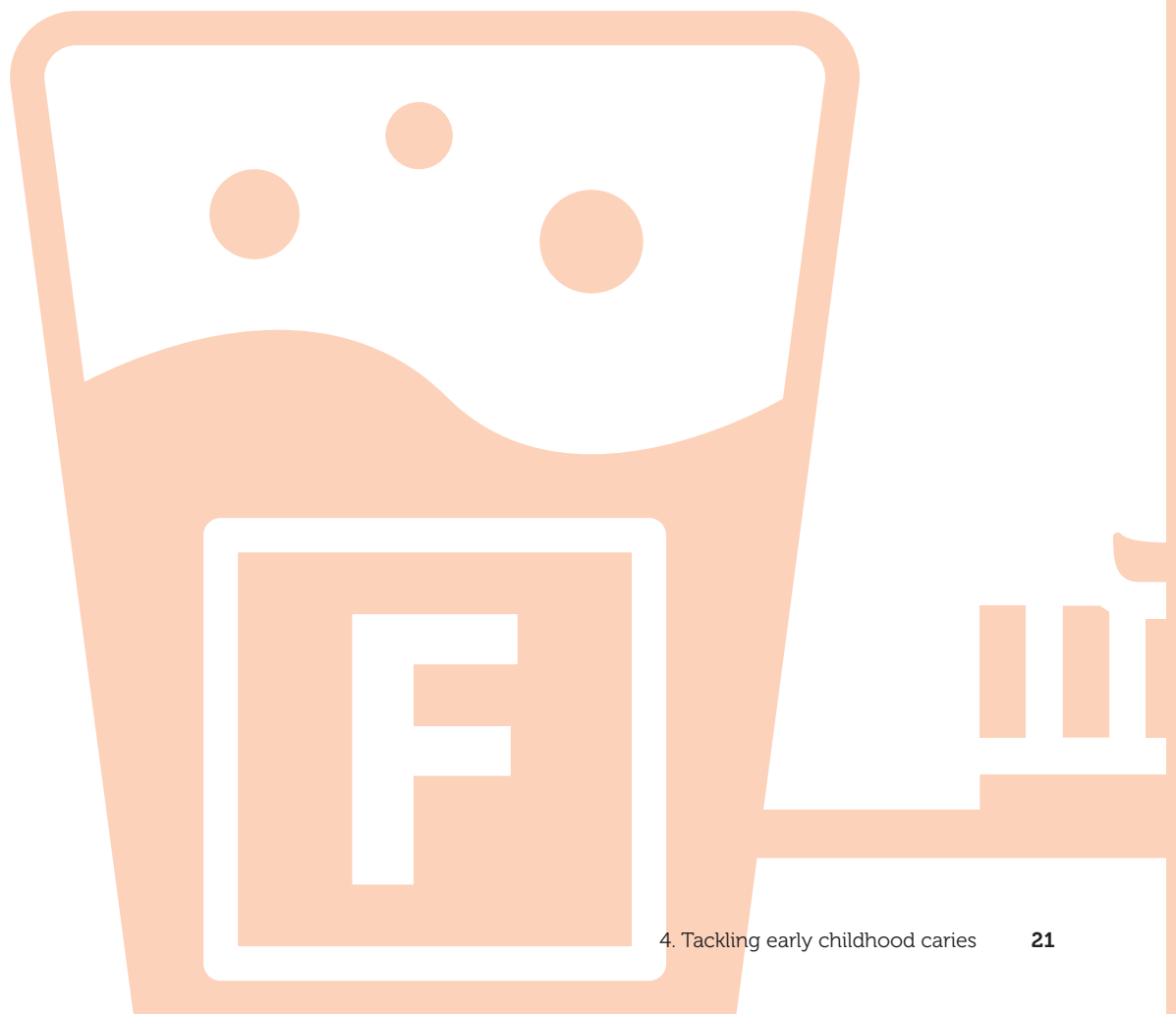
Key messages

- Effective use of fluoride is an essential component of any strategy to control ECC.
- There is substantial evidence that the appropriate use of fluoride, principally through water fluoridation and use of fluoride-containing toothpastes, reduces the prevalence, severity and impact of ECC.

Rationale for implementation of key interventions



Action	Rationale
<p>In communities where there is little fluoride available naturally, fluoride-based community programmes using water, salt or milk should be introduced.</p>	<p>It was shown in the 1930s that dental caries prevalence and severity are inversely related to fluoride concentration in drinking water (37). Although some populations drink water naturally containing an adequate concentration of fluoride, the majority of populations drink water with much lower natural fluoride concentrations. Fluoride concentration in drinking water was adjusted to the optimum level in 1945 in Grand Rapids in the United States (37); since then, at least 78 studies globally have demonstrated that water fluoridation prevents ECC (44). There have been fewer studies of the effectiveness of fluoride added to salt or milk, but these demonstrate effectiveness (37). There is no contradiction to the WHO recommendation of reducing the intake of salt, as only limited salt intake is needed for achievement of the caries-preventive effect. These methods of providing fluoride are low in cost and have the advantage of benefiting the people who are the most difficult to reach with other preventive programmes – very often the people with the greatest health burden (40).</p>
<p>Brushing infants' and children's teeth with an affordable, effective fluoride-containing toothpaste should be routine.</p>	<p>Since fluoride was first added to toothpastes 70 years ago, a very large number of trials have demonstrated its effectiveness in caries prevention (52). Effectiveness increases as the concentration of fluoride in the toothpaste increases but, for infants and young children, the concentration of fluoride is decided after considering benefit and risk; in most countries, concentrations are in the range 1000–1500 ppm.</p> <p>Toothpaste manufacture is a skill. It is important that added fluoride is available to provide its caries-preventive effect and that the shelf-life of toothpaste is suitable; this should be audited by national authorities. Authorities should also take steps to ensure effective toothpastes are affordable for the whole population, and that parents and caregivers have adequate skills and motivation to brush their children's teeth.</p> <p>Brushing twice a day is more effective than less frequent brushing, as it maintains adequate fluoride around the teeth for a greater proportion of the day (56). Toothbrushing is a life skill; in many countries, it is part of school routines aimed at improving health (40).</p>





4.4

Arresting carious lesions through application of sealants, fluoride varnish and minimally invasive techniques for restoration

Background information

Management of ECC should aim to reverse the disease process and to prevent or slow down the progression of carious lesions to cavitation and tooth destruction. Young children are usually apprehensive and may not cooperate fully during dental treatment. The use of non-invasive or minimally invasive treatment approaches is preferred because they are less resource-demanding, are more efficient and cost-effective, and cause less discomfort than other methods (57).

Placement of pit-and-fissure sealants in molar teeth can reduce the development and progression of new carious lesions into dentine (58). Different types of sealant material have their own merits, but glass-ionomer sealants, which are less demanding on technique and moisture control, are often suitable for use in young children and in community settings.

Systematic reviews have shown that regular application of 5% sodium fluoride varnish can prevent the development of new caries in primary teeth and can help remineralization of early enamel lesions (59–62). As the health-care worker controls the amount of fluoride varnish being used, it is regarded as an appropriate professionally applied topical fluoride agent of choice. However, regular applications every three to six months are required to maintain effectiveness.

Carious lesions that have progressed to cavitation should be stabilized in order to preserve tooth structure and to prevent negative health consequences such as pain and infection. Annual or semi-annual application of 38% silver diamine fluoride (SDF) solution is effective in arresting the progression of cavitated carious lesions in primary teeth and in hardening these lesions (63). The effectiveness of SDF is greater with semi-annual application. This can minimize discomfort and potential pulp damage, and help to keep the caries-affected primary teeth symptomless and functional until their natural exfoliation. This is a painless, simple and low-cost treatment that can be widely promoted as an alternative to conventional invasive caries management techniques, especially in populations and areas with low accessibility to dental care services.

Covering cavitated carious lesions with flowable fluoride-releasing glass-ionomer cement may have outcomes similar to SDF application, but the level of skill required by dental personnel is greater (64). In addition, daily toothbrushing with a fluoride-containing toothpaste plays an essential role in arresting ECC (64).

If restoration of decayed primary teeth is required, preference should be given to the use of minimally invasive techniques such as ART using adhesive materials such as glass-ionomer cement, especially when provided in community settings. These techniques do not require a local anaesthetic injection and, being less invasive, are more “child-friendly”. Survival of single-surface ART restorations using high-viscosity glass-ionomer in primary teeth is high (65) and can be comparable to that of restoration placed using a conventional approach (66).

The oral health-care system of the country, the availability of dental personnel and resources, the local community setting, the dental health status of the child, the cooperation of the child, and the child’s preferences are among the various factors that need consideration when choosing the most appropriate method to manage and arrest ECC lesions in a population.



Key messages

- Application of fluoride sealants and varnish with glass-ionomer cement by primary care teams can help to prevent deterioration of ECC-affected dentition.
- Application of silver diamine fluoride by primary care teams can arrest dental caries.
- If restoration of decayed primary teeth is required, minimally invasive techniques such as Atraumatic Restorative Treatment (ART), can be used by primary care teams and oral health professionals to stabilize caries lesions.

Figure 5 Application of sealants



Photo credit: Feldens CA.

(a) Caries lesions on occlusal surfaces of lower molars presented as dentine shadows



Photo credit: Feldens CA.

(b) Acid etching



Photo credit: Feldens CA.

(c) Sealant being applied



Photo credit: Feldens CA.

(d) After sealant application

Figure 6 Fluoride varnish



Photo credit: Feldens CA.

(a) Active enamel lesions of early childhood caries in anterior teeth



Photo credit: Feldens CA.

(b) Lesions treated with fluoride varnish

Figure 7 Silver diamine fluoride (SDF) application



Photo credit: Feldens CA.

(a) Cavitated lesions on upper incisors



Photo credit: Feldens CA.

(b) SDF application with cotton pellet



Photo credit: Feldens CA.

(b) If microbrush is available, apply SDF by microbrush



Photo credit: Feldens CA.

(c) Two weeks after SDF application

Figure 8 Atraumatic Restorative Treatment (ART)



Photo credit: Songpaisan Y.

(a) Cavitated lesion on lower molar



Photo credit: Songpaisan Y.

(b) Use spoon excavator to remove soft caries from cavity of teeth



Photo credit: Songpaisan Y.



Photo credit: Songpaisan Y.

(c) Clean the cavities with small cotton pellets damped with water; dry the cavities with dry cotton pellets



Photo credit: Songpaisan Y.

(d) Paint dentine conditioner thoroughly inside cavity; clean with water and dry cotton



Photo credit: Songpaisan Y.

(e) Press mixed glass-ionomer from capsule into cavity



Photo credit: Songpaisan Y.

(f) Using finger, with thin petroleum jelly press on top of glass-ionomer restoration over tooth



Photo credit: Songpaisan Y.

(g) ART is completed

Rationale for implementation of key interventions



Action	Rationale
Application by primary care teams of sealant on pits and fissures of primary molars that are deep or with initial caries.	Compared with control with no sealant, placement of resin or glass-ionomer sealant in primary molars can reduce the development of new carious lesion involving dentine (58).
Application by primary care teams of sodium fluoride varnish to primary teeth in children with ECC or teeth with signs of early caries.	Topical application of fluoride varnish two to four times a year can reduce the development of new carious lesions into dentine or the need for restoration of teeth (59,60). Fluoride varnish can reverse incipient carious lesions in primary teeth and promote remineralization of early enamel caries in children (61,62).
Keep carious lesions clean by daily toothbrushing with a fluoride-containing toothpaste, with support from caregivers.	Daily toothbrushing with a 1000–1500 ppm fluoride toothpaste can arrest or slow down progression of active carious lesions in primary teeth of young children (64).
Application of SDF by primary care teams to carious lesions that have extended into dentine.	Annual or semi-annual application of 38% SDF solution is simple, inexpensive and highly effective in arresting soft cavitated carious lesions in primary teeth (63).
Use by primary care teams and oral health professionals of flowable fluoride-releasing glass-ionomer cement to cover surface of carious dentine lesions.	Application of flowable fluoride-releasing glass-ionomer cement to cover surface of carious dentine lesions can arrest lesions in primary teeth (64).
If restoration of decayed primary teeth is required, primary care teams and oral health professionals can use minimally invasive techniques such as ART using adhesive materials such as glass-ionomer cement.	Placement of dental adhesive materials using minimally invasive techniques does not require a local anaesthetic injection and is suitable for young children who may not cooperate during treatment. Survival of single-surface ART restorations using high-viscosity glass-ionomer in primary teeth is high (65) and may be comparable to that of restoration placed using a conventional approach (66).



4.5

**Health education
and community
engagement for
prevention of early
childhood caries**

Background information

Although an intake of free sugars, poor oral hygiene and inadequate use of fluoride are rightly given prominence as primary risk factors, reasons for these unfavourable behaviours need to be understood if preventive strategies are to be successful. A review of these aspects reported that rates of ECC are highest among socially disadvantaged groups and indigenous and ethnic minorities; for example, there is an association between low levels of education and low family incomes with a high prevalence of ECC (67).

The family represents the child's primary source of learning about health and risk factors (68,69). Awareness of oral health and attentiveness to ECC prevention among parents can be raised through health communication and by providing them with sound information about disease and intervention. A systematic review outlines the efficacy of behavioural interventions against ECC as applied at the individual and family levels (70).

In addition to parents, caregivers such as kindergarten and nursery staff are vital in young children's health learning, and they may be instrumental in development of viable health practices. They may carry out accompanying ECC preventive actions, particularly by providing a healthy diet, organizing regular toothbrushing with children, facilitating fluoride administration, and contributing to early detection of dental caries (71,72).

In countries where formal education starts before the age of five years, preschools and schools have great potential for influencing the health of young children. Children may spend a large amount of time in preschool and school and can be reached at a life stage when their health habits are being formed. Health promotion may be conducted by preschool teachers when they have adequate background and knowledge about health and risk factors (10). Preschools also provide a convenient platform for training children in regular toothbrushing and for administration of fluoride.

Mass communication through media such as television and radio, books, pamphlets, flyers and posters is important in improving oral health knowledge and practices of parents and caregivers specifically in relation to child oral health (70). A systematic review summarized the evidence of the efficacy of oral health educational programmes directed at pregnant mothers for prevention of ECC in children (73). In general, such intervention programmes may have a positive effect in the fight against ECC.

A range of public health interventions are shown to be beneficial in prevention and control of dental caries among young children. Home visits and telephone communication are important in outreach care (74); they are valuable in engaging parents in prevention of poor oral health in children, and the personal contact may raise parents' understanding of oral health support for infants. Community programmes based on the principles of motivational interviewing have been used successfully for pregnant women, mothers and other caregivers in avoiding dental caries and promoting oral health in infants (72,75,76). A systematic review found that midwives have an excellent opportunity for oral health promotion during pregnancy (77).

Importantly, prevention of ECC also requires addressing the social and economic factors that face many families affected by ECC in low-resource communities. In particular, universal health coverage is vital for all people and communities to receive the health care they need without suffering financial hardship (78,79). Universal health coverage includes the full spectrum of essential care, including health promotion, prevention, treatment, rehabilitation and palliative care, and the experience of good-quality health services.



Key messages

- Advocate the importance of primary teeth to parents and caregivers, non-oral health professionals and the community by raising awareness of the impact of ECC on the quality of life of young children.
- Engage parents and caregivers, nursery staff and school health personnel in the prevention of ECC and promotion of oral health.
- Target ECC prevention and oral health promotion towards low-resource communities.
- Apply scientifically sound oral health education messages.

Rationale for implementation of key interventions



Action	Rationale
<p>Primary care teams, especially community health workers, should advocate the importance of primary teeth to parents, caregivers and the community at large, and raise awareness of the impact of ECC on quality of life of young children.</p>	<p>The adoption of durable health habits in childhood begins at home with parents and main caregivers, as they play an important role in forming the child's oral health behaviours.</p> <p>Providing oral health education to parents and caregivers on ECC risk factors may reduce the risk of ECC (14,71,72).</p> <p>Health education must be based on scientifically sound information (80).</p>
<p>Relevant ministries and local municipalities must establish oral health education programmes in preschools, including toothbrushing with use of fluoridated toothpaste.</p>	<p>Health education in preschools, including toothbrushing programmes with toothpaste containing fluoride 1000–1500 ppm, is effective in reducing dental caries when activities are carried out by preschool teachers (10,11).</p>
<p>Mass communication should be organized to improve oral health knowledge and practices of parents and caregivers.</p>	<p>Several media may be used to increase awareness among parents and caregivers about ECC prevention, diet and oral health practices (70).</p>
<p>Home visits and telephone communication should be introduced in outreach care.</p>	<p>Personal contact with parents of children affected by ECC is relevant for early detection of disease, ECC prevention, and appropriate health care coverage of children (74). Community health workers may undertake this outreach activity.</p>
<p>Motivational interviewing of parents and pregnant women by trained primary care workers and oral health professionals is useful for avoiding dental caries among children.</p>	<p>Community programmes including motivational interviewing are useful in engaging mothers and pregnant women in dental caries prevention (72,75–77).</p>



4.6



Involvement of
primary care teams,
including community
health workers,
in prevention and
control of early
childhood caries

Background information

In most countries, children aged under five or six years are seen by primary care teams including nurses, midwives and community health workers, and less often by oral health professionals. Children may be seen for vaccinations or consultation for systemic health problems.

Primary care teams are already trained to deliver a range of services (e.g. child immunization, family planning, health promotion) and to treat minor conditions and injuries, and they have the educational background and clinical skills needed to learn about oral health promotion and control of ECC. Primary care teams often have profound knowledge of the community, enabling them to gather support from family, friends and organizations, and to offer continuity of care (81).

Primary care workers should have a basic set of practical skills and knowledge about oral disease prevention and oral health promotion. These should enable them not only to advise and treat children affected by ECC when they first seek help for oral health problems, but also to carry out outreach work in schools and at health promotion sessions in various locations and settings where community members gather. Such settings may include meeting halls, religious sites, workplaces, and any other places that are appropriate for information, education and communication activities aimed at modifying behaviours and environments for good oral hygiene, a balanced diet and a good nutritious status, and towards oral health and quality of life (81).

WHO has developed guidelines on health policy and system support to optimize community health worker programmes (82). The preservice training programme suggests that community health workers will gain the following core competences:

- promotion and preventive services, and identification of family health and social needs and risk;
- integration of work activities within the wider health-care system in relation to the range of tasks to be performed in accordance with community health workers' roles, including referral for health care, collaboration with other health workers in primary care teams, patient tracing, community disease surveillance, monitoring, and data collection, analysis and use;
- consideration of the social and environmental determinants of health;
- providing psychosocial support;
- interpersonal skills related to confidentiality, communication, community engagement and mobilization;
- personal safety.

Additionally, community health workers will gain competency in diagnostic practices, treatment and care in alignment with expected roles.

Primary care workers, including community health workers, should be able to play a role in the prevention and control of ECC by undertaking the following activities (81):

- Promotion of oral health and prevention of ECC:
 - conduct routine oral and dental examinations during outreach work;
 - encourage regular general and oral hygiene;
 - promote healthy nutrition and an active lifestyle;
 - provide information, education and communication sessions about toothbrushing with a fluoride-containing toothpaste;



Key messages

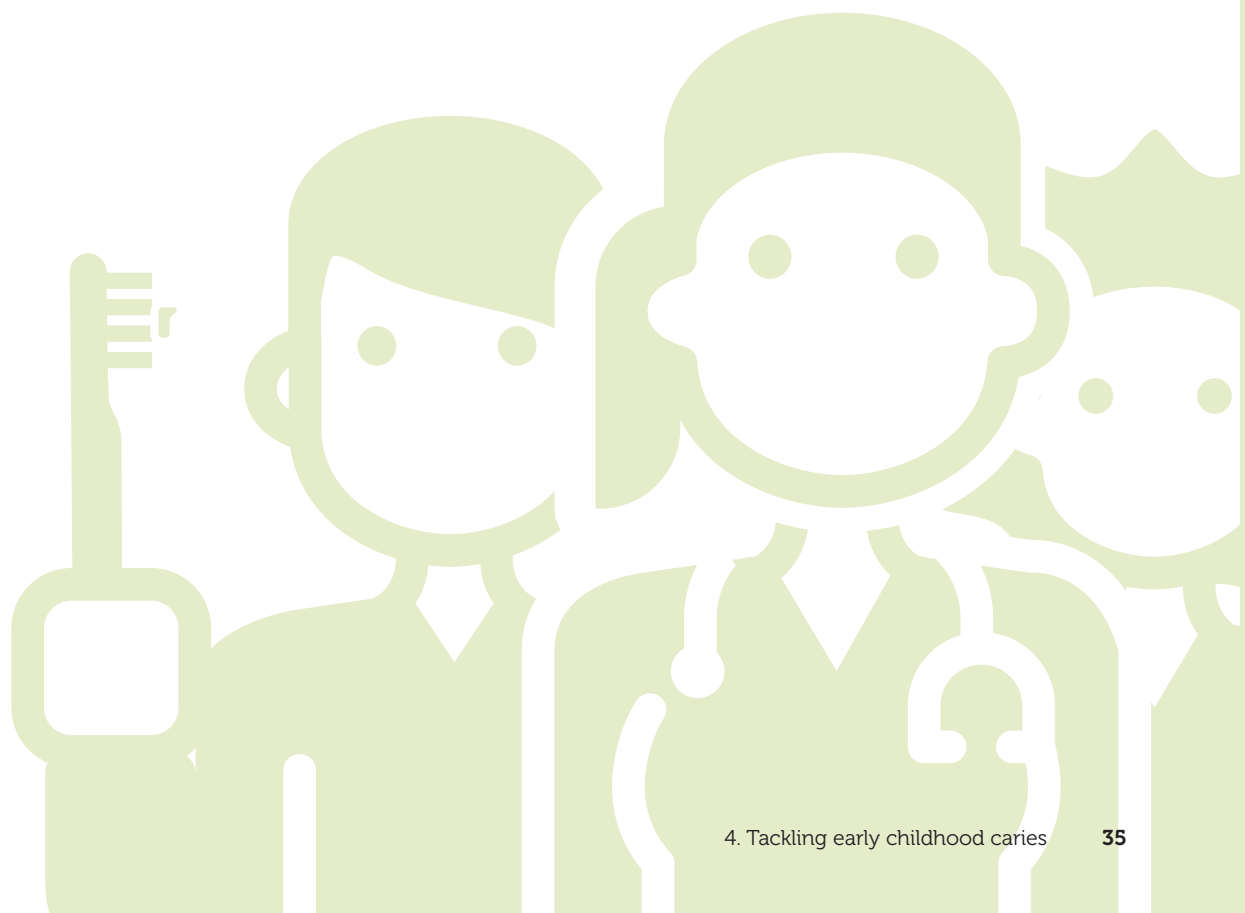
- Primary care teams, including community health workers, are key actors in the prevention and control of ECC.
- An important function of national and local authorities is to advocate and facilitate training on ECC prevention and control for all first-contact health agents – that is, primary care teams, including community health workers, nurses and midwives.

- facilitate healthy environments with restricted access to sugars (e.g. schools, marketplaces).
- Control of ECC:
 - arrest ECC lesions through application of sealants, fluoride varnish and minimally invasive techniques such as ART;
 - avoid cross-infection by effective implementation of appropriate hygiene and disinfection measures;
 - recognize children who need to be referred to a higher level, and have the connections and facilities to do so.

Rationale for implementation of key interventions



Action	Rationale
<p>Advocate and facilitate training for primary care workers, including community health workers, nurses and midwives.</p>	<p>Primary care teams are key actors in prevention and control of ECC. In most countries, children aged under five or six years are seen by primary care teams, including nurses, midwives and community health workers, and less often by oral health professionals.</p> <p>Primary care teams often have profound knowledge of the community, enabling them to work with support from family, friends and organizations, and to offer continuity of care (81).</p>



4.7



Monitoring and evaluation

Background information

It is important that community programmes established for prevention of ECC and health promotion are evaluated. Regular surveys every three years or so may be organized at the local or national level by public health administrators and health-care personnel in order to assess the adequacy, effectiveness and acceptance of implemented programmes. At the local community level, analysis of programme performance may be relevant annually. Surveillance of ECC programmes will help health administrators to learn about experiences and outcomes from interventions against ECC in very young children. Moreover, when outcomes and costs of programmes (e.g. time, number of staff, expenses) are measured concurrently, it may be possible to assess the cost-effectiveness of alternate programmes.

The WHO STEPwise approach to health surveillance should be adopted and put into practice (83). Step 1 focuses on self-assessment of oral conditions and risk factors. The fifth edition of the WHO Oral Health Surveys: Basic Methods is relevant for surveillance of preschool children and ECC programme evaluation (24). This tool helps in collection of information on self-reported severe tooth decay, painful teeth and discomfort, modifiable risk factors such as consumption of sugars and dietary patterns, oral hygiene, quality of life, and socioeconomic and environmental conditions. Information can be obtained based on use of a WHO simplified oral health questionnaire about children addressed to parents or caregivers.

The questionnaire is designed for self-completion or for use in interviews. Basic requirements of anonymity, purpose of questions, clarity and length have to be considered. If an interview mode is used, variation can occur due to intra- or inter-interviewer variability. Similar questionnaires are prepared by WHO for primary school teachers engaged in oral health education of young children. The simplified questionnaires include core questions considered essential in the surveillance of ECC; they should be adapted to local or national settings.

Step 2 implicates the collection of clinical oral health data. A WHO oral health assessment form is used to record ECC lesions. Clinical examination conducted by oral health professionals should include careful assessment of the teeth for any signs of severe decalcification, location and number of affected teeth, and any urgent need for immediate care of ECC. Other symptoms of ill-health are likely to have been recorded by general health personnel when children are brought to the health service facility.

In countries with a shortage of oral health professionals, children are not examined clinically by oral health professionals. Primary care teams involved in interventions for controlling and preventing ECC may use the photographs for caries assessment shown in Section 4.1.

As suggested for regular oral health surveys conducted according to WHO methods and criteria, examiners must be trained to make reliable clinical judgements. Training will ensure uniform interpretation, understanding and application by all examiners of the criteria and codes for ECC. Assistance in calibration for consistency may be available from WHO.



Key messages

- Preschool children may be included in national and subnational oral health surveys as part of regular population surveillance programmes. Such surveys should be based on the WHO Oral Health Surveys: Basic Methods and include assessment for risk factors.
- Promote evaluation, surveillance and research, including into cost-effectiveness, for the prevention of ECC in different communities.

Rationale for implementation of key interventions



Action	Rationale
<p>Preschool children may be included as a target group in national and subnational oral health surveys as part of regular population surveillance programmes.</p>	<p>It is important that community programmes established for prevention of ECC and health promotion be evaluated. National or subnational concerns may call for incorporation of preschool children in oral health surveillance programmes (24).</p>



4.8

**Building
a supportive
framework for
integration of early
childhood caries
prevention and
control in overall
health initiatives**



Background information

The aetiology of ECC is complex due to the multilevel web of factors that direct risk mechanisms. Intervention approaches include changing personal behaviours, working with families and caregivers, and instigating public health solutions such as creating supportive environments that promote equity and reduce inequalities.

Population-directed ECC interventions should target pregnant women, new mothers and primary care teams with the aim of raising awareness about the importance of breastfeeding and common risk factors, particularly the addition of free sugars to drinks and foods (32).

Oral health focal points in ministries of health (e.g. chief dental officers) are important to lead development and implementation of plans for ECC prevention and disease control using the primary health-care approach.

Public health agencies and officers, community leaders and civil society organizations have responsibilities for creating a supportive environment for prevention and control of ECC through integrating ECC prevention and control in overall health initiatives.

For example, ECC prevention and control should be integrated into public health programmes such as:

- initiatives to promote, protect and support breastfeeding, and to ensure regulation of food products that function as breast-milk substitutes (e.g. infant formula, follow-up formula) (26,27);
- initiatives to promote safe drinking water to reduce the intake of sugar-sweetened beverages (84);
- regulation of marketing of foods and drinks (including commercial complementary food and drinks) to children, especially reducing both the exposure of children to, and power of, marketing of foods high in free sugars (85,86);
- taxation of foods and drinks high in free sugars (87);
- existing primary care such as child and maternal health programmes alongside vaccinations and general medical check-ups;
- childhood obesity initiatives through control of common risk factors (e.g. free sugars) (88).

Population-directed and individual fluoride administration for the prevention and control of ECC are vital and should be integral components of existing primary care systems and essential health services provided to children.

Additionally, it is important to consider the design of essential oral health services packages – for example, the promotion of affordable fluoride toothpaste to prevent dental decay; urgent treatment aimed at relief of oral pain and providing emergency treatment; and minimally invasive techniques for restoration to treat existing dental decay and prevent further decay (81).

This basic oral health package should be integrated into the existing primary care system with consideration of health financing (general tax and health insurance) towards universal health coverage whereby children can receive the health services they need without suffering financial hardship.

Implementation of community ECC activities should be monitored according to the District Health Information System (DHIS). Performance of oral health work carried out by primary care teams should be assessed continuously for identification of future roles of non-oral health professionals.



Key messages

- Oral health focal points in ministries of health (e.g. chief dental officers) are important in leading development and implementation of plans for ECC prevention and control using the primary health-care approach.
- ECC prevention intervention is linked to other health intervention initiatives such as promoting, protecting and supporting breastfeeding, regulation of marketing of foods and drinks high in free sugars, and actions against childhood obesity.
- For development of a supportive environment, it is important to integrate ECC prevention and control within primary care, such as maternal and child health programmes.

Responsible agencies must collaborate with related departments and ministries and cooperate with civil society and public and private stakeholders in implementing ECC prevention and control, while avoiding potential conflicts of interest. In addition, the responsible agencies should identify the most suitable policy approach given the national circumstances and develop new or strengthen existing policies.

Rationale for implementation of key interventions



Action	Rationale
Integrate ECC prevention within primary care (e.g. child and maternal health programmes) and ensure engagement of non-oral health professionals in oral health work.	In most countries, children aged under five or six years are seen by primary care teams, including nurses, midwives and community health workers, and less often by oral health professionals.
Promote, protect and support exclusive breastfeeding up to age six months and introduction of nutritionally adequate and safe complementary (solid) foods at age six months together with continued breastfeeding up to two years of age or beyond.	Breastfeeding is associated with better general health and a lower risk of ECC in infants and children (14).
Align ECC intervention with health promotion initiatives against childhood obesity by avoiding consumption of free sugars in foods and drinks, including complementary foods and drinks.	Intake of free sugars has a negative impact on oral and general health, such as dental caries, weight gain, obesity and associated NCDs (32).
Increase efforts to ensure access to clean safe drinking water to avoid unnecessary consumption of sugar-sweetened beverages.	Intake of free sugars has a negative impact on oral and general health, such as dental caries, weight gain, obesity and associated NCDs (32).
Regulate marketing of foods and drinks (including complementary food) to children, and especially reduce exposure of children to, and power of, marketing of foods high in free sugars.	Intake of free sugars has a negative impact on oral and general health, such as dental caries, weight gain, obesity and associated NCDs (32).
Introduce taxation policies on foods and drinks high in free sugars.	Taxes or levies on sugar-sweetened beverages are recommended by WHO as a measure to reduce consumption of sugar-sweetened beverages (87).
Advocate appropriate use of fluoride for caries prevention. This should provide guidance for both public health interventions and health workers advising individuals and caregivers.	Fluoride is a key agent in reducing prevalence of dental caries (38–40). Because ECC severity and social, cultural and economic conditions differ between countries, each country should formulate and implement its own policy on appropriate use of fluoride.
Integrate ECC surveillance into existing national or subnational surveillance systems (e.g. DHIS).	It is important that national programmes established for prevention of ECC and health promotion are evaluated. National or subnational concerns may call for incorporation of preschool children in oral health surveillance programmes (24).

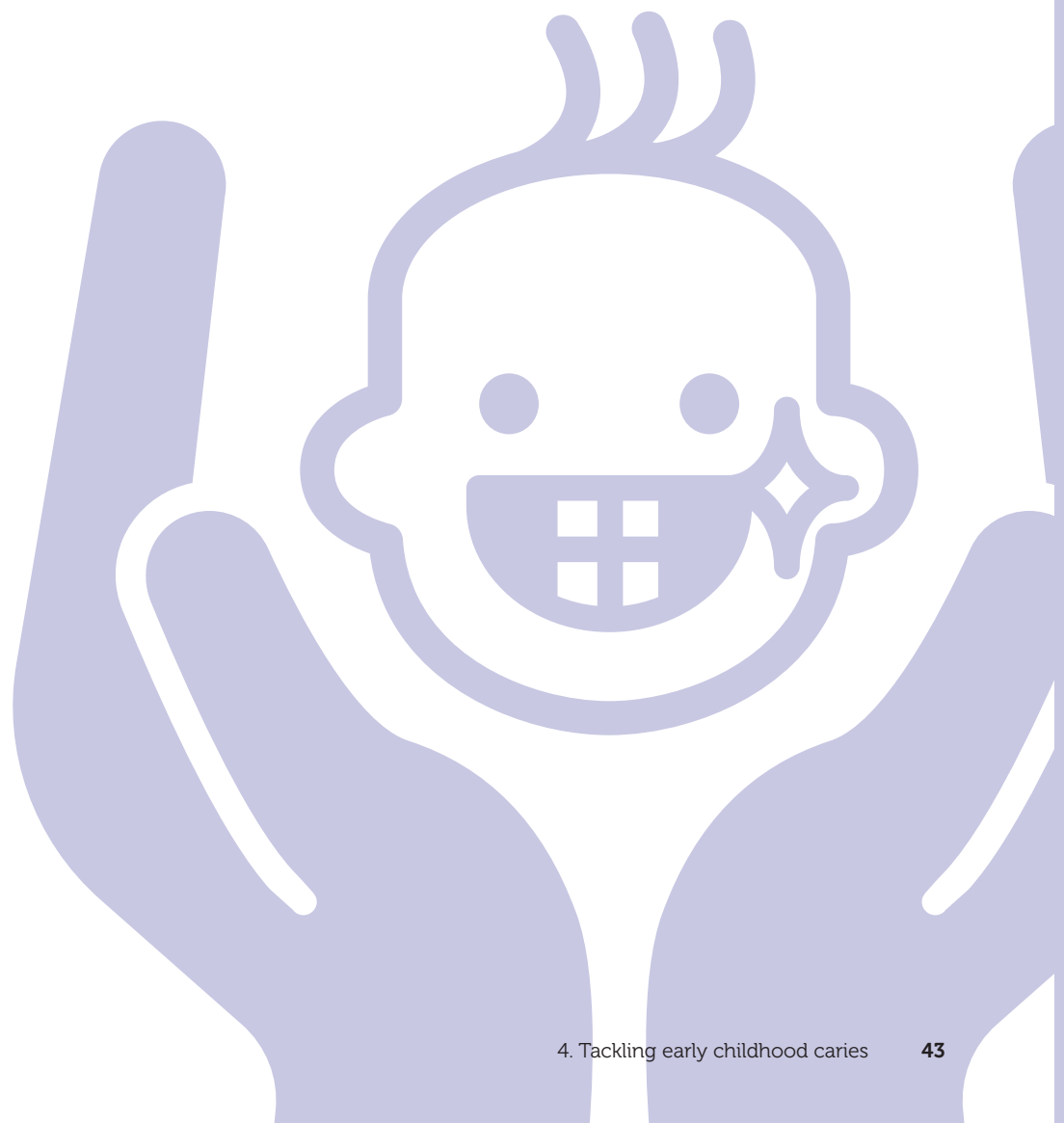


Action

Rationale

Develop a national policy to encourage the development of new skills and competencies of primary care teams and ensure their initial and continuing training for ECC prevention and control.

It is essential that non-oral health professionals (primary care teams, primary care workers) appreciate ECC as a public health problem impacting on infants and children, families and communities. This should be in terms of pain, infection, child growth and development, as well as the economic bearing of the disease. Health professionals should understand the key risk factors for ECC and how to identify them, and they should recognize their responsibilities in the work against ECC.



Annex 1

Review questions related to prevention of early childhood caries

1. Does breastfeeding beyond one year increase the risk of early childhood caries compared with breastfeeding until less than one year of age?
2. Does breastfeeding beyond one year increase the risk of early childhood caries compared with consumption of cow's (or similar) milk as the main milk source from age one year?
3. Does breastfeeding beyond two years increase the risk of early childhood caries compared with breastfeeding for less than two years?
4. Does breastfeeding beyond two years increase the risk of early childhood caries compared with consumption of cow's (or similar) milk as the main milk source from age two years?
5. Does consumption of liquids that contain free sugars from an infant feeding bottle increase the risk of early childhood caries?
6. Does consumption of complementary drinks that contain free sugars increase the risk of early childhood caries?
7. Does consumption of complementary foods to which free sugars have been added increase the risk of early childhood caries?
8. Does oral hygiene provided by a parent or caregiver reduce the risk of early childhood caries?
9. Is oral health education for caregivers effective in preventing early childhood caries?
10. Does an optimum concentration of fluoride in water reduce the risk of early childhood caries?
11. Does consumption of fluoridated milk reduce the risk of early childhood caries?
12. Does salt fluoridation reduce the risk of early childhood caries?

Annex 2

Key interventions for preventing and controlling early childhood caries



	Action	Rationale
Early diagnosis	Early detection of carious lesions is key to managing ECC. Main caregivers assisted by health professionals are an important entry point to detect early caries lesions.	Caries lesions progress faster in primary dentition than in permanent teeth.
	Integrate oral health check-ups into primary care, including community-based health interventions, to encourage early diagnosis of ECC.	Children may be seen for vaccinations or consultation for systemic health problems. Children aged under six years may be seen frequently by primary care staff or general health-care providers and less often by oral health professionals. Early detection of ECC and immediate intervention offer the opportunity to manage ECC and prevent associated problems.
Control of risk factors: infant feeding and diet in young children	Promote, protect and support exclusive breastfeeding up to age six months and introduction of nutritionally adequate and safe complementary (solid) foods at age six months together with continued breastfeeding up to two years of age or beyond.	Breastfeeding is associated with better general health and lower risk of ECC in infants and children.
	Limit consumption of liquids containing free sugars, including natural unsweetened juices.	Consumption of free sugars increases risk of dental caries, including ECC. Consumption of free sugars in drinks, including from feeder bottles, increases risk of ECC.
	Limit consumption of complementary foods containing free sugars.	Consumption of free sugars increases risk of dental caries, including ECC. Consumption of complementary foods high in sugars increases risk of ECC.
	Encourage a combination of different foods that is high in fruits, vegetables and low in free sugars for young children.	A combination of different foods that is high in fruits and vegetables is associated with reduced risk of NCDs, including dental caries.



		Action	Rationale
Control of risk factors: population-based fluoride application	<p>In communities where there is little fluoride available naturally, fluoride-based community programmes using water, salt or milk should be introduced.</p>	<p>It was shown in the 1930s that dental caries prevalence and severity are inversely related to fluoride concentration in drinking water. Although some populations drink water naturally containing an adequate concentration of fluoride, the majority of populations drink water with much lower natural fluoride concentrations. Fluoride concentration in drinking water was adjusted to the optimum level in 1945 in Grand Rapids in the United States; since then, at least 78 studies globally have demonstrated that water fluoridation prevents ECC. There have been fewer studies of the effectiveness of fluoride added to salt or milk, but these demonstrate effectiveness. There is no contradiction to the WHO recommendation of reducing the intake of salt, as only limited salt intake is needed for achievement of the caries-preventive effect. These methods of providing fluoride are low in cost and have the advantage of benefiting the people who are the most difficult to reach with other preventive programmes – very often the people with the greatest health burden.</p>	
	<p>Brushing infants’ and children’s teeth with an affordable, effective fluoride-containing toothpaste should be routine.</p>	<p>Since fluoride was first added to toothpastes 70 years ago, a very large number of trials have demonstrated its effectiveness in caries prevention. Effectiveness increases as the concentration of fluoride in the toothpaste increases but, for infants and young children, the concentration of fluoride is decided after considering benefit and risk; in most countries, concentrations are in the range 1000–1500 ppm.</p> <p>Toothpaste manufacture is a skill. It is important that added fluoride is available to provide its caries-preventive effect and that the shelf-life of toothpaste is suitable; this should be audited by national authorities. Authorities should also take steps to ensure effective toothpastes are affordable for</p>	



	Action	Rationale
		<p>the whole population, and that parents and caregivers have adequate skills and motivation to brush their children's teeth.</p> <p>Brushing twice a day is more effective than less frequent brushing, as it maintains adequate fluoride around the teeth for a greater proportion of the day. Toothbrushing is a life skill; in many countries, it is part of school routines aimed at improving health.</p>
Arresting carious lesions through application of sealants, fluoride varnish and minimally invasive techniques	Application by primary care teams of sealant on pits and fissures of primary molars that are deep or with initial caries.	Compared with control with no sealant, placement of resin or glass-ionomer sealant in primary molars can reduce the development of new carious lesion involving dentine.
	Application by primary care teams of sodium fluoride varnish to primary teeth in children with ECC or teeth with signs of early caries.	Topical application of fluoride varnish two to four times a year can reduce the development of new carious lesions into dentine or the need for restoration of teeth. Fluoride varnish can reverse incipient carious lesions in primary teeth and promote remineralization of early enamel caries in children.
	Keep carious lesions clean by daily toothbrushing with a fluoride-containing toothpaste, with support from caregivers.	Daily toothbrushing with a 1000–1500 ppm fluoride toothpaste can arrest or slow down progression of active carious lesions in primary teeth of young children.
	Application of SDF by primary care teams on to carious lesions that have extended into dentine.	Annual or semi-annual application of 38% SDF solution is simple, inexpensive and highly effective in arresting soft cavitated carious lesions in primary teeth.
	Use by primary care teams and oral health professionals of flowable fluoride-releasing glass-ionomer cement to cover surface of carious dentine lesions.	Application of flowable fluoride-releasing glass-ionomer cement to cover surface of carious dentine lesions can arrest lesions in primary teeth.



Action		Rationale
	If restoration of decayed primary teeth is required, primary care teams and oral health professionals can use minimally invasive techniques such as ART using adhesive materials such as glass-ionomer cement.	Placement of dental adhesive materials using minimally invasive techniques does not require a local anaesthetic injection and is suitable for young children who may not cooperate during treatment. Survival of single-surface ART restorations using high-viscosity glass-ionomer in primary teeth is high and may be comparable to that of restoration placed using a conventional approach.
Health education and community engagement for prevention of ECC	Primary care teams, especially community health workers, should advocate the importance of primary teeth to parents, caregivers and the community at large, and raise awareness of the impact of ECC on quality of life of young children.	The adoption of durable health habits in childhood begins at home with parents and main caregivers, as they play an important role in forming the child's oral health behaviours. Providing oral health education to parents and caregivers on ECC risk factors may reduce the risk of ECC. Health education must be based on scientifically sound information.
	Relevant ministries and local municipalities must establish oral health education programmes in preschools, including toothbrushing with use of fluoridated toothpaste.	Health education in preschools, including toothbrushing programmes with toothpaste containing fluoride 1000–1500 ppm, is effective in reducing dental caries when activities are carried out by preschool teachers.
	Mass communication should be organized to improve oral health knowledge and practices of parents and caregivers.	Several media may be used to increase awareness among parents and caregivers about ECC prevention, diet and oral health practices.
	Home visits and telephone communication should be introduced in outreach care.	Personal contact with parents of children affected by ECC is relevant for early detection of disease, ECC prevention, and appropriate health care coverage of children. Community health workers may undertake this outreach activity.
	Motivational interviewing of parents and pregnant women by trained primary care workers and oral health professionals is useful for avoiding dental caries among children.	Community programmes including motivational interviewing are useful in engaging mothers and pregnant women in dental caries prevention.



Action		Rationale
Role of primary care teams, including community health workers, in prevention and control	Advocate and facilitate training for primary care workers, including community health workers, nurses and midwives.	<p>Primary care teams are key actors in prevention and control of ECC. In most countries, children aged under five or six years are seen by primary care teams, including nurses, midwives and community health workers, and less often by oral health professionals.</p> <p>Primary care teams often have profound knowledge of the community, enabling them to work with support from family, friends and organizations, and to offer continuity of care.</p>
Monitoring and evaluation	Preschool children may be included as a target group in national and subnational oral health surveys as part of regular population surveillance programmes.	It is important that community programmes established for prevention of ECC and health promotion be evaluated. National or subnational concerns may call for incorporation of preschool children in oral health surveillance programmes.
Building a supportive framework for integration of ECC prevention and control into overall health initiatives	Integrate ECC prevention within primary care (e.g. child and maternal health programmes) and ensure engagement of non-oral health professionals in oral health work.	In most countries, children aged under five or six years are seen by primary care teams, including nurses, midwives and community health workers, and less often by oral health professionals.
	Promote, protect and support exclusive breastfeeding up to age six months and introduction of nutritionally adequate and safe complementary (solid) foods at age six months together with continued breastfeeding up to two years of age or beyond.	Breastfeeding is associated with better general health and a lower risk of ECC in infants and children.
	Align ECC intervention with health promotion initiatives against childhood obesity by avoiding consumption of free sugars in foods and drinks, including complementary foods and drinks.	Intake of free sugars has a negative impact on oral and general health, such as dental caries, weight gain, obesity and associated NCDs.
	Increase efforts to ensure access to clean safe drinking water to avoid unnecessary consumption of sugar-sweetened beverages.	Intake of free sugars has a negative impact on oral and general health, such as dental caries, weight gain, obesity and associated NCDs.



	Action	Rationale
	Regulate marketing of foods and drinks (including complementary food) to children, and especially reduce exposure of children to, and power of, marketing of foods high in free sugars.	Intake of free sugars has a negative impact on oral and general health, such as dental caries, weight gain, obesity and associated NCDs.
	Introduce taxation policies on foods and drinks high in free sugars.	Taxes or levies on sugar-sweetened beverages are recommended by WHO as a measure to reduce consumption of sugar-sweetened beverages.
	Advocate appropriate use of fluoride for caries prevention. This should provide guidance for both public health interventions and health workers advising individuals and caregivers.	Fluoride is a key agent in reducing prevalence of dental caries. Because ECC severity and social, cultural and economic conditions differ between countries, each country should formulate and implement its own policy on appropriate use of fluoride.
	Integrate ECC surveillance into existing national or subnational surveillance systems (e.g. DHIS).	It is important that national programmes established for prevention of ECC and health promotion are evaluated. National or subnational concerns may call for incorporation of preschool children in oral health surveillance programmes.
	Develop a national policy to encourage the development of new skills and competencies of primary care teams and ensure their initial and continuing training for ECC prevention and control.	It is essential that non-oral health professionals (primary care teams, primary care workers) appreciate ECC as a public health problem impacting on infants and children, families and communities. This should be in terms of pain, infection, child growth and development, as well as the economic bearing of the disease. Health professionals should understand the key risk factors for ECC and how to identify them, and they should recognize their responsibilities in the work against ECC.

Annex 3

Useful materials

Early diagnosis and monitoring and evaluation of early childhood caries

Oral health surveys: basic methods, fifth edition. Geneva: World Health Organization; 2013 (http://apps.who.int/iris/bitstream/10665/97035/1/9789241548649_eng.pdf?ua=1).

Risk factor control: infant feeding and diet in young children

5 keys to a healthy diet: breastfeed babies and young children. Geneva: World Health Organization (https://www.who.int/nutrition/topics/5keys_healthydiet/en/).

Sugars intake for adults and children: guideline. Geneva: World Health Organization; 2015 (http://www.who.int/nutrition/publications/guidelines/sugars_intake/en/).

Guidance on ending the inappropriate promotion of foods for infants and young children: implementation manual. Geneva: World Health Organization; 2018 (<https://www.who.int/nutrition/publications/infantfeeding/manual-ending-inappropriate-promotion-food/en/>).

Population-based use of fluoride

Basic methods for assessment of renal fluoride excretion in community prevention programmes for oral health. Geneva: World Health Organization; 2013 (https://www.who.int/oral_health/publications/9789241548700/en/).

Fluoride and oral health. Geneva: World Health Organization; 2016 (https://www.who.int/oral_health/publications/fluroide-oral-health/en/).

Prevention of dental caries through the use of fluoride: the WHO approach. Geneva: World Health Organization; 2016 (https://www.who.int/oral_health/publications/prevention-dental-caries-through-use-fluoride/en/).

Role of non-oral health professionals and community health workers in prevention and control of early childhood caries

Promoting oral health in Africa: prevention and control of oral diseases and noma as part of essential noncommunicable disease interventions. Brazzaville: World Health Organization Regional Office for Africa; 2016 (https://www.who.int/oral_health/publications/promoting-oral-health-africa/en/).

WHO guideline on health policy and system support to optimize community health worker programmes. Geneva: World Health Organization; 2018 (<http://apps.who.int/iris/bitstream/handle/10665/275474/9789241550369-eng.pdf?ua=1>).

Building a supportive environment through integration of prevention and control in other health initiatives

Resolution WHA 60.17. Oral health: action plan for promotion and integrated disease prevention. In: Sixtieth World Health Assembly, Geneva, 23 May 2007. Geneva: World Health Organization; 2007 (http://apps.who.int/iris/bitstream/handle/10665/22590/A60_R17-en.pdf).

Strategy for oral health in South-East Asia, 2013–2020. New Delhi: World Health Organization Regional Office for South-East Asia; 2013 (http://www.searo.who.int/entity/noncommunicable_diseases/documents/sea_ncd_90/en/).

Global action plan for the prevention and control of noncommunicable diseases 2013–2020. Geneva: World Health Organization; 2013 (http://apps.who.int/iris/bitstream/handle/10665/94384/9789241506236_eng.pdf?sequence=1).

Regional oral health strategy 2016–2025: addressing oral diseases as part of noncommunicable diseases – report of the Secretariat. Addis Ababa: World Health Organization Regional Office for Africa; 2016 (<https://apps.who.int/iris/handle/10665/250994>).

Action plan for the prevention and control of noncommunicable diseases in the WHO European region 2016–2025. Copenhagen: World Health Organization Regional Office for Europe; 2016 (http://www.euro.who.int/__data/assets/pdf_file/0008/346328/noncommunicable_disease-ActionPlan-GB.pdf?ua=1).

Provisional agenda item 12.1. Maternal, infant and young child nutrition: guidance on ending the inappropriate promotion of foods for infants and young children – report by the Secretariat. In: Sixty-ninth World Health Assembly, Geneva, 13 May 2016. Geneva: World Health Organization; 2016 (http://apps.who.int/gb/ebwha/pdf_files/WHA69/A69_7Add1-en.pdf?ua=1).

Report of the Commission on Ending Childhood Obesity. Geneva: World Health Organization; 2016 (<http://www.who.int/end-childhood-obesity/publications/echo-report/en/>).

Tackling noncommunicable diseases: “best buys” and other recommended interventions for the prevention and control of noncommunicable diseases. Geneva: World Health Organization; 2017 (<http://apps.who.int/iris/handle/10665/259232>).

References

1. Closing the gap in a generation: health equity through action on the social determinants of health – final report of the Commission on Social Determinants of Health. Geneva: World Health Organization; 2008 (https://www.who.int/social_determinants/thecommission/finalreport/en/).
2. Otero G, Pechlaner G, Liberman G, Gürcan E. The neoliberal diet and inequality in the United States. *Soc Sci Med*. 2015;142:47–55.
3. Thomson WM. Public health aspects of paediatric dental treatment under general anaesthetic. *Dent J (Basel)*. 2016;4(2).
4. Monse B, Heinrich-Weltzien R, Benzian H, Holmgren C, van Palenstein Helder W. PUFA: an index of clinical consequences of untreated dental caries. *Community Dent Oral Epidemiol*. 2010;38(1):77–82.
5. Oziegbe EO, Esan TA. Prevalence and clinical consequences of untreated dental caries using PUFA index in suburban Nigerian school children. *Eur Arch Paediatr Dent*. 2013;14(4):227–31.
6. Gandeegan K, Ramakrishnan M, Halawany HS, Abraham NB, Jacob V, Anil S. The role of feeding practices as a determinant of the pufa index in children with early childhood caries. *J Clin Pediatr Dent*. 2016;40(6):464–71.
7. Kamran R, Farooq W, Faisal MR, Jahangir F. Clinical consequences of untreated dental caries assessed using PUFA index and its covariates in children residing in orphanages of Pakistan. *BMC Oral Health*. 2017;17(1):108.
8. Khanh LN, Ivey SL, Sokal-Gutierrez K, Barkan H, Ngo KM, Hoang HT, et al. Early childhood caries, mouth pain, and nutritional threats in Vietnam. *Am J Public Health*. 2015;105(12):2510–17.
9. Fisher-Owens SA, Gansky SA, Platt LJ, Weintraub JA, Soobader MJ, Bramlett MD, Newacheck PW. Influences on children's oral health: a conceptual model. *Pediatrics*. 2007;120:e510–20.
10. Jürgensen N, Petersen PE. Promoting oral health of children through schools: results from a WHO global survey 2012. *Community Dent Health*. 2013;30(4):204–18.
11. Petersen PE, Hunsrisakhun J, Thearmontree A, Pithpornchaiyakul S, Hintao J, Jürgensen N, et al. School-based intervention for improving the oral health of children in southern Thailand. *Community Dent Health*. 2015;32(1):44–50.
12. Phantumvanit P, Makino Y, Ogawa H, Rugg-Gunn A, Moynihan P, Petersen PE, et al. WHO global consultation on public health intervention against early childhood caries. *Community Dent Oral Epidemiol*. 2018;46(3):280–87.
13. WHO Expert Consultation on Public Health Intervention against Early Childhood Caries: report of a Meeting – Thailand, 26–28 January 2016. Geneva: World Health Organization; 2017 (http://www.who.int/oral_health/publications/early-childhood-caries-meeting-report-Thailand/en/).
14. Moynihan P, Tanner LM, Holmes RD, Hillier-Brown F, Mashayekhi A, Kelly SAM, et al. Systematic review of evidence pertaining to factors that modify risk of early childhood caries. *JDR Clin Trans Res*. 2019;4(3):202–16.
15. Health matters: child dental health. London: Public Health England; 2017 (<https://www.gov.uk/government/publications/health-matters-child-dental-health/health-matters-child-dental-health>).
16. National dental epidemiology programme for England: oral health survey of five-year-old children 2017. London: Public Health England; 2018 (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/768368/NDEP_for_England_OH_Survey_5yr_2017_Report.pdf).
17. Dental health: extractions data 2016–17 – tooth extractions in hospital for 0–19 year olds 2011/12–2016/17. London: Public Health England; 2018 (<https://www.gov.uk/government/publications/hospital-tooth-extractions-of-0-to-19-year-olds>).

37. O'Mullane DM, Baez RJ, Jones S, Lennon MA, Petersen PE, Rugg-Gunn AJ, et al. Fluoride and oral health. *Community Dent Health*. 2016;33(2):69–99.
38. Fluorides and oral health. WHO technical report series 846. Geneva: World Health Organization; 1994.
39. Resolution WHA 60.17. Oral health: action plan for promotion and integrated disease prevention. In: Sixtieth World Health Assembly, Geneva, 23 May 2007. Geneva: World Health Organization; 2007 (http://apps.who.int/iris/bitstream/handle/10665/22590/A60_R17-en.pdf).
40. Petersen PE, Ogawa H. Prevention of dental caries through the use of fluoride: the WHO approach. *Community Dent Health*. 2016;33(2):66–8.
41. A systematic review of the efficacy and safety of fluoridation. Canberra: Australian National Health and Medical Research Council; 2007.
42. Centers for Disease Control and Prevention. Ten great public health achievements: United States, 1900–1999. *MMWR Morb Mortal Wkly Rep*. 1999;48:241–3.
43. One in a million: the facts about water fluoridation, 3rd edition. Oldham: British Fluoridation Society; 2012 (<https://www.bfsweb.org/one-in-a-million>).
44. Rugg-Gunn AJ, Do L. Effectiveness of water fluoridation in caries prevention. *Community Dent Oral Epidemiol*. 2012;40(Suppl. 2):55–64.
45. Iheozor-Ejiogor Z, Worthington HV, Walsh T, O'Malley L, Clarkson JE, Macey R, et al. Water fluoridation for the prevention of dental caries. *Cochrane Database Syst Rev*. 2015(6):CD010856.
46. Sodium intake for adults and children: guideline. Geneva: World Health Organization; 2012 (http://www.who.int/nutrition/publications/guidelines/sodium_intake/en/).
47. Yeung CA, Chong LY, Glenny AM. Fluoridated milk for preventing dental caries. *Cochrane Database Syst Rev*. 2015(9):CD003876.
48. Bian JY, Wang WH, Wang WJ, Rong WS, Lo EC. Effect of fluoridated milk on caries in primary teeth: 21-month results. *Community Dent Oral Epidemiol*. 2003;31(4):241–5.
49. Milk fluoridation for the prevention of dental caries. Geneva: World Health Organization; 2009 (https://www.who.int/oral_health/publications/milk_fluoridation_2009_en.pdf).
50. Cagetti MG, Campus G, Milia E, Lingström P. A systematic review on fluoridated food in caries prevention. *Acta Odontol Scand*. 2013;71(3–4):381–7.
51. Petersen PE, Kwan S, Ogawa H. Long-term evaluation of the clinical effectiveness of community milk fluoridation in Bulgaria. *Community Dent Health*. 2015;32(4):199–203.
52. Walsh T, Worthington HV, Glenny AM, Appelbe P, Marinho VC, Shi X. Fluoride toothpastes of different concentrations for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev*. 2010(1):CD007868.
53. Wright JT, Hanson N, Ristic H, Whall CW, Estrich CG, Zentz RR. Fluoride toothpaste efficacy and safety in children younger than 6 years: a systematic review. *J Am Dent Assoc*. 2014;145(2):182–9.
54. Basic methods for assessment of renal fluoride excretion in community prevention programmes for oral health. Geneva: World Health Organization; 2013 (https://www.who.int/oral_health/publications/9789241548700/en/).
55. Sugars and dental caries. Geneva: World Health Organization; 2017 (<https://apps.who.int/iris/bitstream/handle/10665/259413/WHO-NMH-NHD-17.12-eng.pdf?sequence=1>).
56. Marinho VC, Higgins JP, Sheiham A, Logan S. Fluoride toothpastes for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev*. 2003(1):CD002278.

57. Duangthip D, Chen KJ, Gao SS, Lo ECM, Chu CH. Managing early childhood caries with atraumatic restorative treatment and topical silver and fluoride agents. *Int J Environ Res Public Health*. 2017;14(10).
58. Wright JT, Tampi MP, Graham L, Estrich C, Crall JJ, Fontana M, et al. Sealants for preventing and arresting pit-and-fissure occlusal caries in primary and permanent molars: a systematic review of randomized controlled trials – a report of the American Dental Association and the American Academy of Pediatric Dentistry. *J Am Dent Assoc*. 2016;147(8):631–45.
59. Marinho VC, Worthington HV, Walsh T, Clarkson JE. Fluoride varnishes for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev*. 2013(7):CD002279.
60. Weyant RJ, Tracy SL, Anselmo TT, Beltrán-Aguilar ED, Donly KJ, Frese WA, et al. Topical fluoride for caries prevention: executive summary of the updated clinical recommendations and supporting systematic review. *J Am Dent Assoc*. 2013;144(11):1279–91.
61. Lenzi TL, Montagner AF, Soares FZ, de Oliveira Rocha R. Are topical fluorides effective for treating incipient carious lesions? A systematic review and meta-analysis. *J Am Dent Assoc*. 2016;147(2):84–91.
62. Gao SS, Zhang S, Mei ML, Lo EC, Chu CH. Caries remineralisation and arresting effect in children by professionally applied fluoride treatment: a systematic review. *BMC Oral Health*. 2016;16:12.
63. Gao SS, ZI, Hiraishi N, Duangthip D, Mei ML, Lo EC. Clinical trials of silver diamine fluoride in arresting caries among children: a systematic review. *JDR Clin Trans Res*. 2016;1:201–10.
64. Duangthip D, Jiang M, Chu CH, Lo EC. Non-surgical treatment of dentin caries in preschool children: systematic review. *BMC Oral Health*. 2015;15:44.
65. De Amorim RG, Leal SC, Frencken JE. Survival of atraumatic restorative treatment (ART) sealants and restorations: a meta-analysis. *Clin Oral Investig*. 2012;16(2):429–41.
66. Tedesco TK, Calvo AF, Lenzi TL, Hesse D, Guglielmi CA, Camargo LB, et al. ART is an alternative for restoring occlusoproximal cavities in primary teeth: evidence from an updated systematic review and meta-analysis. *Int J Paediatr Dent*. 2017;27(3):201–9.
67. Kim Seow W. Environmental, maternal, and child factors which contribute to early childhood caries: a unifying conceptual model. *Int J Paediatr Dent*. 2012;22(3):157–68.
68. Brickhouse TH. Family oral health education. *Gen Dent*. 2010;58(3):212–19.
69. Hooley M, Skouteris H, Boganin C, Satur J, Kilpatrick N. Parental influence and the development of dental caries in children aged 0–6 years: a systematic review of the literature. *J Dent*. 2012;40(11):873–85.
70. Albino J, Tiwari T. Preventing childhood caries: a review of recent behavioral research. *J Dent Res*. 2016;95(1):35–42.
71. Vann WF, Lee JY, Baker D, Divaris K. Oral health literacy among female caregivers: impact on oral health outcomes in early childhood. *J Dent Res*. 2010;89(12):1395–400.
72. Naidu R, Nunn J, Irwin JD. The effect of motivational interviewing on oral healthcare knowledge, attitudes and behaviour of parents and caregivers of preschool children: an exploratory cluster randomised controlled study. *BMC Oral Health*. 2015;15:101.
73. Henry JA, Muthu MS, Swaminathan K, Kirubakaran R. Do oral health educational programmes for expectant mothers prevent early childhood caries? Systematic review. *Oral Health Prev Dent*. 2017;15(3):215–21.
74. Plonka KA, Pukallus ML, Barnett A, Holcombe TF, Walsh LJ, Seow WK. A controlled, longitudinal study of home visits compared to telephone contacts to prevent early childhood caries. *Int J Paediatr Dent*. 2013;23(1):23–31.
75. Rai NK, Tiwari T. Parental factors influencing the development of early childhood caries in developing nations: a systematic review. *Front Public Health*. 2018;6:64.

76. Colvara BC, Faustino-Silva DD, Meyer E, Hugo FN, Hilgert JB, Celeste RK. Motivational interviewing in preventing early childhood caries in primary healthcare: a community-based randomized cluster trial. *J Pediatr*. 2018;201:190–95.
77. George A, Johnson M, Blinkhorn A, Ellis S, Bhole S, Ajwani S. Promoting oral health during pregnancy: current evidence and implications for Australian midwives. *J Clin Nurs*. 2010;19(23–24):3324–33.
78. Petersen PE. Strengthening of oral health systems: oral health through primary health care. *Med Princ Pract*. 2014;23(Suppl. 1):3–9.
79. The World Health Report 2008: primary health care (now more than ever). Geneva: World Health Organization; 2008 (<https://www.who.int/whr/2008/en/>).
80. Kranz AM, Preisser JS, Rozier RG. Effects of physician-based preventive oral health services on dental caries. *Pediatrics*. 2015;136(1):107–14.
81. Promoting oral health in Africa: prevention and control of oral diseases and noma as part of essential noncommunicable disease interventions. Brazzaville: World Health Organization Regional Office for Africa; 2016 (https://www.who.int/oral_health/publications/promoting-oral-health-africa/en/).
82. WHO guideline on health policy and system support to optimize community health worker programmes. Geneva: World Health Organization; 2018 (<http://apps.who.int/iris/bitstream/handle/10665/275474/9789241550369-eng.pdf?ua=1>).
83. STEPwise approach to noncommunicable disease risk factor surveillance (STEPS). Geneva: World Health Organization (<https://www.who.int/ncds/surveillance/steps/riskfactor/en>).
84. Be smart: drink water – a guide for school principals in restricting the sale and marketing of sugary drinks in and around schools. Manila: World Health Organization Regional Office for the Western Pacific; 2016 (https://iris.wpro.who.int/bitstream/handle/10665.1/13218/WPR_2016_DNH_008_eng.pdf).
85. A framework for implementing the set of recommendations on the marketing of foods and non-alcoholic beverages to children. Geneva: World Health Organization; 2012 (https://www.who.int/dietphysicalactivity/framework_marketing_food_to_children/en/).
86. Set of recommendations on the marketing of foods and non-alcoholic beverages to children. Geneva: World Health Organization; 2010 (<https://www.who.int/dietphysicalactivity/publications/recsmarketing/en/>).
87. Tackling noncommunicable diseases: “best buys” and other recommended interventions for the prevention and control of noncommunicable diseases. Geneva: World Health Organization; 2017 (<http://apps.who.int/iris/handle/10665/259232>).
88. Report of the Commission on Ending Childhood Obesity. Geneva: World Health Organization; 2016 (<http://www.who.int/end-childhood-obesity/publications/echo-report/en/>).

