WHO Expert Consultation on Public Health Intervention against Early Childhood Caries

REPORT OF A MEETING

Bangkok, Thailand, 26–28 January 2016

World Health Organization

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NOTE

The views expressed in this report are those of the participants of the WHO Expert Consultation on Public Health Intervention against Early Childhood Caries and do not necessarily reflect the policies of the conveners.

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Abbreviations and acronyms

AAPD	American Academy of Pediatric Dentistry
AAP	American Academy of Pediatrics
ART	Atraumatic Restorative Treatment
ECC	Early Childhood Caries
ICD	International Classification of Diseases and related health problems
ICDAS	International Caries Detection and Assessment System
ITR	Interim Therapeutic Restorations
ppm	Part per million
SIDS	Sudden Infant Death Syndrome
SMART	Simplified and Modified Atraumatic Restorative Treatment
UNICEF	United Nations Children's Fund
WHO	World Health Organization

Executive summary

The global epidemiology of early childhood caries (ECC) has demonstrated the prevalence of caries in preschool children in both developed and developing countries. ECC is a public health problem, with more severity in communities of low socioeconomic status where mostly untreated caries have a major impact on the general health and quality of life of infants and toddlers. Nevertheless, ECC is preventable through correct management of common risk factors, and by following WHO's recommendations for infant feeding and reduced intake of free sugars – especially in complementary foods for young children. Strategies for management of ECC include all levels of prevention as early as possible, starting with tooth brushing with fluoride toothpaste and modification of sociobehavioural factors.

Primary prevention – covering promotion of healthy behaviours and appropriate fluoride use – will be the key to ECC management. Prevention of ECC should be integrated into existing primary health care programmes, especially those for maternal and child health. Health promotion aimed at pregnant women, new mothers and primary caregivers should raise concerns at the common risk factors of ECC by emphasizing WHO's recommendations on breastfeeding until six months of age, no added sugars for complementary feeding up to two years, and after that limited free sugars intake in accordance with the WHO guideline. Primary caregivers should be trained to provide a proper tooth brushing with the right amount of fluoride toothpaste from the first primary tooth eruption, followed by early detection of early lesions of caries during the vaccination period within primary care. Management of ECC should be part of the curriculum for all health professionals who promote the health of infants and toddlers in society. Moreover, a health policy should be developed to include affordable and effective fluoride toothpaste, a non-sugar complementary diet, a healthy environment and community fluoride administration.

Secondary prevention of ECC should focus on the early detection of carious lesions. Therefore, ECC – as well as severe ECC – should be clearly defined. Not only dental personnel but also other health professionals and even mothers should be trained to detect the early signs of carious lesions. Oral health check-up records should be integrated into the child's health profile at the child health clinic during the vaccination period and when the child has general health examinations. Diet counselling, proper bottle-feeding, and especially limited free sugars intake should be regularly emphasized during the periodic visits to the child health clinic. Application of fluoride varnish on early carious lesions, such as white spot lesions, by trained personnel is recommended, as are sealants with glass ionomer cement on non-cavitated lesions. Parents and caregivers should be actively and routinely involved in the dietary and oral hygiene practices of their children.

Tertiary prevention of ECC aims to reduce the negative impact of the untreated frank, open cavity and improve the quality of life of children by avoiding unnecessary extraction and restoration functions. Silver diamine fluoride or fluoride varnish can stop dentine carious lesions. However, atraumatic restorative treatment/simplified modified ART/interim therapeutic restoration (ART/SMART/ITR) is an alternative option, with glass ionomer cement as the material of choice for tertiary prevention. If ECC are left untreated, extensive treatment will soon be required. Depending on the child's behaviour and cooperation, in serious cases the child's rehabilitation may need to be done under general anesthesia by skilled professionals in appropriate facilities. For this, more resources are needed and the cost of such treatment would be higher than primary and secondary prevention.

WHO Global Consultation on Early Childhood Caries brought together staff from WHO headquarters and regional offices with representatives of WHO collaborating centres for oral health, international experts and rapporteurs. Participants agreed on a set of recommendations for a future action plan on ECC, as follows:

- Propose the definition of ECC to WHO (ICD-11).
- Include the three-year-old age group as one of the index ages recommended for population surveys in the next edition of WHO's *Oral health surveys: basic methods.*
- Detect early carious lesions for early prevention, such as initial (white spot lesions), moderate (non-cavitated lesions) and extensive (frank, open cavities).
- Advocate the importance of primary teeth to mothers and the community by raising concern for the impact of ECC on the quality of life of young children.
- Emphasize ECC within oral health education and interprofessional education with other health professions.
- Integrate ECC within the primary health care approach, such as well-child clinics or during the childhood vaccination period.
- Apply WHO recommendations for infant feeding for the prevention of ECC.
- Use the common risk factors approach, such as emphasizing limited free sugars intake in accordance with WHO recommendations, for control of ECC together with child obesity.
- Provide a training package for dental and non-dental personnel, including appropriate management for all three levels of prevention of ECC.
- Confirm the use of community fluoride administration – such as water, milk or salt – as primary prevention of ECC.
- Use fluoride varnish and sealants with glass ionomer cement as secondary prevention for ECC.
- Support silver fluoride and ART/SMART/ITR with glass ionomer cement as an alternative procedure for tertiary prevention of ECC.
- Promote evaluation, surveillance and research for cost-effectiveness and consequences of prevention of ECC in different communities.

However, public health measures for controlling ECC will depend on the local or domestic situation and should be followed up with updated evidence-based information, with the firm intention to improve the quality of life of the world's children, especially in developing countries.

Introduction

Since the adoption of World Health Assembly resolution WHA60.17 on oral health in 2007,[1] WHO has recommended Member States to formulate a national oral health plan – including integrated oral disease prevention and health promotion for young children. The recommendation is an impetus to countries to develop or adjust national oral health programmes while the resolution supports global actions that have been carried out by WHO's Oral Health programme in recent years.[2]

The prevalence of dental caries in primary teeth is growing rapidly in low- and middle-income countries and, in those countries with the most severe dental caries, early childhood caries (ECC) is becoming a significant health problem. This disease pattern has been observed in many parts of the world in a parallel transition towards modern diet and changing lifestyles. Moreover, carious teeth are often left untreated and thus deteriorate to pain. This situation has a large impact on oral health, general health, growth and development, and the quality of life of the children's families and communities. However, evidence-based information about intervention against ECC has recently been gained in some regions.

[1] The World Health Assembly agreed on a resolution (WHA.60.17) on "Oral health: an action plan for promoting and integrating disease prevention". The resolution comprises a wide-ranging policy that gives direction to better oral health for people in WHO Member States.

[2] Petersen PE. Strengthening of oral health systems: oral health through primary health care. Med Princ Pract. 2014;23(Suppl 1):3–9.

Opening

The World Health Organization (WHO) Expert Consultation on Public Health Intervention against Early Childhood Caries (ECC) was held in Bangkok, Thailand, on 26-28 January 2016. The consultation was jointly hosted by Mahidol University, Thailand, and the Borrow Foundation, United Kingdom, and was organized by the WHO Collaborating Centre for Oral Health Education and Research at the Faculty of Dentistry, Mahidol University.

Professor Passiri Nisalak, Dean of Mahidol University Faculty of Dentistry and Director of the WHO Collaborating Centre, welcomed participants to the consultation and expressed gratitude and appreciation to both WHO and the Borrow Foundation for their support and contributions. Professor Nisalak stated that Mahidol University recognized ECC as a worldwide public health problem and had organized the consultation to provide an opportunity for possible public health solutions to be explored. The meeting would provide a global platform against ECC and would hopefully be beneficial to the quality of life of future generations.

The Borrow Foundation has supported many oral health programmes, including milk fluoridation, in many countries including Thailand. The representative of the foundation expressed appreciation to be a part of this initiative against ECC and to promote oral health of young children globally.

Dr. Hiroshi Ogawa of WHO's Oral Health programme, expressed concern at ECC problems in many parts of the world. Despite its high prevalence which leads to poor quality of life in young children, consensus on a guideline for ECC prevention is still lacking. The consultation was an opportunity to bring together all the experts to share their experiences to help develop a public health approach to preventing ECC. Dr. Ogawa declared the consultation open with the wish that it would eventually result in global guidelines to prevent ECC.

Overview and objectives

The American Academy of Pediatric Dentistry (AAPD) defines ECC as the presence of one or more decayed (non-cavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child 71 months of age or younger.[3] In children younger than 3 years of age, any sign of smooth-surface caries is indicative of severe early childhood caries (S-ECC).[3] From ages 3 to 5 years, one or more cavitated, missing (due to caries) or filled smooth surfaces in primary maxillary anterior teeth, or a decayed, missing or filled score of ≥ 4 (age 3), ≥ 5 (age 4) or ≥ 6 (age 5) surfaces constitutes S-ECC. Not only is ECC prevalent but a very limited number of teeth with ECC are treated. Many factors associated with ECC are not easily modified.

Background knowledge of ECC was reviewed, illustrated and discussed by experts with different backgrounds from many countries. In particular, they considered:

- the global epidemiology of caries in the primary dentition, pattern and development of ECC;
- the overview of the etiology of ECC;
- specific risk factors, infant feeding and young children's diets that represent risk behaviours related to ECC;
- strategies for preventing and modifying risk factors, including sociobehavioural factors.

The global consultation aimed to explore possible public health solutions to ECC and consider actions to ensure that future generations of children have better oral health and quality of life worldwide. Its objective was to identify preventive approaches and to highlight the applicability of programme components to low- and middle-income countries in an effort to identify common ground for evidence-based health policy in the field of ECC prevention and control.

The consultation proposed strategies and policies based on the best available evidence and WHO committed to providing appropriate direction to support national policies.

[3] American Academy of Pediatric Dentistry Policy on Early Childhood Caries (ECC): classifications, consequences, and preventive strategies. Reference manual. Pediatr Dent. 2015;37(6):50–52.

Plenary session

The consultation's technical sessions included both plenary sessions and group discussions. Plenary sessions focused particularly on global epidemiology, patterns and development of ECC, etiology, socio-behavioural factors, and prevention strategies.

Global epidemiology of early childhood caries

ECC continues to be a pandemic disease worldwide. Prevalence among children aged 3-5 years age varies between continents and countries. Data from the USA show a higher prevalence than European countries with 40% of children acquiring caries by kindergarten age, while in the United Kingdom 12% of 3-year-old children had visible caries.[4] In Japan, the National Oral Health Survey of 2011 showed that 25% of 3-year-olds experienced caries with a rate of decayed and filled primary teeth (dft) of 0.6. Published studies show higher prevalence of 36-85% in Asia, 38-45% in Africa and 22-61% in the Middle East.[5] Cambodia and Indonesia have reported high ECC prevalence and severity since 90% of 3-5-year-olds have caries with a rate of decayed, missing and filled teeth (dmft) higher than 6. ECC prevalence is in the 50-60% range in Iran, Senegal and Thailand among the 3-5-year-old age group. However, severity has declined in some countries, as in Thailand. Data have shown that ECC prevalence increases with age and can start as early as 12 months of age (Nigeria). The report from Bangalore City, India, among the younger age groups of 8-48 months of age has demonstrated 27.5% caries prevalence and a mean def of 0.85.[6]

In some countries, ECC is not pandemic but rather endemic in specific sectors or population groups. Prevalence is high in many low-income countries, particularly in South-East Asia and Africa and specifically among socioeconomically disadvantaged groups. Most caries is left untreated, which could lead to a lack of physical development and reduced learning ability of children, and the treatment costs could increase. ECC also represents a risk factor for permanent tooth caries.

The WHO Oral Health Country/Area Profile Programme (CAPP) was established 1995 in collaboration with WHO's Noncommunicable Diseases cluster, several WHO collaborating centres, organizations and individuals around the world. The CAPP has a set up a database of country oral health profiles, a number of which were presented to consultation participants. The profiles show that, despite the decline in caries prevalence in western countries, ECC remains a public health problem in both developed and developing countries worldwide. Research needs include areas such as epidemiology of caries or caries surveillance, reasons for poor compliance in caries prevention, reasons for untreated early childhood caries, design of caries prevention programmes and control of risk factors for ECC, and methods to raise public awareness. ECC is one of the most prevalent health problems in infants and toddlers. Several studies have reported the impact of ECC on children's quality of life.[7] Preschool children with oral disease and disorders have been shown to have a poorer quality of life.[8]

ECC affects young children's growth. One study showed that children with at least one decayed tooth were significantly underweight with odd ratios 1.6 (95%CI; 1.1-2.3) for 6-8-year-olds and 1.5 (95%CI; 1.1-2.0) for 9-12-year-olds.[9] Children with severe ECC have pain and chewing difficulties, and could require hospitalization due to life-threatening infection. The cost of treatment of ECC is expensive, especially when general anaesthesia is required for tooth extraction or restoration.

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4 National Oral Health Survey UK, 2013.

5 Colak H, Dulgergil CT, Dalli M, Hamidi MM. Early childhood caries update: a review of causes, diagnoses, and treatments. J Nat Sci Biol Med. 2013;4(1):29–38.

6 Prakash P, Subramaniam P, Durgesh BH, Konde S. Prevalence of early childhood caries and associated risk factors in preschool children of urban Bangalore, India: a cross-sectional study. Eur J Dent. 2012;6(2):141–52.

7 Colak H, Dulgergil CT, Dalli M, Hamidi MM. Early childhood caries update: a review of causes, diagnoses, and treatments. J Nat Sci Biol Med. 2013;4(1):29–38.

8 Prakash P, Subramaniam P, Durgesh BH, Konde S. Prevalence of early childhood caries and associated risk factors in preschool children of urban Bangalore, India: a cross-sectional study. Eur J Dent. 2012;6(2):141–52

9 Mishu MP, Hobdell M, Khan MH, Hubbard RM, Sabbah W. Relationship between untreated dental caries and weight and height of 6- to 12-year-old primary school children in Bangladesh. Int J Dent. 2013;2013: doi: 10.1155/2013/629675.

Patterns and development of early childhood caries

The first clinical signs of ECC usually appear in the first two years of life, the disease develops rapidly and may affect oral health-related quality of life. The elaboration of preventive strategies should consider the patterns and development of the disease through early childhood. Studies from several countries that investigated patterns of ECC have shown similar patterns across the studies even from different parts of the world.[10,11,12]

Although some variations may occur due to eruption time and feeding practices, the ECC pattern is generally similar worldwide. At the age of 1 year, the most affected teeth are upper central incisors followed by upper lateral incisors. At age 2 years, upper central incisors remain the most affected teeth, followed by first lower molars. The ECC pattern changes at 3 years of age when second lower molars become considerably affected by ECC, along with upper central incisors. At age 4 years, lower second molars are the most affected. At age 5 years, lower second molars are the most affected teeth, followed by first lower molars, second upper molars and upper central incisors, which are similarly affected.

As for surface distribution, up to 2 years of age, the buccal surfaces of upper central incisors represent the most affected surfaces. After that age, the most affected are occlusal surfaces of lower second molar. At the age of 5 years, the occlusal surface of the second lower molar is the most affected, followed by occlusal surfaces of first lower molars and second upper molars, mesial and buccal surfaces of upper central incisors and occlusal surface of first upper molars. Thus ECC varies according to age, teeth and surface. Before the age of 2 years, our concern should be the buccal and mesial surfaces of upper central incisors. Then, the area of concern incorporates the occlusal surfaces of first and second molars.

The etiology of ECC involves interactions between socioeconomic, behavioural and microbiological factors, but the pattern of disease is primarily linked to behavioural characteristics, especially feeding practices.[13,14] Dietary patterns in infancy, characterized by a greater number of highly-sweetened foods and drinks are strongly associated with the incidence of ECC in the subsequent years.[13] Age-specific feeding practices and their relation with the ECC pattern – such as an anterior caries pattern in children who drink sugary liquids in a bottle while sleeping or between meals – can be identified.

To manage ECC rationally, strategies must focus on the right causes at the right time and should focus on preventing initiation rather than on controlling severity. Early infancy is a critical period in which exposure to various foods and tastes importantly influences food preferences and behaviours later in childhood.[15] Thus, the best time for effective action against the causes of ECC is during the first 1000 days (from pregnancy through to the child's second birthday).The main message to reduce ECC and change its pattern is "no sugars before two years". Even if consumption cannot be eliminated entirely, current evidence indicates benefit from reducing or delaying exposure to sweet items during the first two years. This proposal is consistent with WHO's strategy to address dietary intake under a common risk factor approach to chronic disease prevention.

[10] Ismail AI, Lim S, Tellez M. Tooth surface level caries progression in the primary dentition among preschool children. Caries Res. 2015;49(4):442–8.

[11] Thitasomakul S, Thearmontree A, Piwat S, Chankanka O, Pithpornchaiyakul W, Teanpaisan R, Madyusoh S. A longitudinal study of early childhood caries in 9- to 18-month-old Thai infants. Community Dent Oral Epidemiol. 2006;34(6):429–36.

[12] Hallett KB, O'Rourke PK. Pattern and severity of early childhood caries. Community Dent Oral Epidemiol. 2006;34(1):25–35.

[13] Chaffee BW, Feldens CA, Rodrigues PH, Vítolo MR. Feeding practices in infancy associated with caries incidence in early childhood. Community Dent Oral Epidemiol. 2015;43:338–48.

[14] Feldens CA, Giugliani ER, Duncan BB, Drachler Mde L, Vítolo MR. Long-term effectiveness of a nutritional program in reducing early childhood caries: a randomized trial. Community Dent Oral Epidemiol. 2010;38(4):324–32.

[15] Chaffee BW, Feldens CA, Rodrigues PH, Vítolo MR. Feeding practices in infancy associated with caries incidence in early childhood. Community Dent Oral Epidemiol. 2015;43:338–48.

Overview of etiology of early childhood caries

Dental caries is a multifactorial disease of teeth resulting from an ecological shift in the dental biofilm and presenting as localized dissolution and destruction of the mineralized tissues. A number of systematic reviews on ECC attempt to identify the characteristics of children with ECC (more severe ECC). Harris et al.[17] reported lists of 106 factors related to ECC. A systematic review by Leong et al.[16] demonstrated 28 risk factors during the first year of life that related to the development of ECC. A recent review by Congiu et al.,[18] including eight review papers, listed 39 background factors related to the prevalence of ECC.

The causes of ECC and the process it follows are expected to be similar to those of the general dental caries model. The causative model illustrates the interaction of three factors – host (susceptible tooth surfaces), agent (plaque bacteria) and environment (carbohydrate diet) – over time.[19]

Host factor (susceptible tooth surfaces)

Tooth: A developmental defect of tooth predisposes the tooth to caries. Factors related to the increased risk of the developmental defect are maternal stress and health during pregnancy, adverse birthing conditions, postnatal illness and malnutrition.

Child: Oral health-related behaviours (tooth cleaning, dietary practices, use of preventive services in the dental visit) and individual susceptibility of the child (genetics, nutrition, past caries experience) are associated with caries.

Agent factor (plaque bacteria)

Streptococcus mutans is potentially transmissible, and mothers are a major source of early colonization. Factors related to bacterial transmission include pre-tasting food (i.e. taking a taste of the food and letting the food cool), sharing utensils, mother's Mutans Streptococci level, oral hygiene and dental caries status.

Environmental factor (carbohydrate diet)

Tooth: A fermentable carbohydrate is cariogenic. Low molecular weight carbohydrate is more cariogenic than complex carbohydrate. Among the former, sucrose is more cariogenic than glucose, fructose and lactose. Saliva surrounding tooth surfaces has protective factors that include flow, protein, buffer and minerals to promote remineralization. Intake/presence of sugars at night-time or bedtime when saliva secretion is low is associated with ECC, whereas the presence of low-concentration fluoride around the teeth is an important protective factor. Factors related to fluoride presence are background fluoride level and use of fluoride toothpaste.

Child: Research suggests that socioeconomic and family background related to child-rearing pattern (including low educational level of parents, unemployed or low-skilled occupation, low income, immigrant, single-parent family, and many adults and children in the household) are associated with ECC.

Parental factors (especially the mother) that are related to ECC are young age, low education, poor oral hygiene practices, high dental caries and irregular dental visits. There is evidence that children of low socioeconomic status whose diet is high in sugars have higher caries experience. The disease is a matter of health behaviour. Severe ECC is linked to the disadvantaged social background that is commonly associated with economic and familial stresses and which in turn results in maternal psychological distress. These factors may be compounded by a child with a difficult temperament that can lead to dysfunctional parenting.[20]

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[16] Harris R, Nicoll AD, Adair PM, Pine CM. Risk factors for dental caries in young children: a systematic review of the literature. Community Dent Health. 2004;21(1 Suppl):71–85. Review.

[17] Leong PM1, Gussy MG, Barrow SY, de Silva-Sanigorski A, Waters E. A systematic review of risk factors during the first year of life for early childhood caries. Int J Paediatr Dent. 2013;23(4):235-50.

[18] Congiu G, Campus G, Luglìè PF. Early childhood caries (ECC) prevalence and background factors: a review. Oral Health Prev Dent. 2014;12(1):71–6.

[19] ten Cate JM. The need for antibacterial approaches to improve caries control. Adv Dent Res. 2009;2(1):8–12.

[20] Seow K. Environmental, maternal, and child factors which contribute to early childhood caries: a unifying conceptual model. Int J Paediatr Dent. 2012;22(3):157–68.

Infant feeding and diets of the young child

United Nations Children's Fund (UNICEF) has reported that 101 million children under 5 years of age are undernourished, 165 million have stunted growth, and 45 million are obese or overweight.[21] More than 30% of children aged under 5 years have vitamin deficiency. However, breastfeeding and appropriate complementary feeding can reduce mortality in children under 5 years by 19%. WHO recommends that mothers should immediately initiate breastfeeding and should breastfeed exclusively for six months. Complementary feeding with continued breastfeeding should last up to two years and beyond. Appropriate micronutrient supplements such as vitamin A, iron, zinc and iodine should be provided.

Breastfeeding

Breastfeeding exclusively for six months and until two years or beyond has health benefits for infants and mothers. Global strategies for infant and young child feeding have been adopted by the World Health Assembly, and UNICEF provides a framework for action to promote breastfeeding and includes additional targets for infants and young children. Although 44% of newborns worldwide are breastfed within one hour of birth, only 38% are exclusively breastfed for six months. In Thailand, for instance, only 46.3% of infants are breastfed in the first hour of life. An even lower percentage of 29.2% has been reported in Bangkok, and only 12% of mothers exclusively breastfeed for the first six months, according to UNICEF. In the United Kingdom, although 81% of mothers initiated breastfeeding at birth, only 1% exclusively breastfed for the first six months, according to the Infant Feeding Survey of 2010.[22]

Breastfeeding of duration beyond 12 months benefits mothers as a natural birth control.[23] Although some studies had shown some medical benefits to the child, the research methods were weak. Breastfeeding beyond 12 months of age is most useful in certain specific situations, such as for keeping children hydrated where clean water is lacking and as a source of nutrition when complementary foods are inadequate.

Nocturnal breastfeeding has benefits in enhancing the contraceptive effect and improves milk supply.[23] It ensures infants an adequate milk intake and may reduce the incidence of sudden infant death syndrome (SIDS).[24] Nocturnal breastfeeding can also contribute up to 20% of intake which is important for babies with faltering weight. Serotonin in breastmilk promotes the sleep of both babies and mothers.[25]

Baby-led (on-demand) breastfeeding is recommended by WHO and the American Association of Pediatrics (AAP). It increases the flow of milk, is better tailored to the infant's need, boosts oxytocin to reduce baby stress[26] and helps regulate the baby's body temperature and blood glucose.[27]

Breastfeeding and oral health

A systematic review and meta-analysis demonstrated that children breastfed after 12 months of age increased the risk of caries when compared with children breastfed shorter than 12 months. Among children breastfed longer than 12 months, those fed nocturnally or more frequently had a further increased caries risk.[28] On the contrary, children exposed to longer versus shorter duration of breastfeeding up to age 12 months (more versus less breastfeeding) had a reduced risk of caries.[28] Therefore, breastfeeding is prolonged and nocturnal, here is a possible increased risk of dental caries. However, the studies did not control for confounding factors such as free sugars in complementary foods and oral hygiene.

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21 Improving child nutrition: the achievable imperative for global progress. New York (NY): UNICEF; 2013 (https://www.unicef.org/gambia/Improving_Child_Nutrition_-_the_achievable_imperative_for_global_progress.pdf, accessed 03 March 2017).

22 McAndrew F, Thompson J, Fellows L, Large A, Speed M, Renfrew M. Infant Feeding Survey 2010. (UK Data Archive Study No. 7281). London: Health and Social Care Information Centre; 2012 (http://doc.ukdataservice.ac.uk/doc/7281/mrdoc/pdf/7281_ifs-uk-2010_report.pdf, accessed 03 March 2017).

23 Victora CG, Bahl R, Barros AJ, Franca GV, Horton S, Krasevec J, et al. Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect. Lancet. 2016;387(10017):475–90.

24 Leung AK, Sauve RS. Breast is best for babies. J Natl Med Assoc. 2005;97(7):1010–9

25 Mennella JA, Yourshaw LM, Morgan LK. Breastfeeding and smoking: short-term effects on infant feeding and sleep. Pediatrics. 2007;120(3):497–502.

26 Dewar G. Parenting Science [Internet]. Breastfeeding on demand: a cross-cultural perspective. (http://www.parentingscience.com/breastfeeding-on-demand.html, accessed 22 February 2017).

27 Anderson GC, Moore E, Hepworth J, Bergman N. Early skin-to-skin contact for mothers and their healthy newborn infants. Birth. 2003;30(3):206–7.

28 Tham R, Bowatte G, Dharmage SC, Tan DJ, Lau MX, Dai X, et al. Breastfeeding and the risk of dental caries: a systematic review and meta-analysis. Acta Paediatrica. 2015;104(467):62–84.

Formula and follow-on formula feeding

For non-breastfed infants, formula milk can be used as a substitute until 1 year of age, before cow's milk can be used. The composition of formula milk is based on breastmilk, and it is important that no additional sugars are added. For infants who are intolerant to cows' milk protein and lactose, allergic to lactose or from families with a history of atopy, hypoallergenic infant formula with entirely or partially hydrolyzed cow's milk protein can be used under medical supervision. This can contain sucrose and fructose (up to 20% of total carbohydrates) to camouflage the taste of hydrolysate but will not exceed 10% of energy.

Some types of formula that may be used in specific cases might put the baby at risk of developing caries due to the sugars content included in low-lactose or lactose-free formula, nutrient enriched post-discharge formula and soya formula. Soya formula used for vegan infants contains soya protein with vegetable fats and is recommended for continuation post-infancy as it is richer in micronutrients. However, it contains glucose syrups and sucrose as the carbohydrate source. Some formula milk contains oligosaccharides as pre-biotic. Parents should be advised that, because free sugars are present in these infant milk products, good weaning practice and oral hygiene are needed.

According to WHO, follow-on formula is unnecessary and is unsuitable as a replacement for breastmilk after six months. It can contain maltodextrins and other oligosaccharides, but the carbohydrate in some brands is entirely lactose. The regulations for follow-on formula (including composition) were being reviewed for the Codex Alimentarius by WHO and the Food and Agriculture Organization (FAO) of the United Nations and were due to be completed in 2016. The European Food Standards Agency issued its guidance in 2014, namely that carbohydrate content can range from 36% to 53% of energy, and sucrose and fructose should provide no more than 20% of total carbohydrates. This means no more than 10% of energy can come from added sugars. In Thailand, Ministerial Regulation No. 286 issued in 2004 is intended to prohibit the addition of any sugars or sweeteners to modified milk for infants and follow-on formula since they may lead to dental caries and obesity in infants and young children.

Sugars intake

WHO strongly recommends reduced intake of free sugars throughout the life-course (strong recommendation). For both adults and children, the intake of free sugars should not exceed 10% of total energy (strong recommendation). WHO also suggests that there should be a further reduction to below 5% of total energy (conditional recommendation), because reducing the intake of free sugars below 5% of total energy intake would provide additional health benefits in the form of reduced dental caries. Free sugars are all monosaccharides and disaccharides added by the manufacturer, cook or consumer, plus the sugars naturally present in honey and syrups, fruit juices and fruit juice concentrates.[29] The AAP's guidelines for carbohydrate recommend less than 10% energy from added sugars from the age of 2 years. Fruit juice is not recommended before six months of age and should never be given in a bottle or lidded cup. Public Health England recommends, for children aged 4-6 years, that the intake of free sugars should be only 19g or up to 4 sugar cubes per day. Unsweetened fruit juice can count towards fruit and vegetable intake but only one 150 ml should be served per day and should be given from a cup.

Complementary feeding

WHO recommends nutritionally adequate and safe complementary foods provided after six months of exclusive breastfeeding, while breastfeeding continues for up to 2 years of age or beyond. The European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) Committee on Nutrition recommended in 2008 that complementary foods should not be introduced before 17 weeks of age. The AAP, the Academy of Nutrition and Dietetics and the United States Department of Agriculture all recommend exclusive breastfeeding with complementary feeding when infants are between 4 and 6 months of age and are developmentally ready.

[29] Guideline: Sugars intake for adults and children. Geneva: World Health Organization; 2015.

A variety of tastes and textures are introduced from 6-7 months onwards. A wide variety will help ensure essential micronutrients. Complementary food should be energy- and nutrient-dense (not low-fat, high-fibre or high free sugars), and 90% of iron needs should come from complementary foods and drinks. Cow's milk should not be used as main drink before 12 months but from the age of 6 months cow's milk can be added to complementary food. In some countries, micronutrient supplements are recommended from the time complementary foods are introduced.

Introducing gluten no earlier than 4 months of age and no later than 7 months of age while the infant is breastfeeding may reduce the risk of coeliac disease, type 1 diabetes mellitus and wheat allergy.

Infants and young children receiving vegetarian diets should receive 500 ml of formula and dairy products daily. Infants and young children should not receive a vegan diet.

Complementary feeding and oral health considerations

Most guidelines on infant feeding rarely mention oral health, yet complementary feeding has a major influence on both immediate and future dental health. Foods and drinks containing free sugars should be limited to main meals. There is absolutely no advantage to dental health if sucrose is replaced by other sugars such as fruit juices or fructose. There is increased salivary amylase activity before pancreatic enzymes reach maturity at around 4 months of age. Earlier than desirable complementary feeding with starchy foods or formula containing glucose polymers (maltodextrins/glucose syrups) may increase the risk of caries. The earlier complementary feeding commences, the earlier free sugars are introduced. Complementary foods should be low in free sugars – including sugars derived from fruit juices or concentrates. Unsweetened cereals, fruits and vegetables, and unsweetened yoghurts should be encouraged. Milk and water should constitute the majority of drinks. Other drinks should be given by cup and confined to mealtimes, and should not be given at bedtime.

From 6 months of age infants should be introduced to drinking from a cup and at 1 year drinking from a bottle should be discouraged. Drinks contribute little to nutrient intake and may spoil the appetite for nutritious foods. Soft drinks, baby fruit juices and herbal drinks, including those designed specifically for infants, are unnecessary from a nutritional standpoint. Drinks containing sugar substitutes are not recommended for infants and children under 3 years of age as they contain artificial sweeteners. Carbonated water is also unsuitable for infants. Bottled mineral water may vary in composition and may be too high in some minerals and trace elements.

Nutrition of young children

For children under the age of 5 years, frequent intake may be necessary due to small appetites. The 50% energy from fat gradually reduces to 35% by the age of 5 years. Children who consume fruit juices usually take too little fat and may fail to thrive. Starch-rich carbohydrate should be in all meals and snacks while very high-fibre food is not recommended. The United Kingdom recommends 2-3 portions of meat and alternatives or, if vegetarian, 3-4 portions (of eggs, nuts, pulses), and three portions of dairy foods with five small fruit and vegetable portions per day. If vitamin supplements are advised, they should be sugar-free.

Vitamin D is important for bone metabolism, calcium homoeostasis and immune system regulation, and an adequate amount of vitamin D may protect against dental caries. Dietary sources of vitamin D include oily fish, egg, liver and fortified foods.

Sociobehavioural factors

Low socioeconomic status widens inequalities and contributes to the child's exposures to caries risk factors which are associated with social determinants[30] such as the mother's educational level, cultural attitudes and family income and socioeconomic status (SES).

The adoption of consistent behavioural habits in childhood begins at home, with the parents, especially the mother, playing an important role in the child's oral health behaviours. Parents should be informed that their dental health habits influence their children's oral health and consequently their quality of life. There is a need for a sound health educational programme that involves all family members and that provides parents with adequate guidance on how to maintain the oral health of their children.

Important systematic reviews[31] have indicated that factors significantly related to the prevalence and the incidence of deciduous caries in children aged 6 years or under include sociodemographic factors, dietary factors, oral hygiene, factors related to breast/bottle-feeding, and oral bacterial flora.

Sociodemographic factors include gender of the child (male), family income, unemployed father, low parental education, the single mother, occupation of the head of household, a high number of children per family, birth background, immigrant status, young age of mother, and ethnicity.

Dietary factors are high frequency of sugars/fat snacks, high number of sugary food/drinks between meals, no set time for snacks, more than six periods of eating/drinking per day, high pocket money for sweets, high age of weaning, not eating fruit, food before sleeping, sugary bedtime drink/diluted syrup/dates.

Elements of oral hygiene that are significantly related to prevalence and incidence of deciduous caries include frequency of tooth brushing, age brushing started, visible plaque, parental supervision, adults involved in brushing, lack of use of fluoride-containing toothpaste, not cleaning teeth at bedtime, and high gingival bleeding score.

Risks related to breast/bottle-feeding have been shown to be bottle-fed as opposed to breastfed, frequency of breastfeeding, duration of breastfeeding, nocturnal breastfeeding, night-time bottle use, use of sugar/cereal in the bottle, bottle at night for longer than 24 months and bottle carried around during the day.

Other factors included pacifier sucking for longer than 24 months, mother's irregular oral hygiene, high caries amount in mothers, father seldom uses toothpaste, suboptimal use of fluoride, a level of water fluoride at home, and mother's dental attendance.

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Discussion

The etiology of ECC is more complicated than caries at later ages because of the strong influence of infant feeding practices and family behaviour. The reality about the recommendations for optimal infant and child feeding and how the practices affect oral health need to be considered. WHO recommends exclusive breastfeeding for six months and complementary food up to 24 months of age. The addition of sugars in bottle-feeding is strongly associated with an occurrence of ECC. Weaning and solid food should start at about 6 months of age. However, consultation participants felt that sufficiently authoritative advice on the weaning diet – taking WHO recommendations into account – is needed.

The etiology of ECC also includes other risk factors such as genetics, saliva, enamel hypoplasia, oral hygiene, family, behaviour and environment. The articles by Abbasoglu (2015) demonstrated several genotypes related to increased or decreased ECC risk among 2-5-year-old Turkish children. While salivary flow is known to be a protective factor, the protein in saliva is still a relatively new area of study. Microbial flora are also likely to be important. The nutrition during pregnancy – such as lack of calcium supplement, low milk and lower vitamin D status – was related to hypoplasia and ECC.[32,33] The relationship between infant's weight and ECC was found in the U-shaped relation that infants with underweight and overweight tended to be positively associated with ECC. The preventive effects of fluoride exposure during the period from birth to 5 years of age were also well established. The enamel hypoplasia was found to be related to low vitamin D and calcium. Caufield et al.[34] has proposed the term HAS-ECC (hypoplasia associated with severe early childhood caries) that emphasizes the characteristics of hypoplasia as a risk factor for ECC.

Dental plaque and poor oral hygiene are strong risk factors for ECC. The earlier tooth brushing begins, with the parent or caregiver brushing for a child, brushing twice daily with fluoride toothpaste is well associated with lower ECC experience. The review by Seow (2012) identified environmental, maternal and child factors which contributed to ECC – including the low level of education, family's low income, child's temperament, infant's difficulty sleeping, mother's stress level, family functioning, fatalistic oral beliefs, mother's poor health and smoking.[35]

[32] Thitasomakul S, Thearmontree A, Piwat S, Chankanka O, Pithpornchaiyakul W, Teanpaisan R, Madyusoh S. A longitudinal study of early childhood caries in 9- to 18-month-old Thai infants. Community Dent Oral Epidemiol. 2006;34(6):429–36.

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[34] Caufield PW1, Li Y, Bromage TG. Hypoplasia-associated severe early childhood caries--a proposed definition. J Dent Res. 2012;91(6):544–50.

[35] Seow K. Environmental, maternal, and child factors which contribute to early childhood caries: a unifying conceptual model. Int J Paediatr Dent. 2012;22(3):157–68

Strategies for prevention of early childhood caries

Primary prevention at an early age is both crucial and necessary because of rapid progression of caries in primary teeth. The anatomy and structure of primary teeth are different from those of permanent teeth. The primary teeth have very thin enamel and dentin and relatively large pulp, with pulp as horn being close to the tooth surfaces. This promotes the advance of dental caries and contributes to rapid caries progression in primary molars.

Studies have found that caries progression in the enamel of primary molars was twice as fast as that of permanent molars while the progression rate in dentin did not differ.[36] A recent study showed that progression of caries from surfaces with initial caries or white spot lesion (International Caries Detection and Assessment System (ICDAS) 1-2) to moderate caries (ICDAS 3-4) was 9.6 times higher than that of sound surfaces. Caries progressed to extensive caries or cavitation (ICDAS 5-6) from initial caries 6.1 times faster, and from moderate caries 20.6 times faster, in relation to sound surfaces. In contrast to other studies, initial caries at baseline was found to progress to extensive caries at rates about two times higher in smooth surfaces than in pitted and fissured surfaces.[37] This supports the proposal for prevention at an early age.

Caries risk assessment is essential to planning and making decisions for prevention and management of ECC. Health-care professionals should assess children's caries risk by their first year as a part of overall health assessment, and should re-evaluate it periodically. Caries experience, dietary habits, oral hygiene habits including fluoride use, and socioeconomic status should be considered when assessing caries risk in young children. In addition, the factors associated with primary caregivers such as parent's oral health status and behaviours are also the important predictors of ECC.[38]

Caries management at early stages can prevent pain and suffering as well as the unnecessary expenses to treatment. Comprehensive caries management includes primary prevention (oral hygiene instruction, dietary control, fluoride toothpaste, fluoride mouth rinse), secondary prevention (early detection, fluoride varnish, glass ionomer sealant, silver fluoride application), and tertiary prevention including minimum intervention such as Atraumatic Restorative Treatment (ART) and Simplified and Modified Atraumatic Restorative Treatment (SMART). However, in advanced cases, extensive rehabilitation may be necessary.

Effective management strategies for ECC include caries risk assessment, brushing with fluoride toothpaste, fluoride varnish applications, and certain behavioural interventions that affect preventive self-care. Early oral assessment is more feasible when incorporated into well-child care. Integrating oral health into overall health care, such as a dental visit by the age of 1 year and during well-child visits, may yield a better quality of care and improve outcomes for ECC at lower costs.[39]

The consultation also reviewed evidence of efficacy and effectiveness of preventive measures. Daily tooth brushing with fluoride toothpaste from the eruption of the first tooth must be regarded as the best clinical practice today (*moderate evidence*).[40] Fluoride varnish can, to some extent, decrease caries incidence in early childhood (*low evidence*).[41] Silver diamine fluoride can arrest dentine caries in primary teeth and prevent recurrence after treatment *(very low evidence)*.[42] In considering whether sealants are as effective as conventional restorations for the management of non-cavitated dentine occlusal lesions in primary teeth, there was also considered to be *very low evidence.*[43]

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[39] Garcia R, Borrelli B, Dhar V, Douglass J, Gomez FR, Hieftje K, et al. Progress in early childhood caries and opportunities in research, policy, and clinical management. Pediatr Dent. 2015;37(3):294–9.

[40] 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. JADA. 2014;145(2):182–9.

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[43] Borges BC, De Souza Bezerra Araujo RF, Dantas RF, De Araujo Lucena A, De Assuncao Pinheiro IV. Efficacy of a non-drilling approach to manage non-cavitated dentin occlusal caries in primary molars: a 12-month randomized controlled clinical trial. Int Paediatr Dent. 2012;22(1):44–51.

Fluoride concentration in toothpaste for anti-caries efficacy ranges from 1000 to 1500 Part per million (ppm) with a minimum of 800 ppm fluoride ion bioavailable.[44] Brushing frequency should be at least two times per day. To promote safety, the amount of fluoride toothpaste used in young children should be limited.

The amount of F toothpaste recommended by the consultation was:

- for children from 6 months to 2 years – a thin smear, half a pea (0.05-0.1 g);
- for children aged 2–6 years, a small pea size or width of the toothbrush (0.25 g);
- for children aged 6 years and older, the full length of a child's toothbrush (1–1.5 g).

Brushing time should be a minimum of two minutes. Spitting out the toothpaste and rinsing minimum times with minimal water were recommended. The ideal time for brushing is after meals in the morning and immediately before going to bed. If used as recommended, fluoride toothpaste is safe to use irrespective of low, normal or high fluoride exposure from other sources.

The United States Food and Drug Administration stated in 1995 that toothpaste with NaF should have more than 650 ppm and toothpaste with sodium mono-fluorophosphate should have more than 800 ppm available fluoride. ISO standard 11609 (2010) requires toothpaste packaging to declare total fluoride content but not the free available fluoride content.

There is insufficient evidence to conclude that daily use of chlorhexidine alone or in combination with fluoride for an extensive period would reduce *Mutans streptococci or Lactobacilli* levels in young children. Povidone iodine temporarily reduced these counts in young children but does not improve the overall effect on cariogenic bacterial reduction. Antimicrobial interventions and treatments show temporary reductions in *Mutans streptococci* colonization levels. There is insufficient evidence to indicate that the antimicrobial therapeutic approaches currently used produced sustainable effects on cariogenic microbiota or ECC reduction and prevention.[45]

Sealants are effective in high-risk children. Sealant benefit is increased by placement on surfaces that are judged to be at high risk or are exhibiting incipient carious lesions; sealants are effective at inhibiting lesion progression.[46] Glass ionomer can be used as transitional sealants and may prove to be effective as long-term pit and fissure sealants.[47] The American Dental Association recommends that sealants should be placed on pits and fissures of children's primary teeth when it is determined that a tooth or patient is at risk of experiencing caries.[48] After one year, sealant seems to be better at preventing occlusal caries lesions in primary molars than the application of only fluoride varnish. Varnished surfaces were three times (OR 2.92) more likely to develop new lesions and caries progression compared to sealed ones.[49]

It is not ethical to withhold restorative dental care from a child with occluso-proximal caries lesions to dentine of primary molars.[50] The nonrestorative caries treatment (NRCT) trial, for which restorative dental care was withheld, demonstrated a dental abscess or irreversible pulpitis within one year.[51] The worst

[44] Zero DT, Marinho VC, Phantumvanit P. Effective use of self-care fluoride administration in Asia. Adv Dent Res. 2012;24(1):16–21.

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[50] Nainar SM. Is it ethical to withhold restorative dental care from a child with occlusoproximal caries lesions into dentin of primary molars? Pediatr Dent 2015;37(4):329–31.

[51] Santamaria RM, Innes NPT, Machiulskiene V, Evans DJP, Splieth CH. Caries management strategies for primary molars: 1-yr randomized control trial results. J Dent Res. 2014;93(11):1062–9

outcome for which it is plausible to withhold treatment for dental caries in children is likely to be dental pain and tooth loss.[52] Placement of restorations in carious primary molars improved the subsequent exfoliation, with survival rates double those of untreated teeth.[53]

Glass ionomers have several properties that are favourable for use in children – including chemical bonding to enamel and dentine, thermal expansion similar to tooth structure, biocompatibility, uptake and release of fluoride, and decreased moisture sensitivity. There is evidence in favour of glass ionomer for the restoration of Class I, and expert opinion for Class II restoration in primary teeth.[54] There is strong evidence supporting ART with high-viscosity glass ionomer for a single surface of both primary and permanent teeth. Additionally, glass ionomer can be used for caries control in children.

Several techniques have been demonstrated as an effective restorative dental care for primary molars. SMART consists of partial caries removal and filling with capsulated glass ionomers.[55] Hall technique was performed on primary molars by placing stainless steel crowns without tooth preparation or local anesthesia.[56] Interim therapeutic restorations (ITR) used glass ionomers without local anesthesia,[57] while ART removes demineralized carious dentine with hand-instrument and filling with glass ionomers.[58]

Based on review studies, incomplete caries removal seems to have advantages over complete excavation, especially in proximity to the pulp.[59] Partial caries removal reduced the incidence of pulp exposure by 77% compared to complete caries removal; the mean incidence of pulp exposure was 21.9% in the complete caries removal groups and 5% in the partial caries removal groups.[60]

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[52] Casamassimo PS, Thikkurissy S, Edelstein BL, Maiorini E. Beyond the dmft: the human and economic cost of early childhood caries. JADA. 2009;140(6):650–7.

[53] Stephenson J, Chadwick BL, Playle RA, Treasure ET. A competing risk survival analysis model to assess the efficacy of filling carious primary teeth. Caries Res. 2010;44(3):285–93.

[54] Dhar V, Hsu KL, Coll JA, Ginsberg E, Ball BM, Chhibber S, et al. Evidence-based update of pediatric dental restorative procedures: dental materials. J Clin Pediatr Dent. 2015;39(4):303–10.

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[56] Innes NP, Evans DJ, Stirrups DR. Sealing caries in primary molars: randomized control trial, 5-year results. J Dent Res. 2011;90(12):1405–10.

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Discussion

As in the strategic framework suggested by Fisher-Owens and colleagues[61], prevention stages of the disease include: 1) prevention, 2) disease management, 3) access to dental services and systems of integration, and 4) coordination that is linked to the child, family and community.

Consultation participants proposed the following strategies for prevention of ECC:

- integration of oral health with general health;
- non-dental health-care workforce training in some specific countries;
- payment incentives to primary care providers;
- systematic support from the media and educational system;
- regular dental visits (6-monthly) by both mother and child;
- oral hygiene education for mothers and children;
- systematic oral health-care interventions;
- public health interventions (e.g. water fluoridation);
- use of topical or fluoride supplements if water fluoridation is not available;
- mobilization of resources to address the ECC problem.

[61] 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(3):e510–20.

Group discussions

Participants were divided into three discussion groups, with each group focusing on the three topics of primary, secondary and tertiary prevention of ECC. The coordinators summarized the discussions and presented the recommendations and strategies discussed by all participants.

Group 1: Primary prevention of early childhood caries

Participants identified the four key public health interventions: promoting healthy behaviour, fluoride use, oral hygiene practice, and appropriate diet/nutrition practice.

1. *Promote healthy behaviour*

Five target groups were identified: pregnant women, mothers and primary caregivers, policy-makers, the community (including the private sector), and health-care professionals.

Pregnant women must be fully involved in proper oral hygiene and dietary practice. The recommended strategies included developing instructional materials and guidelines, the development of standard methodologies and the application of standard methods.

Mothers and primary caregivers must adhere to the first dental visit and vaccination schedule. An oral check-up after the first tooth eruption should be integrated into the existing health programme such as vaccinations and general medical check-ups. The continuing programme of interventions should give reassurance and should help mothers and caregivers to keep appointments.

Policy-makers at local and national levels must integrate an oral health element into existing health promotion programme and policies.

The community, including the private sector, should utilize community health workers, social media and mobile telephones to promote healthy behaviours at local and national levels.

Health-care professionals, including bodies governing curriculum design, should develop curricula and improve the competency of health professionals to recognize the need for ECC prevention and how to implement it.

2. *Fluoride use*

Affordable and effective fluoride toothpaste should be available for all children. Policy-makers and dental professionals should advocate for, and promote, legislation conducive to the affordability, accessibility and quality of fluoride toothpaste. Strategies should include the elimination of taxes on fluoride toothpaste and designation of the toothpaste as a health product and not a cosmetic product.

When feasible, access to national fluoridation schemes using water, salt and milk as vehicles should be promoted. Policy-makers should reinforce fluoridation at an optimal level to prevent dental caries, using WHO recommendations.

3. *Oral hygiene practice*

Mothers and caregivers should be recommended to use 1000-1500 ppm fluoride toothpaste twice daily. Tooth brushing should be supervised at home, and at daycare centres and preschools for children, using an appropriate amount of toothpaste according to age. Training in the techniques of brushing – such as how to estimate the appropriate amount of toothpaste (a smear, the size of the little fingernail,

etc.) and not to rinse after brushing – should be given to mothers and caregivers at vaccination visits and to teachers at daycare centres.

4. *Appropriate diet/nutrition practices*

Policy-makers, health professionals and kindergarten teachers should discourage bottle-feeding. Health professionals should follow WHO guidelines on infant and child feeding and nutrition (refer to the WHO recommendation on sugars guideline). There should be no added sugars in complementary food and drinks before 2 years of age. Sugary beverages and juices and food high in added sugars should be avoided, while fruit, starchy staple food and cow milk as a main milk after 1 year of age should be promoted. Manufacturers should minimize the addition of free sugars. Policy-makers should pass laws and regulations to create a healthy environment for diet and nutrition, and should advocate the regulation of manufactured products.

After the panel discussion, participants provided additional comments as follows:

- The recommendation for salt fluoridation must be considered along with the amount of salt consumption because of concern to minimize salt intake to prevent hypertension.
- Fluoride varnish should be considered as secondary prevention and may be recommended for moderate-to-high caries risk communities.
- Advice on the use of fluoride toothpaste must focus on both the concentration and the amount of toothpaste, based on scientific evidence. The use of fluoride toothpaste under supervision should be emphasized for preschool children.
- Advice about bacterial transmission from mothers to children should focus on the need for good oral hygiene of mothers rather than on transmission.
- Information on complementary foods should focus on less than 5% energy from free sugars, in accordance with WHO's recommendation.
- The strategy to advocate for the food industry to minimize sugars in complementary foods should be promoted as a national measure.

Group 2: Secondary prevention of early childhood caries

Secondary prevention includes early disease detection, making it possible to prevent worsening of the lesions and also to control the spread of the disease. Secondary prevention is not to be implemented alone but must be on top of primary prevention. The recommended strategies include the following:

1. *Early detection*

   When the first tooth erupts or at 6 months of age, the child should be screened in a postnatal health care programme and, a simple checklist for caries risk factors needs to be assessed. This screening visit should be part of the package of health care, and oral status should be included in a baby's medical profile. Training health personnel to detect ECC is recommended. Periodical oral check-ups should be fully integrated with general health care for mothers and children. Subsequent check-ups should be on every occasion of the child's general health examination and vaccination visit, or at least every 3-6 months according to caries risk.

2. *Diet counselling*

   Dietary advice should follow the recommendation for primary prevention, but intensively. In case breastfeeding is not possible, weaning bottle-feeding is recommended after 6 months of age. Milk and water should be the main drink without sugars added.

3. *Fluoride uses*

   In homes, daycare centres and kindergartens, supervised tooth brushing with a smear layer of fluoride toothpaste containing 1000 ppm fluoride should continue to be promoted. For non-cavitated lesions, the recommendation on fluoride application for primary prevention should be followed. Use fluoride varnish with 2.26% fluoride every 3-6 months, when possible, until the lesion is arrested.

4. *Behaviour modification*

   Parents and caregivers need to be actively involved in the dietary and oral hygiene practices of their children. National health policy should promote a healthy environment at home, kindergarten and in the community, and should make the hygiene armamentarium affordable to the community.

5. *Sealant*

   When the tooth or the child is at risk of developing caries, and for those children who have non-cavitated lesions, sealant should be placed by trained personnel with adequate equipment following the primary prevention recommendation and manufacturer's instructions. The lesion should be checked regularly and re-sealed when necessary.

6. *Non-fluoride agent: calcium*

   On the basis of current evidence and potential side-effects, non-fluoride caries-preventive agents are not recommended.

7. *Referral*

   Health and non-health personnel should be trained to deliver education and referral.

Group 3: Tertiary prevention of early childhood caries

The goal of tertiary prevention is to reduce the negative impact of established disease (cavity) by restoring function and reducing disease-related complications. Tertiary prevention also aims to improve the quality of life for children with ECC.

Participants agreed that the definition of ECC should be included in WHO's *International Classification of Diseases and related health problems* (ICD-11). While the definition of ECC is the presence of one or more decayed (non-cavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child 71 months of age or younger according to the AAPD, a revision of this definition is needed to represent the high-risk group of ECC.

The strategies for tertiary prevention of ECC should focus on the following:

1. **Control progression and restore function** with public health approaches in children under 6 years of age.
2. **Detect the cavity** by primary caregivers, mothers, primary health-care workers, nurses, doctors and dental professionals.
3. **Provide training**, both self-training and in-service training workshops, for health and dental professionals.
4. **Use the standard tools** for screening, disease detection and referral.
5. **Minimum intervention** should avoid unnecessary extraction, preserve the tooth structure, and avoid negative consequences such as pain and infection which have an impact on young children's ability by disturbing concentration and school participation. The daily consequences of ECC to families, communities and societies often go unnoticed. In extreme cases, ECC and its lack of treatment can lead to serious disability and death.
6. **Alternative procedures** include using fluoride varnish, silver diamine fluoride to arrest caries, using ART/SMART/ITR techniques, and Hall technique (by dentists). Restorative adhesive materials with fluoride release, including glass ionomers, are the materials of choice. Other treatment options are available for further crown restoration and rehabilitation of primary dentition.

   Techniques and materials used for treatment should follow professional guidelines and protocols recommended by professional organizations and evidence-based documents.
7. **Establish referral system and increase access** to care by using non-dental personnel such as primary health-care workers for screening and referrals. Referral may include the use of a benefits package/insurance coverage and include public-private partnership approaches.

Further consideration of the following information:

The consultation noted some issues for further consideration, namely:

- variations in oral health systems and human resources in different countries;
- the need to establish a permanent group assigned to data collection and toolkit development for ECC prevention;
- the cost of care/cost-effectiveness analysis;
- the need for further research to determine the choice of materials, methods and settings;
- the need for future studies to carry out high-quality research to provide evidence and point out existing knowledge gaps in ECC prevention and control.

Participants' statement

Participants agreed that primary teeth should be included in national oral health surveys and that the age for primary teeth should be indicated in WHO's *Oral health surveys basic methods.* Oral health information should be integrated with general health data collection systems such as the general health survey, nutritional survey or noncommunicable diseases survey. The questionnaire for mothers would also be useful for collecting valuable data on behaviours and risk factors.

The consultation was informed that WHO's databank still lacks oral health data that could provide an overview of oral health conditions in many countries. In Japan, the oral health check-up is part of a general health check-up and is a mandatory programme for children at birth, at 18 months and at 3 years of age. The health and medical system should provide protection to young children and it is imperative to prevent and control diseases.

It is also important that dentists should understand that prevention is a priority. In approaches to both non-dental personnel and other health-care providers, support and training must be available so that dental professionals are made aware of the problem of ECC. Future research should include patterns of development of ECC. A comprehensive health programme should include diet and nutrition as common risk factors for oral diseases. Participants proposed that dental caries should be classed as a noncommunicable disease that will benefit from emphasis on healthy behaviours and healthy lifestyles. Prevention of dental caries should be part of a life-course approach.

ANNEXES

Annex 1. Agenda

Agenda: WHO Expert Consultation on Public Health Intervention against Early Childhood Caries (ECC), 26-28 January 2016

26 January 2016

09.00-09.30	**Opening address** WHO-CC Mahidol University: P. Nisalak Borrow Foundation: M. Woodward WHO-SEARO India: O.P. Kharbanda WHO-ORH Geneva: H. Ogawa **Group photograph**
09.30-10.25	**Global epidemiology of caries in the primary dentition** *H. Ogawa (WHO, Geneva)* Discussant *Y. Songpaisan (Thailand)*
10.25-10.35	Coffee Break
10.35-11.30	**Pattern and development of ECC within the mouth** *C. Feldens (Brazil)* Discussant: *W. Evans (Australia)*
11.30-12.00	Q/A
12.00-13.00	Lunch break
13.00-14.30	**Overview of etiology of ECC** *E. Lo (Hong Kong, China)* **Infant feeding and diets of the young child** *P. Moynihan (United Kingdom)* Discussant: *M. Woodward (United Kingdom)*
14.30-14.50	Q/A
14.50-15.00	Coffee break
15.00-16.30	**Strategies for prevention** *P. Phantumvanit (Thailand)* **Modifiable risk factors: sociobehavioural factors** *R. Baez (U.S.A)* Discussant: *MH. Khoshnevisan (Iran)*
16.30-17.00	Q/A
18.00-20.00	Welcome reception

27 January 2016

09.00-17.00

Group discussions: Prevention strategy for ECC

Group I: Primary prevention

Public health intervention
- Awareness-raising
- Education
- Community and personal development
  - Family engagement dietary habits
  - Automatic fluoridation
  - Fluoride administration

Home care - tooth brushing
- Community engagement
- Maternal and Child Health programme
- Schools and kindergartens

Coordinators:
T. Vichayanrat

Participants:
R. Baez
V. Benoit
H. Miyazaki
M. Woodward
Y. Songpaisan

LOC:
K. Mitrakul
W. Praphansilp

Rapporteur:
C. Ungchusak

Group II: Secondary prevention

Clinical intervention
- Early detection
  - Diet counselling
  - Fluoride application
  - Behaviour modification
  - Control transmission of cariogenic bacteria
  - Sealant

Coordinators:
S. Nakornchai

Participants:
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P. Moynihan
C. Feldens
P. Melo
P. Nisalak

LOC:
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K. Vongsavan
V. Yimcharoen

Rapporteur:
P. Leelataweewud

Group III: Tertiary prevention

- Minimum intervention
- Restorative care
- Advanced treatment approaches

Coordinators:
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P. Phantumvanit

Participants:
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E. Lo
N. Shakavets
O.P. Kharbanda
E. Beltran

LOC:
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P. Banditsing
A. Phonghanyudh

Rapporteur:
C. Khitdee

19.00- 21.00	Dinner cruise

January 28, 2016:

09.00-10.00	**Group report**
10.00-12.00	**General discussion:** Implication of ECC prevention and control to the public health programme - Integration of oral health with health promotion - Development of action plans
12.00-13.00	Lunch break
13.00-15.00	**Summary and conclusion** Close of meeting
19.00-21.00	Farewell dinner

Annex 2. List of participants

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