MOH / P / PAK / 558.24 (GU) – e

MINISTRY OF HEALTH MALAYSIA
ORAL HEALTH PROGRAMME

CLINICAL PRACTICE GUIDELINES

MANAGEMENT OF
EARLY CHILDHOOD CARIES
(3RD EDITION)

Published by:
Oral Health Technology Section
Oral Health Programme
Ministry of Health Malaysia
Level 5, Block E10, Precinct 1
Federal Government Administrative Centre
62590 Putrajaya, Malaysia

ISBN: 978-629-99918-7-8

Available on the following websites:
http://www.moh.gov.my
http://www.acadmed.org.my
https://hq.moh.gov.my/ohp/ms/

STATEMENT OF INTENT

These guidelines update and supplant the previous guidelines developed in 2012 and are based on the best available contemporary evidence. They are intended as a guide for the best clinical practice in the management of early childhood caries presently. However, it must be noted that adherence to these guidelines do not necessarily lead to the best clinical outcome in individual patient care, as every health care provider is responsible for the management of his/her unique patient based on the clinical presentation and management options available locally.

UPDATING THE CLINICAL PRACTICE GUIDELINES

This guideline was approved in 2024 and will be reviewed in 2029 or earlier if important new evidence becomes available. When it is due for updating, the head of the related specialty will be informed about it. A multidisciplinary team will be formed and discussion will be done on the need for a revision including the scope of the revised CPG. The Systematic Review (SR) methodology used by the Malaysia Health Technology Assessment Section (MaHTAS) will be employed in reviewing the guidelines.

Every care was taken to ensure that this publication is correct in every detail at the time of publication. However, in the event of errors or omissions, corrections will be published in the web version of this document, which is the definitive version at all times.

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LEVELS OF EVIDENCE

Level	Study design
I	Properly powered and conducted randomised controlled trial; well-conducted systematic review or meta-analysis of homogeneous randomised controlled trials
II-1	Well-designed controlled trial without randomisation
II-2	Well-designed cohort or case-control analysis study
II-3	Multiple time series, with or without the intervention; results from uncontrolled studies that yield results of large magnitude
III	Opinions of respected authorities, based on clinical experience; descriptive studies or case reports; reports of expert committees

SOURCE: *U.S. Preventive Services Task Force. U.S. Preventive Services Task Force Procedure Manual. Rockville, MD: USPSTF; 2015.*

FORMULATION OF RECOMMENDATION

- In line with the new development in CPG methodology, the **Grading Recommendations, Assessment, Development and Evaluation (GRADE)** was adapted in its work process. The quality of body of evidence and related effect size are carefully assessed/reviewed by the CPG Development Group (DG).
- In formulating the recommendations, overall balances of the following aspects are considered in determining the strength of the recommendations which includes:
  - overall quality and level of the evidence
  - balance of benefits and harms of the options
  - patient's preference and values
  - resource implications
  - equity, feasibility and acceptability to the local target population
- The more criteria being fulfilled, the more certain is the evidence leading to strong recommendations using the word "**should**" being considered. Otherwise, weak recommendations use the word "**may**" in proposing an action to be made.
- In the CPG, a yellow box ☐ highlights important message(s) in the management while a blue box ☐ contains evidence-based recommendation(s) for the particular condition.

KEY RECOMMENDATIONS

The following recommendations are highlighted by the CPG Development Group as the key recommendations that answer the main questions addressed in the CPG and should be prioritised for implementation.

Feeding Practices

- Breastfeeding among infants should be encouraged up to two years of age.
- Bottle feeding among infants should be discontinued after 12 months of age.

Dietary Sugars

- Consumption of free sugars among children should be limited in daily diet.

Diagnosis of Caries

- Visual examination should be considered for the diagnosis of initial occlusal caries, advanced occlusal caries and advanced proximal caries.
- Bitewing radiographic examination should be considered for the diagnosis of initial proximal caries.
- International Caries Detection and Assessment System (ICDAS) should be used for caries diagnosis.

Diet Advice

- Advice on diet should be provided to pregnant women, new mothers and other primary caregivers in preventing early childhood caries.
- Interdisciplinary approaches by healthcare professionals in dental, medical, nursing and allied health setting should be practiced for formula feeding and bottle cessation in the prevention of early childhood caries, overweight and obesity.

Plaque Control

- Mechanical plaque control with electric or manual toothbrushes should be used in removing dental plaque to prevent early childhood caries.
- Chemical agents may be considered as an adjunct to mechanical plaque control in removing dental plaque to prevent early childhood caries.

Tooth Brushing

- Tooth brushing to prevent early childhood caries should be:
  - commenced on eruption of primary teeth.
  - performed at least twice daily including last thing at night.
  - done with toothpaste containing 1000 to 1500 ppm Fluoride for children:
    - <3 years old apply with a smear or rice-sized amount
    - ≥ 3 to 6 years old, use a pea-sized amount
  - supervised by adults.
- Toothpaste should be spit out without rinsing after tooth brushing.

Oral Health Education

- Oral health education should be provided to expectant mothers, new mothers and caregivers for preventing early childhood caries.
- Oral health education intervention adjunct with social stories may be considered in promoting oral health-related behaviours among young children with special healthcare needs to prevent early childhood caries.

Other Preventive Programmes

- Interdisciplinary cooperation between paediatric cardiologist, paediatrician, paediatric dental specialist and dentist should be implemented to prevent early childhood caries effectively among the children with congenital heart disease.
- Motivational interviewing should be conducted on parents of children with high risk for early childhood caries by trained oral health professionals.
- Anticipatory guidance should be given to all parents and caregivers of children as early as afterbirth to prevent early childhood caries.

Caries Risk Assessment

- Caries risk assessment should be done for children aged six years old and below.

Topical Fluoride

- Diflourosilane (0.9%) three monthly or sodium fluoride varnish (5%) six monthly application should be used in children under the age of six for prevention of early childhood caries.

Treatment Modalities

Non-invasive Treatment

- For non-invasive treatment of caries in early childhood caries:
  - silver diamine fluoride may be used to control caries progression in the primary dentition.
  - fluoride varnish should be applied according to caries risk assessment.
  - fissure sealant should be used in primary molars with non-cavitated occlusal lesions.
  - resin infiltration may be used on non-cavitated carious lesions.
  - sealing with composite resin may be considered for cavitated lesions limited to 1.5mm in diameter and outer half of the dentine in primary molars.

Invasive Treatment

- Selective removal of caries may be the preferred approach for managing deep caries lesions in vital primary teeth for early childhood caries.
- The following treatment should be considered for deeply carious primary teeth with normal pulp or reversible pulpitis in early childhood caries:
  - indirect pulp capping
  - pulpotomy

Materials for Vital Pulp Therapy

- For indirect pulp capping amongst patients with early childhood caries, agents that may be used are Biodentine, calcium hydroxide, Theracal LC, Dycal, bonding agent liners, mineral trioxide aggregate, glass ionomer cement and resin modified glass ionomer cement.
- For pulpotomy amongst patients with early childhood caries:
  - Mineral trioxide aggregate and formocresol should be used as pulpotomy agents.
  - Biodentine and ferric sulphate may be considered as pulpotomy agents.
  - Calcium hydroxide should not be used.

Non-Vital Pulp Therapy

- For teeth with irreversible pulpitis or necrotic pulp in children with early childhood caries:
  - Pulpectomy and Lesion Sterilisation Tissue Repair may be considered when pre-operative root resorption is absent.
  - Lesion Sterilisation Tissue Repair may be considered when pre-operative root resorption is present.
  - Endoflas, zinc oxide-eugenol and calcium hydroxide plus iodoform may be considered as pulpectomy fillers.

Restorative Materials

In early childhood caries:

- resin-modified glass ionomer cement, composite resin and compomer may be used for Class I and II cavities.
- atraumatic restorative treatment with high-viscosity glass ionomer cement may be used in Class I cavities when patient cooperation or treatment resources are limited.
- for multi-surface cavities and following pulpal treatment, preformed crowns should be considered over direct fillings.
- Hall Technique may be considered for advanced proximal caries in primary molars.

Extraction and Space Maintenance

- Space maintainer may be considered in cases with premature extraction of primary tooth as indicated in children with early childhood caries.

Sedation and General Anaesthesia

- For patients requiring conscious sedation, the use of Oral Midazolam for the procedure may be considered in management of patients with early childhood caries.
- Comprehensive dental treatment (CDT) under General Anaesthesia should be considered as one of the options in rehabilitation treatment for children with early childhood caries.

Follow-Up

- Patients with early childhood caries should be followed up every:
  - 3 monthly for high caries risk.
  - 6 monthly for moderate caries risk.
  - 1 year for low caries risk.

GUIDELINES DEVELOPMENT

The members of the Development Group (DG) for these Clinical Practice Guidelines (CPG) were health care providers from the Ministry of Health (MoH), Ministry of Higher Education, Ministry of Defence and private healthcare. There was active involvement of a multidisciplinary Internal Review (IR) during the process of the CPG development.

A systematic literature search was carried out using the following electronic databases: mainly Medline via Ovid and Cochrane Database of Systematic Reviews and others e.g. PubMed and Guidelines International Network (**refer to Appendix 1** for **Example of Search Strategy**). The search was limited to literature published on humans, publication from year "2012 to Current" and English language. In addition, the reference lists of all retrieved literature and guidelines were searched, and experts in the field contacted to identify relevant studies. All searches were conducted from 22 October 2021 to 10 January 2022. Literature searches were repeated for all clinical questions at the end of the CPG development process allowing any relevant papers published before 31 January 2024 to be included. Future CPG updates will consider evidence published after this cut-off date. The details of the search strategy can be obtained upon request from the CPG Secretariat.

References were also made to other CPGs on early childhood caries which are:

- The American Academy of Pediatric Dentistry (AAPD)
- Scottish Dental Clinical Effectiveness Programme (SDCEP)
- World Health Organization (WHO)
- Scottish Intercollegiate Guidelines Network (SIGN 138)

These CPGs were evaluated using the Appraisal of Guidelines for Research and Evaluation (AGREE) II prior to them being used as references.

A total of 7 clinical questions (CQ) were developed under different sections. Members of the DG were assigned individual questions within these sections (**refer to Appendix 2** for **Clinical Questions**). The DG members met 36 times throughout the development of these guidelines. All literature retrieved were appraised by at least two DG members using Critical Appraisal Skill Programme checklist, presented in evidence tables and further discussed in each DG meetings. All statements and recommendations formulated after that were agreed upon by both the DG and IR. Where evidence was insufficient, the recommendations were made by consensus of the two groups. This CPG was developed largely based on the findings of SRs, meta-analyses and clinical trials, with local practices taken into consideration. Although ideally patients' views and preferences need to be considered in the development of CPGs, in this instance, it was not feasible.

The literature used in these guidelines were graded using the U.S. Preventive Services Task Force Level of Evidence (2015), while the grading of recommendation was done using the principles of GRADE (refer to page i). The writing of the CPG follows strictly the requirement of AGREE II.

On completion, the draft of the CPG was reviewed by external reviewers. It was also posted on the MoH Malaysia official website for feedback from any interested parties. The draft was finally presented to the Technical Advisory Committee for CPG and, the HTA and CPG Council MoH Malaysia for review and approval. Details on the CPG development methodology by MaHTAS can be obtained from Manual on Development and Implementation of Evidence-based Clinical Practice Guidelines published in 2015 (available at https://www.moh.gov.my/moh/resources/CPG_MANUAL_MAHTAS.pdf)

OBJECTIVES

- **General Objective**:
  To provide evidence-based guidelines in the management of early childhood caries for the best possible outcomes.
- **Specific Objectives**:
  - To enhance awareness on early detection of children at risk for early childhood caries.
  - To improve recognition and diagnosis of early childhood caries.
  - To update on the latest evidence-based procedures for management of early childhood caries.
  - To specify referral criteria in the management of early childhood caries.

CLINICAL QUESTIONS

Refer to **Appendix 2**.

TARGET POPULATION

These guidelines are applicable to all children, including those with special healthcare needs who are potentially at risk of developing early childhood caries.

Inclusion Criteria
- Children in primary or early mixed dentition .
- Children with special healthcare needs.

Exclusion Criteria
- Children above 72 months who have caries.

TARGET GROUP/USERS

This document is intended to guide those involved in the management of early childhood caries at any healthcare level including:

i. Dental specialists
ii. Dental and medical practitioners
iii. Dental therapists
iv. Dental students
v. Allied health personnel
vi. Patients and their advocates
vii. Professional societies

HEALTHCARE SETTINGS

Primary and Specialist Oral Healthcare Clinics, Health Clinics, Maternal and Child Health Clinics and community settings are the common areas of use of this guideline.

DEVELOPMENT GROUP

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The draft guideline was reviewed by a panel of experts. They were asked to comment primarily on the comprehensiveness and accuracy of the interpretation of evidence supporting the recommendations in the guideline.

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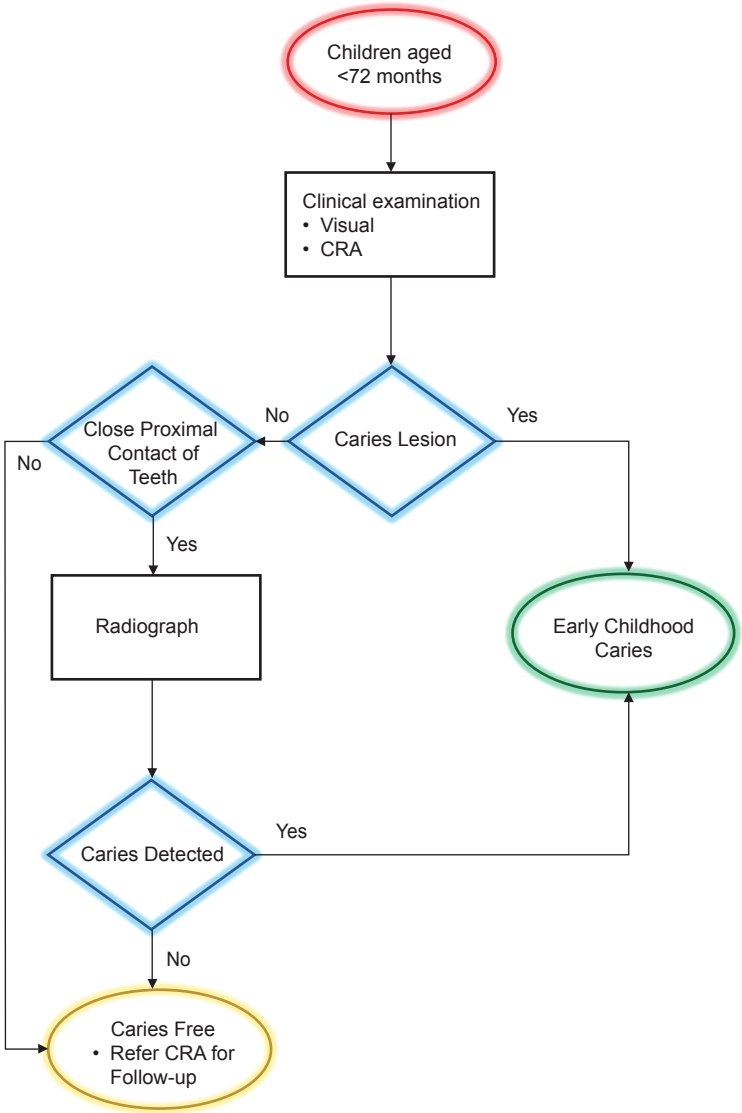
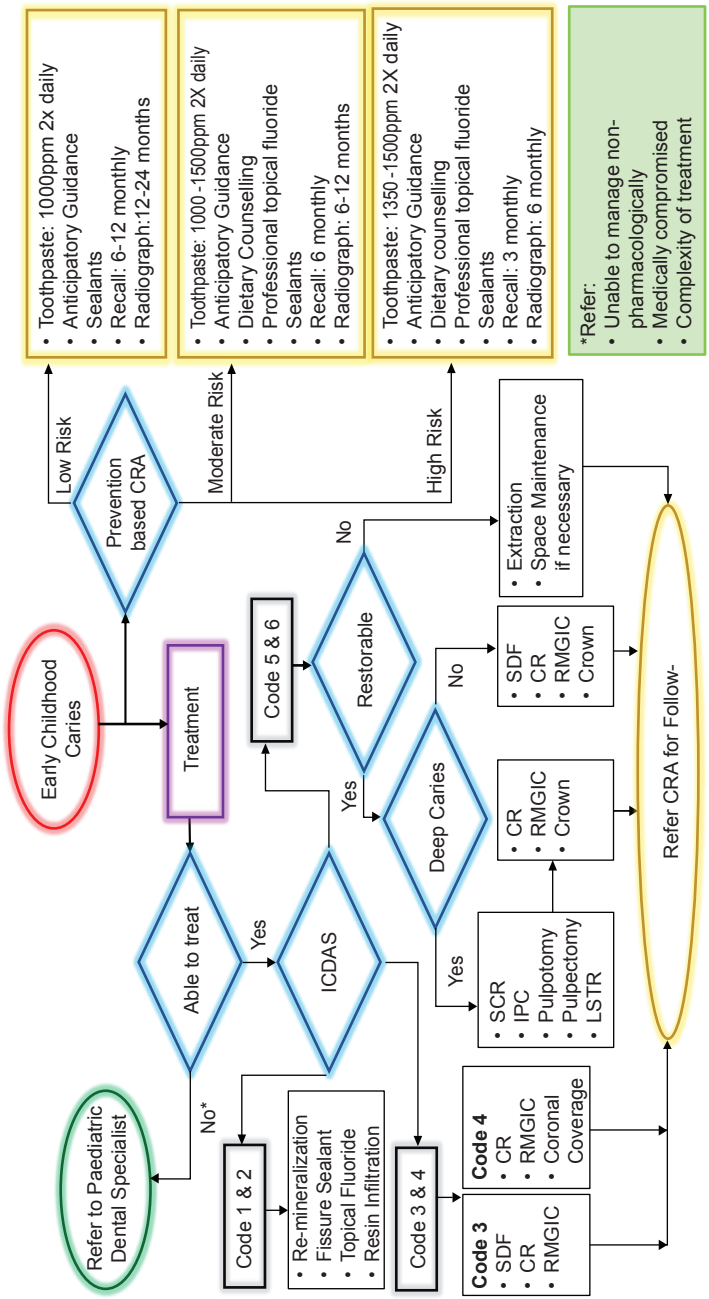
Algorithm 1: Diagnosis of Early Childhood Caries



Algorithm 2: Management of Early Childhood Caries



1.0 INTRODUCTION

Dental caries in the primary dentition of children below 6 years of age, known as early childhood caries (ECC) remains a serious public health challenge worldwide, particularly in developing countries and among the underprivileged, those with low socioeconomic status and the minority groups. It is one of the most prevalent, non-communicable childhood diseases with a major impact on quality of life and high costs for individuals, families and society. Early childhood caries, formerly referred to as nursing bottle caries or baby bottle tooth decay is a significant chronic disease of childhood. It is multifactorial in origin, and the notion that the principal aetiology is inappropriate feeding modalities is no longer tenable, hence the adoption of the name to ECC to raise appropriate awareness.

Although ECC is not life-threatening, it negatively impacts the quality of life as it may lead to infection, swelling, pain, and other symptoms. It affects the function, social interactions, cognitive and neurodevelopment of affected children, whose parents also suffer financial and emotional stress.[1] Children with dental caries also experience poor school performance and poor school attendance.[2]

ECC also 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 to 2.3) for 6-8 year olds and 1.5 (95% CI:1.1 to 2.0) for 9-12 year olds.[3]

In Malaysia, a national survey (NOHPS, 2015) among pre-school children five years of age, reported a slow reduction of decayed, filled teeth (dft) scores in three decades with 5.8 (1995), 5.5 (2005) and 4.8 (2015) and the prevalence of caries decreasing from 87.1% to 76.2% and 71.3% over the same study period. However, even though the caries trend was declining, the caries-free prevalence was far from the target of the National Oral Health Plan to achieve a 50% caries-free score among 6 year old children by 2020.[4]

The high disease burden resulting in heavy workload and economic costs on dental healthcare as well as negative implications on the child and parents are the main reasons this CPG was developed. The first Malaysian CPG for management of early childhood caries was a consensus guideline in 2005 and the revised edition in 2012 used evidence-based principle. Since then, there have been many changes of concepts and discovery of new evidence with regards to the diagnostic methods and tools, prevention therapy, management and treatment modalities which necessitates the revision of the CPG. This edition is the first evidence-based CPG developed using Systematic Review (SR) methodology. The change of the title of the present CPG

from the 2nd edition CPG was necessary due to the current evidence suggesting that management of ECC should start as soon as the diagnosis of the disease is made.

2.0 DIAGNOSIS OF EARLY CHILDHOOD CARIES

2.1 Definition of Early Childhood Caries

The modified definition of ECC which was proposed in 1999, and adopted by the American Academy of Pediatric Dentistry is the presence of a primary tooth with one or more carious (non-cavitated or cavitated lesions), missing (due to caries), or filled surfaces in a child under the age of six years (72 months). This definition was also accepted recently at the Bangkok Declaration by a group of international experts IAPD Bangkok declaration.[5]

2.2 Definition of Severe Early Childhood Caries

The definition of severe early childhood caries (S-ECC) is **(Refer Table 1)**:

a. Any sign of smooth-surface caries in a child younger than three years of age.
b. From ages three through five, one or more cavitated, missing (due to caries), or filled smooth surfaces in primary maxillary anterior teeth, or
c. A decayed, missing, or filled surfaces score of greater than or equal to four (age three), greater than or equal to five (age four), or greater than or equal to six (age five).[6]

Table 1. Guide to Assigning S-ECC Status by Age

Age (Years)	S-ECC Status
<3	Any sign of smooth surface caries
3	dmfs ≥4
4	dmfs ≥5
5	dmfs ≥6

In addition, more than two surfaces with caries experience in the primary second molars at age 5 suggests a clinically useful indicator for being at high risk to caries at age 10.[7]

2.3 Epidemiology

Early childhood caries remains a serious challenge to health care providers despite the improvement of dental practices and the decline in the prevalence of dental caries. The findings of the 2015 Global Burden of Diseases study revealed that dental caries of the primary dentition was the 12th most prevalent disease (560 million children) in all ages combined.[8] A meta-analysis of cross-sectional studies using the WHO criteria shows the global prevalence of ECC to be 48% (95% CI 42 to 52).[9]

However, prevalence among children aged 3-5 years varies between continents and countries. Published studies show high prevalence of 36-85% in Asia, 38-45% in Africa and 22-61% in the Middle East.[10]

Most developed countries report a prevalence rate of ECC between 1 and 12%.[11] In less developed countries and among the disadvantaged groups in the developed countries, the prevalence has been reported to be as high as 70%.[12]

According to a study, the highest prevalence of ECC is found in the 3-4 year old age group and that boys are significantly more affected than girls.[13]

The National Oral Health Survey of Preschool Children in Malaysia (NOHPS) reported a small decreasing trend in caries prevalence among preschool children with a prevalence of 76.2% in 2005 and 71.2% in the latest survey in 2015.[4] Similarly, there was a slow decreasing trend in caries severity in the past two decades with the dft in 1995 being reported to be 5.8, and in 2015 it was 4.8.[4]

Nevertheless, the treatment needs for these preschoolers remain high with 64.9% requiring treatment for their primary teeth whereby 63.6% need restorations and a further 12.1% need extractions of their primary teeth. A substantial proportion of these preschoolers, 9.8%, had dental abscess. Around 0.1% required treatment for both primary and permanent dentitions with 0.1% needing restorations on their permanent dentition and 7.2% requiring extraction of their permanent teeth.[4] These epidemiologic data in Malaysia suggest ECC continues to be a major healthcare challenge in this country.

2.4 Clinical Presentation

ECC initially presents as soft glutinous plaque accumulations at gingival margin progressing to decalcified white or brown bands or spots beneath the plaque. It typically affects the smooth surfaces of the teeth. In the absence of prevention, the white or brown spots will progress to cavitated lesions.

ECC has a special caries pattern with the maxillary primary incisors to be the most vulnerable and the first teeth to be affected. Subsequent teeth that are affected follow the sequence of eruption of the primary teeth with the exception of the mandibular incisors. These lower incisors are physically protected by the lip and tongue and kept washed in protective saliva.

The lesion can progress quite rapidly resulting in all the tooth surfaces being affected leading to the complete destruction of the crown, leaving only root stumps. In severe cases, the anterior teeth breakdown can happen as the teeth are erupting.

3.0 MODIFYING FACTORS OF EARLY CHILDHOOD CARIES
3.1 Risk Factors

ECC has a complex aetiology and is considered to be a multifactorial disease. A multitude of risk factors have been implicated in the literature. Although some risk factors appear to be more important than others, evidence of varying quality suggests there may be interactions among the risk factors.

Dental caries shares common risk factors with other non-communicable diseases (NCDs) associated with excessive sugar consumption, such as cardiovascular disease, diabetes, and obesity. Therefore, the primary risk factor for ECC is undoubtedly exposure to sugars through the diet and feeding practices. Infant feeding practices, complementary feeding practices and diet in young children have immediate and long-lasting effects on the child's oral and general health.

3.1.1 Feeding Practices

Feeding practices of infants include breastfeeding and/or bottle feeding. This is an important risk factor in early childhood caries.

To synthesise the current evidence for the associations between breastfeeding and risk of early childhood caries, with respect to duration of breastfeeding, one meta-analysis of two cross-sectional studies with moderate quality found breastfed children were less affected by dental caries than bottle fed children (OR=0.43, 95%CI 0.23 to 0.08).[14] level III

Another SR stated that based on the best available evidence from one cohort study albeit of limited evidence, infants who are breastfed up to two years of age do not have a greater risk of ECC than those breastfed up to one year of age (Mean ratio=1.9, 95% CI 1.5 to 2.4).[15] level II-2

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.[16] Malaysian Breastfeeding Policy also states that all mothers are encouraged to breastfeed their children exclusively with breast milk from birth until six months old continuing until two years of age. Complementary foods should be given from six months old onwards.[17]

Although there are clear benefits of breastfeeding in a child's first year of life, breastfeeding and baby bottle use beyond 12 months, especially if frequent and/or nocturnal, are associated with ECC.[18]

In respect to non-breastfed infants, WHO recommends formula milk (bottle feeding) can be used as a substitute until one year of age.[3] Moreover, it has been stated that there is no reason for a healthy infant to continue a bottle past one year of age when developmentally they are ready to drink from a cup.[19]

The CPG DG members opine that mothers should be encouraged to breastfeed till two years of age as the risk of developing caries is not increased whilst maintaining the health benefits for the child.

Recommendation 1
- Breastfeeding among infants should be encouraged up to two years of age.
- Bottle feeding among infants should be discontinued after 12 months of age.

3.1.2 Dietary Sugars

Apart from feeding practices, it is well established that the amount of dietary free sugars consumed is one of the primary causative factors for dental caries. 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.[20] This should not be mistaken for the term "sugar-free," which means a serving of food contains less than 0.5g of added or naturally occurring sugar.

This is evidenced in a SR of 55 studies which assessed the level of free sugar intake, showed an increased caries prevalence in the higher intake group compared to the lower intake group (RR=7.15, 95% CI 2.82 to 8.14).[21] level II-2 The majority of the included studies were conducted among children, while only four studies were conducted in adults. Based on GRADE, the overall quality of evidence in this study was moderate.

Another SR 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. Only one cohort study in this SR showed:[15] level II-2
- a significant increased risk of severe ECC with use of bottles containing fruit juices or soft drinks at 12 months of age (RR=1.41, 95% CI 1.08 to 1.86).
- consumption of complementary foods with high density of added sugars versus no consumption of added sugars had a relative risk of severe ECC of RR=1.43 (95% CI 1.08 to 1.89).

The evidence from this SR was found to be of low quality.

Similarly in another SR of 10 longitudinal studies of moderate quality, it was reported that:[22] level II-1

- consumption of candies more than once a week had higher development of new caries in maxillary right deciduous second molar (HR=6.83, $p<0.05$) and mandibular left deciduous second molar (HR=8.18, $p<0.05$).
- consumption of sweet drinks among 4-5 years old Australian children was associated significantly with higher dental caries (OR=1.1, $p=0.01$).

According to WHO, free sugars are the essential dietary risk factor in the development of dental caries.[23]

Generally, consuming food and drinks containing free sugars around bedtime could be an important risk factor for ECC because of the decreased salivary flow during sleep, reducing the self-cleansing effect and buffering capacity of saliva in the oral cavity. Thus, this shifts the balance towards demineralisation rather than remineralisation.

A SR of 18 observational studies among children aged 3 to 5 years assessing the relationship between food and drink consumption containing free sugar with dental caries around bedtime showed a positive association in:[24] level II-2

- two cohort studies (OR ranged 1.33 to 1.92, ($p<0.05$)
- three cross sectional studies (OR ranged 1.59 to 2.4, $p<0.05$)

However, the quality of included studies was rated as very low as measured by GRADE guideline.

The AAPD recommends limiting the provision of drinks and snacks containing free sugars to children at night to reduce the risk of ECC.[25]

Recommendation 2

- Consumption of free sugars among children should be limited in daily diet.

3.1.3 Oral Microbiome

A SR investigated the acquisition and colonisation of oral bacteria in children during their first year of life and subsequent development of ECC.[26] level I The studies in this review reported the presence of cariogenic bacteria in the pre-dentate and very early dentate of infant's life. Every child diagnosed with dental caries had *Streptococcus mutans* (*S. mutans*), however not all children harbouring these bacteria developed caries during the study period. These maternal characteristics significantly influence the bacterial acquisition:

- maternal *S. mutans* level (OR=4.0, 95% CI 1.2 to 12.6)
- maternal caries status >4 teeth (OR=2.0, $p<0.05$)

- pre-tasting of food (OR=6.4, 95% CI 2.9 to 14.5)
- sharing of eating utensils >3 times/day (OR=4.6, 95% CI 2.3 to 9.5)
- mother's education (RR=0.78, 95% CI 0.50 to 0.92)
- habitual kissing on the lips (OR=6.4, 95% CI 3.0 to 13.4)

Behaviour and habit associated with bacterial colonisation:

- sweetened beverages (OR=4.0, p<0.001)
- inefficient brushing habit ≤1 time/day (OR=2.1, 95% CI 1.20 to 2.60)
- snacking (OR=5.6, 95% CI 2.30 to 9.50)
- night feeding (p<0.001)

However, the results for each outcome in this study were obtained from different individual papers.

3.1.4 Other Factors

Many other studies implicating various risk factors in ECC have been done.

A meta-analysis of 18 good quality observational studies examining the relationship of preterm and low birth weight (LBW) on risk of ECC showed:[27] level II-2

- increased risk of ECC in preterm versus full-term birth (OR=1.59, 95% CI 1.36 to 1.87)
- three studies indicated that LBW was not a risk factor for ECC compared to normal birth weight

Another meta-analysis of 29 cohort studies assessing risk factors associated with ECC reported:[28] level I

- in high-income countries the risks factors are:
  - the presence of enamel defects (OR=14.62, 95% CI 6.10 to 35.03)
  - increased baseline salivary levels of *S. mutans* (OR=9.21, 95% CI 4.97 to 17.07)
- in upper-middle income countries the risk factors are:
  - high levels of Mutans Streptococci (OR=3.83, 95% CI 1.81 to 8.09)
  - frequent consumption of sweetened foods (OR=3.14, 95% CI 0.89 to 11.04)
  - poor oral hygiene (OR=3.12, 95% CI 1.77 to 5.49)
  - presence of visible plaque (OR=3.10, 95% CI 2.0 to 4.80)

The evidence was assessed to be of moderate quality.

In a different cohort study in children with ECC, reported that the high mean decayed, missing, filled teeth (dmft)/ decayed, missing, filled surfaces (dmfs) values (dmft: 9.49 and dmfs: 26.35) correlated significantly with:[29] level II-2

- mothers from non-European Union countries (p<0.05)
- beginning of tooth brushing (p<0.05)
- lack of supervised tooth brushing (p<0.01)

According to WHO, socioeconomic and family background factors, such as low parental education, unemployment, low income, and single-parent households, are linked to ECC. Additionally, parental characteristics like young age, poor oral hygiene, irregular dental visits, along with high-sugar diets in low socioeconomic status children, contribute to ECC, which is also often exacerbated by maternal psychological distress and challenging child temperament.[3]

3.2 Protective Factors

3.2.1 Food and Drinks

Milk and cheese are known to mitigate metabolic acids and lower plaque acidity, reducing their cariogenic potential. In addition, fruits contain polyphenols that hinder plaque formation and acid production by oral bacteria, along with compounds promoting enamel remineralisation, while their fibrous texture encourages thorough chewing, stimulating saliva and enhancing its buffering capacity. A combination of different foods that is high in fruits and vegetables is associated with reduced risk of NCDs.[30] This may also include ECC.

A small cross-sectional study among preschool children in Egypt using the Healthy Eating Index-2005 (HEI-2005) scores, found prevention of ECC was significantly affected by consumption of whole fruit (OR=0.47, 95% CI 0.27 to 0.84) and milk (OR=0.50, 95% CI 0.3 to 0.83).[31] level III

In a recent SR, daily consumption of water and dairy products was reported to be protective against ECC. However, only one cohort study of 7 to 15 years old with moderate consumption of dairy products and daily tooth brushing had protective effects against caries development (OR=0.6, p=0.049) at four years follow-up.[22] level II-1

3.2.2 Saliva

Saliva is one of the innate defense systems of the human body that protects teeth by several mechanisms. The physical properties (pH and buffering capacity, flow rate and viscosity) and chemical properties (inorganic ions, protein and peptides) of saliva play an important role in prevention of dental caries in children by neutralizing low plaque pH, rinsing food debris, microorganisms and sugar aggregation, improving tooth enamel by remineralization, and by its antibacterial and antimicrobial properties.[32, 33]

4.0 EXAMINATION AND DIAGNOSIS

Caries detection and diagnosis is fundamental in oral disease management. This process involves the identification of changes in enamel, dentine, or other dental tissues. Caries process itself is dynamic and a continuum that results from repeated cycles of demineralisation and remineralisation.[34] Sensitivity and specificity are the most commonly used indicators to describe and determine the diagnostic ability of the studied methods. Sensitivity is the probability that a test will indicate the presence of caries among the tooth surfaces. Specificity is the probability of a test which will indicate the absence of caries among the tooth surfaces. In terms of validity, histological validation (laboratory) was frequently referred to as the gold or reference standard.

4.1 History Taking

Patient's assessment starts with addressing the patient's complaint, thorough history taking, comprehensive physical examination and radiographic investigations.

History taking should include:

- Patient's complaint or parents' concern.
- Medical history - any relevant medical illness / syndrome / disability.
- Dental history - frequency of visits to the dentist.
- Family history - any family member with untreated caries.
- Social history - social economic status/ parents' level of education.
- Habit - oral hygiene practice / dietary / feeding practices.

4.2 Visual Examination

Visual examination is the standard method used for caries diagnosis. The application of this method in daily clinical practice is undoubtedly common and universally accepted. In this method, a dental examination is done under a light source on clean and dry teeth.

In a large meta-analysis with moderate quality studies, the overall diagnostic accuracy in clinical (visual examination) and laboratory (histology) findings for dental caries in primary teeth is summarised in Table 2:[35] level III

Table 2: Clinical (visual examination) versus Laboratory (histology)

Stages of caries and surfaces affected	Setting of the study	Results			Interpretation (by CPG DG)
		Sensitivity	Specificity	AUC	
Initial caries lesions in occlusal surfaces	Clinical	0.752 (95% CI 0.708 to 0.793)	0.573 (95% CI 0.519 to 0.626)	0.85	These results show that clinical diagnostic methods for detection of initial caries on occlusal surfaces is an acceptable diagnostic tool.
	Laboratory	0.811 95% CI 0.788 to 0.832	0.656 95% CI 0.607 to 0.704	0.83	
Initial caries lesions in proximal surfaces	Clinical	0.430 (95% CI 0.397 to 0.464)	0.908 (95% CI 0.882 to 0.930)	0.80	These results show that the clinical diagnostic method for detection of initial caries in proximal surfaces is less accurate.
	Laboratory	0.709 (95% CI 0.667 to 0.749)	0.865 (95% CI 0.821 to 0.902)	0.91	
More advanced caries lesions in occlusal surfaces	Clinical	0.663 (95% CI 0.591 to 0.730)	0.881 (95% CI 0.859 to 0.901)	0.89	These results show that clinical diagnostic methods for detection of more advanced caries on occlusal surfaces is an acceptable diagnostic tool.
	Laboratory	0.671 (95% CI 0.629 to 0.711)	0.842 (95% CI 0.821 to 0.861)	0.88	
More advanced caries lesions in proximal surfaces	Clinical	0.543 (95% CI 0.457 to 0.627)	0.992 (95% CI 0.986 to 0.996)	0.91	These results show that visual diagnostic methods for detection of more advanced caries on proximal surfaces is an acceptable diagnostic tool.
	Laboratory	0.709 (95% CI 0.667 to 0.749)	0.865 (95% CI 0.821 to 0.902)	0.91	

In another recent SR, assessing the diagnostic test accuracy in in-vivo studies involving visual, radiographic and other alternative methods in the primary teeth are summarised in Table 3 to Table 6:[36] level III

Table 3: Diagnostic Tools for Sensitivity of Occlusal Caries

Surfaces	Diagnostic Tools	Specificity	Interpretation (by CPG DG)
Occlusal	SoproLife	0.86 to 0.98	In terms of detecting presence of caries in occlusal surfaces, SoproLife showed the highest sensitivity followed by CarieScan Pro, Diagnodent Pen, DIAGNOdent and visual examination. Bitewing radiography showed the lowest sensitivity.
	CarieScan Pro	0.72 to 0.91	
	DIAGNOdent Pen	0.63 to 1	
	DIAGNOdent	0.43 to 1	
	Visual examination	0.42 to 1	
	Bitewing radiography	0.14 to 0.96	

Table 4: Diagnostic Tools for Specificity of Occlusal Caries

Surfaces	Diagnostic Tools	Specificity	Interpretation (by CPG DG)
Occlusal	SoproLife	0.92 to 0.96	In terms of detecting absence of caries in occlusal surfaces, SoproLife showed the highest specificity followed by bitewing radiography, visual examination, DIAGNOdent and DIAGNOdent Pen. CarieScan Pro showed the lowest specificity.
	Bitewing radiography	0.78 to 0.99	
	Visual examination	0.51 to 1	
	DIAGNOdent	0.5 to 1	
	DIAGNOdent Pen	0.44 to 1	
	CarieScan Pro	0 to 0.92	

Table 5: Diagnostic Tools for Sensitivity of Approximal Caries

Surfaces	Diagnostic Tools	Specificity	Interpretation (by CPG DG)
Approximal	DIAGNOdent Pen	0.16 to 0.97	In terms of detecting presence of caries in approximal surfaces, DIAGNOdent Pen showed the highest sensitivity followed by bitewing radiography. Visual examination showed the lowest sensitivity.
	Bitewing radiography	0.14 to 0.96	
	Visual examination	0.05 to 0.96	

Table 6: Diagnostic Tools for Specificity of Approximal Caries

Surfaces	Diagnostic Tools	Specificity	Interpretation (by CPG DG)
Approximal	Visual examination	0.73 to 1	In terms of detecting absence of caries in approximal surfaces, visual examination showed the highest specificity followed by DIAGNOdent Pen. Bitewing radiography showed the lowest specificity.
	DIAGNOdent Pen	0.68 to 1	
	Bitewing radiography	0.62 to 1	

Recommendation 3
- Visual examination should be considered for the diagnosis of initial occlusal caries, advanced occlusal caries and advanced proximal caries.

4.3 Radiographic Examination

Radiography is commonly used and generally accepted as an adjunct in caries diagnosis. Bitewing radiography provides an additional diagnostic yield, in particular for proximal dentinal caries detection or if proximal surfaces cannot be visualised or probed. Patients without evidence of disease and with open proximal contacts may not require a radiographic examination at this time.[18]

In a large in-vivo cross-sectional study assessing accuracy of three diagnostic tools (visual examination, bitewing radiographic examination and laser fluorescence pen) for proximal caries detection in primary molar teeth showed demineralisation in the:[37] level III
- outer half of enamel level, visual examination with temporary tooth separation (TTS) had the highest area under the receiver operating characteristic curve (ROC) (ROC=0.83, 95% CI 0.77 to 0.88).
- outer one third of dentine level, bitewing radiographic examination without TTS had the highest ROC (ROC=0.89, 95% CI 0.87 to 0.92).

Recommendation 4
- Bitewing radiographic examination should be considered for the diagnosis of initial proximal caries.

4.4 International Caries Detection and Assessment System

Visual inspection is carried out with visual scoring systems to aid in the caries diagnosis process. Several visual scoring systems or criteria, such as International Caries Detection and Assessment System (ICDAS), Nyvad criteria, World Health Organization (WHO) or Ekstrand-Ricketts-Kidd (ERK) criteria have been adopted in different studies to aid in the caries diagnosis process. The accuracy and reliability of these systems are varied.

In a meta-analysis that compared the effect of differences of studies regarding utilisation of visual scoring systems in the primary teeth, in terms of relative diagnostic odds ratio (RDOR):[35] level II-2

- occlusal initial caries lesions showed:
  - Nyvad criteria (RDOR=8.82, 95% CI 3.10 to 25.05).
  - ICDAS (RDOR=4.86, 95% CI 2.76 to 8.54).
  - ERK criteria (RDOR=2.93, 95% CI 1.41 to 6.09).
  - non-reported or own criteria (RDOR=1).
  - WHO criteria (RDOR=0.80, 95% CI 0.38 to 1.70).
- occlusal advanced caries lesions showed:
  - ICDAS (RDOR=4.72, 95% CI 1.51 to 14.71).
  - Nyvad criteria (RDOR=3.60, 95% CI 0.79 to 16.48).
  - ERK criteria (RDOR=1.90, 95% CI 0.56 to 6.45).
  - Nytun criteria (RDOR=1.38, 95% CI 0.44 to 4.39).
  - non-reported or own criteria (RDOR=1).

In a SR that evaluated the overall reproducibility and accuracy of ICDAS in assessing coronal caries lesions at the outer third dentine (D1) and at the inner third dentine (D3) threshold in primary teeth, it was demonstrated:[38] level II-2

- any caries lesions at the D1 threshold, the laboratory studies (AUC=0.8695) were slightly better than the clinical studies (AUC=0.7908)
- more advanced caries lesions (D3), the clinical studies (AUC=0.9246) were almost similar to the laboratory studies (AUC=0.9171)

ICDAS is a robust and meticulous system that was developed in the year 2002 to 2004 to systematically detect or diagnose dental caries.[39] ICDAS II was devised a few years later with some revisions of the scoring system in the earlier ICDAS.[40] To date, ICDAS II has been widely used and accepted as the standard caries detection system. In the local setting, Modified MOH ICDAS is used.[41]

Recommendation 5
- International Caries Detection and Assessment System (ICDAS) should be used for caries diagnosis.

4.5 Other Modes of Diagnosis

4.5.1 Artificial Intelligence-Driven Tools

A SR of three cross-sectional studies assessing the performance and applicability of Artificial Intelligence (AI)-Driven Tools on treatment decision making in ECC revealed that the performance of machine learning-based models was comparable to that of the conventional methods in prediction, detection and management with AUC ranged between 0.740 to 0.785.[42], level III

4.5.2 Saliva

Saliva is a remarkable fluid that embodies the complexity and vitality of human biology which serves as a reservoir of diverse biological components, ranging from essential electrolytes and biochemicals to metabolites and intricate microbiomes.

A recent diagnostic study presented a novel approach to diagnose ECC by identifying panel of salivary metabolites biomarkers using nuclear magnetic resonance (NMR) showed:[43] level III

- increased levels of formate, glycerophosphocholine (GPC) and lactate, along with reduced levels of alanine, glycine, isoleucine, lysine, proline and tyrosine in saliva of children with ECC compared to healthy controls (p<0.001).
- biomarker panels of four types of metabolites (formate, lactate, proline, and glycine) exhibited better diagnostic performance compared with any single metabolite-formate, lactate, lysine, proline and tyrosine (AUC=0.916).
- correlation between metabolite levels and caries severity:
  - patients with ICDAS <3
    - formate and lactate levels were significantly increased
    - glycine, isoleucine, tyrosine, and lysine levels were significantly decreased.
  - patients with ICDAS >3
    - formate and lactate levels were significantly increased.
    - GPC levels significantly increased.
    - glycine, isoleucine, tyrosine, and lysine levels were significantly decreased.

However, this study has limitations due to its small sample size. Further studies with larger sample size would be more accurate to produce more reliable and precise results.

In a cross-sectional study with a large sample size which assessed the ability to use salivary microbiome and electrolytes in diagnosing ECC, in terms of the performance of the diagnostic model, it was demonstrated:[44] level III

- saliva electrolytes (AUROC = 0.94, 95% CI 91.50 to 96.91).
- saliva electrolytes and saliva microbiomes (AUROC=0.89, 95% CI 85.81 to 92.80).
- saliva microbiomes alone (AUROC=0.70, 95% CI 63.86 to 75.15).

However, in this study the diagnosis was not explicitly attributed to any specific investigator. Despite that, calibration was performed, adhering to the WHO criteria for the dmft index concerning primary teeth.

The CPG DG members opine, these studies have highlighted the potential of AI-driven tools and salivary biomarkers, including metabolites and microbiomes, for diagnosing ECC. These findings underscore the promise of innovative diagnostic approaches, such as machine learning-based models and salivary analyses, in improving ECC detection and management, despite some limitations in sample size and diagnostic attribution.

5.0 PREVENTION

Early childhood caries prevention is targeted on early intervention in expectant mothers and in young children, focusing on health promotion and oral disease control. These interventions have the potential to prevent the initiation and progression of caries in young children and hence reduce the burden of ECC across the life-course.[45]

WHO advocates the integration of ECC prevention into existing primary healthcare programmes especially for maternal and child health.[3] In Malaysia, the Toddler Oral Health Programme emphasises on smart partnership between parents, childcare providers and healthcare personnel to prevent ECC.[46]

5.1 Diet Advice

Early establishment of dietary habits and childhood food preferences may impact a child's oral health, general health and overall well-being.[47]

A Cochrane SR with 14 RCTs assessed the effects of interventions among pregnant women, new mothers or other primary caregivers in preventing ECC with follow-up periods ranging from seven months to four years.[48] level I

- Child diet and feeding practice advice versus standard care showed:
  - reduced risk of caries (RR=0.85, 95% CI 0.75 to 0.97)
  - lower mean dmfs in intervention group (MD=-0.29, 95% CI -0.58 to 0).
  - no significant (NS) difference in terms of mean dmft between the two groups.
- Breastfeeding promotion versus standard care showed NS difference in terms of dmft score and risk of caries between the two groups.
- Dietary advice (infant diet low in saturated fat and cholesterol) versus standard care showed NS difference in terms of the risk of caries between the two groups.

Standard care which was delivered in the control group was not well defined in this study. The evidence was of very low to moderate certainty.

A recent integrative review of 27 studies (13 RCTs, five quasi-experimental and nine non-randomised controlled trials) evaluated interventions at primary healthcare/community setting on both among parents/caregivers and young children on best practice formula feeding and bottle cessation in the prevention of ECC, overweight and obesity within a period of one day education session to five years follow-up.[49] level I

- One RCT with mothers received oral health promotion at 6, 12, 18 months versus delayed intervention at 24, 30, 36 months of child age showed decreased ECC prevalence:
  - at two years of age in intervention group (19.7%, $p<0.0001$) compared to control (23.6%) but not on follow-up at five years of age.
- One RCT with children received oral health promotion at Primary Care Groups in health districts versus usual care and standard development checks showed:
  - at 21 months:
    - increased bottle cessation (33%, $p=0.04$) in intervention than in control group (18%)
    - increased limited bottle use only at bedtime, by bottle-using children in intervention group (43%, $p=0.02$) than in control group (62%)
    - decreased cup use for only drinking unsafe (cariogenic) drinks (13%, $p=0.02$) in intervention than in control (30%)
    - no difference in non-cariogenic drink use in bottles; trainer cup use; cup use for combined cariogenic and non-cariogenic drinks.
  - at 3 to 4 years of age:
    - decreased prevalence of ECC at <3 years of age (16.6%, $p=0.003$) in intervention compared to 23.5% in control.
    - decreased prevalence of ECC at ≥3 years of age (28.7%, $p= 0.001$) in intervention compared to 39.2% in control.

This study also emphasised the importance of employing collaborative interdisciplinary approaches, which involve the integration of dental and nutritional advice. The aim is to address ECC and the issues of childhood overweight and obesity. This can be achieved by incorporating theories of behavioural change, taking input from stakeholders, and involving co-design principles in the development of interventions. The evidence was of low to moderate quality.

In the local setting, the stakeholders include MOH (paediatrician, family medicine specialist, dietition, nutritionist, paediatric dental specialist, dental officer, dental therapist and other dental staff), MOE, MOHE, MOD, MDA (private dental practitioners) and other private parties (industry player and NGO).

The AAPD recognises a healthy diet in early childhood is essential to optimal growth and development and prevention of chronic diet-related diseases such as caries, obesity, and cardiovascular disease through dietary and nutritional counselling.[25]

AAPD recommends preventive oral health intervention for infants and children based on age-group:[50]

a. for age 6-12 months:
- provide oral hygiene counselling for parents, including the implication of oral health of caregiver.
- assess the appropriateness of feeding practices, including bottle and breastfeeding and provide counselling as indicated, provide dietary counselling related to oral health.

b. for age 12 - 24 months:
- repeat the procedure for ages 6 to 12 months every six months or as indicated by the child's individual needs or risk status or susceptibility to disease.
- assess the appropriateness of feeding practices including bottle and breastfeeding and no-spill training cups and provide counselling as indicated.

c. for age 2 - 6 years:
- repeat the procedures for ages 12 to 24 months every six months or as indicated by the child's individual needs or risk status or susceptibility to disease.
- assess diet and body mass index to identify patterns placing patients at increased risk for dental caries or obesity. Provide counselling or appropriate referral to a paediatric or nutritional specialist as indicated.

Recommendation 6
- Advice on diet should be provided to pregnant women, new mothers and other primary caregivers in preventing early childhood caries.
- Interdisciplinary approaches by healthcare professionals in dental, medical, nursing and allied health setting should be practised for formula feeding and bottle cessation in the prevention of early childhood caries, overweight and obesity.

5.2 Plaque Control

Plaque can be controlled using mechanical and chemical agents and it is essential for the prevention of early childhood caries.

5.2.1 Mechanical plaque control

Mechanical plaque control plays a crucial role in maintaining oral hygiene by effectively removing dental plaque.

An RCT among children aged three to six year-olds (with parental brushing) assessing the effectiveness of powered oscillating-rotating toothbrushes and manual toothbrushes in plaque reduction at 4-period follow-up showed statistically significant plaque reduction in pre and post brushing from baseline (p<0.001) in both groups.[49] level I

The CPG DG members opine using powered oscillating-rotating toothbrushes and manual toothbrushes are both effective in removing plaque among children with ECC.

5.2.2 Chemical Plaque Control

Chemical agents such as chlorhexidine (gels, varnish and mouthrinses), xylitol (tablets, wipes and confection), and 0.3% triclosan varnish play a role in plaque control and preventing dental caries as adjunct to proper mechanical plaque control methods.[52, 53]

The CPG DG members opine that the selection of the chemical agent, its dosage, and how it is applied, must be thoughtfully evaluated according to each patient's unique risk factors, age, and specific requirements. Therefore, it is crucial to consult with a dentist or paediatric dental specialist to determine the most suitable chemical plaque control method for patients with ECC.

Recommendation 7

- Mechanical plaque control with electric or manual toothbrushes should be used in removing dental plaque to prevent early childhood caries.
- Chemical agents may be considered as an adjunct to mechanical plaque control in removing dental plaque to prevent early childhood caries.

5.2.3 Frequency of Toothbrushing

In a meta-analysis of nine observational studies assessing the effectiveness of toothbrushing frequency showed significantly increased dental caries incidence following toothbrushing less than twice daily as compared to twice or more a day (OR=1.45, 95% CI 1.21 to 1.74).[54] level II-2 However, included primary papers in this study were in the mixed dentition.

SDCEP recommends toothbrushing twice daily, including last thing at night with age-appropriate amount of toothpaste containing 1000 to 1500 ppm fluoride on eruption of primary teeth.[55]

5.2.4 Toothbrushing Technique

Toothbrushing technique is important for the efficacy of dental plaque removal to promote comprehensive toothbrushing for young children. Common toothbrushing methods for children include horizontal scrub, Fones and modified Bass techniques.

An RCT evaluated the effectiveness of horizontal scrub, Fones and modified Bass techniques for plaque control among schoolchildren

aged 6 to 8 years old after 24 hours follow-up, found NS differences in mean plaque score using the Silness and Loe Plaque Index.[56] level I

Oral Health Programme in Malaysia advocate Fones (circular) and modified Bass techniques for tooth brushing at nursery, preschool and primary school children at local setting.[57] Whilst, AAPD does not recommended any particular tooth brushing technique.[58]

5.2.5 Supervised Toothbrushing

The term supervised toothbrushing includes the act of an adult brushing the child's teeth or assisting to brush their teeth.

An RCT comparing the effectiveness of teacher-supervised tooth brushing programme in Thailand revealed significant reduction in the mean plaque score (p<0.001) after 24 months versus unsupervised school children's tooth brushing programme.[59] level I However, the quality of this study was moderate.

Similarly, in a local pragmatic RCT conducted among preschool children using *Senyuman Indah Milik Semua Programme* (*SIMSP*) [daily teacher-supervision + supervised home tooth brushing at night by parents + Preschool Oral Health Programme (POHPS)] versus POHPS alone at 6 months follow-up showed significantly:[60] level I

- lower percentage of children with visible plaques in SIMSP (56.1%) vs POHPS alone (64.4%) (p=0.031).
- mean decrease in the plaque score was higher in the SIMSP vs the POHP (p=0.027, effect size (ES) = +0.51.

AAPD recommends supervised toothbrushing by a parent twice daily, using a soft toothbrush of age-appropriate size. In children under the age of three, a smear or rice-sized amount of fluoridated toothpaste should be used. In children ages three to six, a pea-sized amount of fluoridated toothpaste should be used.[58]

SDCEP recommends the practice of supervised toothbrushing with fluoridated toothpaste as a preventive measure against ECC and to reduce the risk of fluorosis.[55]

Regarding toothbrushing, both the SIGN 138 and SDCEP recommends children to spit out excess toothpaste and not to encourage rinsing of mouth after brushing.[55, 61]

In the absence of evidence from home settings, NHS England suggested that when brushing, children need to be helped and supervised by an adult, until at least seven years of age.[62]

5.2.6 Age of Starting Toothbrushing

AAPD recommends that toothbrushing with fluoridated toothpaste should start as soon as the first teeth erupt.[18]

Both AAPD and SDCEP recommend a smear of fluoridated toothpaste for children aged three and below, and a pea-sized amount for those above the age of three.[18, 56]

5.2.7 Flossing

The current guidelines from AAPD and SDCEP do not strongly endorse flossing as an effective preventive measure for ECC.[55, 58] The CPG DG opines that the emphasis should be on other evidence-based interventions such as tooth brushing, fluoride toothpaste, reducing sugar intake, and professional fluoride applications.

5.2.8 Fluoride Toothpaste

The role of fluoride toothpastes in the control of dental caries is well established and beyond dispute.

A meta-analysis of 8 studies have shown that the use of standard fluoride toothpastes (1000 to 1500 ppm) reduces the incidence of dental caries in the primary dentition of preschool children. When standard fluoride toothpastes were compared to placebo or no intervention, significant caries reduction at surface (PF=31%, 95% CI 18 to 43), tooth (PF=16%, 95% CI 8 to 25) and individual (RR=0.86, 95% CI 0.81 to 0.93) level were observed.[63], level I

In a recent SR comparing the standard fluoride toothpaste (1000-1500 ppm) and low fluoride content (≤ 600 ppm), greater efficacy in the prevention of ECC was found with toothpastes containing 1000- 1500 ppm of fluoride.[64], level I

In terms of concentration of fluoride toothpaste, the existing guidelines recommends the use of 1000 ppm for standard use in prevention of ECC irrespective of the age of the child (to be used on eruption of teeth).[55, 61]

However, SDCEP cautions that fluorosis can occur with:[55]

- eating/licking toothpaste habit
- inappropriate use of fluoride supplements or toothpaste
- unsupervised toothbrushing (under six years)

Recommendation 8
- Tooth brushing to prevent early childhood caries should be:
  - commenced on eruption of primary teeth
  - performed at least twice daily including last thing at night
  - done with toothpaste containing 1000 to 1500 ppm Fluoride for children:
    - <3 years old apply with a smear or rice-sized amount
    - ≥ 3 to 6 years old, use a pea-sized amount
  - supervised by adults
- Toothpaste should be spit out without rinsing after tooth brushing.

5.3 Oral Health Education

Oral health education (OHE) is the process of providing individuals with personally relevant information about their oral health based on scientific principles and evidence. It involves motivating, teaching and training both individuals and small groups. The AAPD recognises that perinatal and infant oral health are the foundations of OHE and enhances the opportunity for a child to have a lifetime free from preventable oral disease.[18] In local setting, OHE has been implemented as part of preventive measure of ECC among expectant mothers.[65]

5.3.1 Oral Health Education Intervention for Mothers and Caregivers

In a recent field trial, comparing four distinct approaches (comprehensive intervention, performing group discussion sessions, face to face advice by Primary Healthcare Provider (PHCP), social networking) for pregnant mothers in their second and third trimesters against a control group (which received routine maternal care), the follow-up at 24 months assessed whether the children were caries-free showed:[66] level II-1
- higher chance of being caries-free (OR=4.54, 95% CI 1.58 to 12.94) in the comprehensive intervention group.
- higher chance of being caries-free (OR=3.16, 95% CI 1.16 to 8.57) in PHCP intervention group.
- NS difference in social network and group discussion.

A SR of four RCTs evaluated the efficacy of OHE among expectant mothers in preventing ECC compared to no intervention (control) reported only one RCT showed 82% caries reduction (RR=0.18, 95% CI 0.06 to 0.52) at 18 months follow-up, but there was NS difference at six years follow-up. However, another two studies showed NS difference between the two groups.[67] level I

In a meta-analysis of ten RCTs assessing the effectiveness of OHE among caregivers for preventing ECC compared to no OHE (control) showed significant reduction in risk of ECC among children of caregiver

(OR=0.39, 95% CI 0.19 to 0.79) at 18 months follow up. However, there was NS difference in terms of mean dmft between the two groups.(15) level I The quality of included primary papers for this outcome were of moderate quality.

Regular OHE is essential for expectant and new mothers in high-risk communities as it plays a vital role in creating awareness. Along with additional counselling and delivery of preventive services, it helps in promoting oral health and preventing oral diseases. Furthermore, these findings emphasise the importance of regular follow-up and ongoing education to ensure long-lasting benefits in oral health outcomes.

Recommendation 9

- Oral health education should be provided to expectant mothers, new mothers and caregivers for to prevent early childhood caries.

5.3.2 Oral Health Education Intervention in Children with Special Healthcare Needs

Children with special healthcare needs including autism, global developmental delay, attention-deficit hyperactivity disorder, cerebral palsy, epilepsy, Down Syndrome, learning disabilities and sensory disabilities, have unique healthcare requirements and challenges, making them significantly more susceptible to ECC.

Children who have medical conditions which affect the dental treatment or manifests as a specific oral health problem are also categorised as children with special healthcare needs.

An RCT investigating the efficacy of OHE intervention (tooth brushing + social stories) versus control (tooth brushing + manual leaflets) to improve oral health status of preschool children aged 2 to 6 years old with special healthcare needs at 6, 12 and 24 months follow-up showed statistically significant:(68) level I

- lower Modified Gingival Index (MGI) score
  - mean MGI=0.6 ± SD 0.5, $p<0.05$ vs mean MGI=0.8 ± SD 0.6 at 12 months follow-up
  - incidence rate ratio (IRR)=-0.11, 95% CI -0.19 to -0.03 at 24 months follow-up
- lower Simplified Debris Index score (DI-S)
  - mean DI-S=0.6 ± SD 0.5, $p<0.01$ vs mean DI-S=0.8 ± SD 0.6 at 12 months follow-up
  - incidence rate ratio (IRR)=-0.14, 95% CI -0.25 to -0.03 at 24 months follow-up
- improved number of tooth brushing step
  - mean=9.0 ± SD 2.9, $p<0.01$ vs mean = 0.8 ± SD 0.6 at 12 months

- improved tooth brushing frequency
  - 37.2%, $p<0.01$ vs 20.7% at 12 months
- improved overall toothbrushing behaviour
  - 94.9%, $p<0.05$ vs 86.7% at 24 months follow-up
  - OR=2.85, 95% CI -0.19 to -0.03 at 24 months follow-up

AAPD recommends preventive strategies in the management of children with special healthcare needs as follows:[69]

- education of parents/caregivers of special healthcare needs children is critical for ensuring appropriate and regular supervision of daily oral hygiene
- an oral hygiene programme that accommodates the unique disability of the patient (assistance from other health professions for example occupational therapy) may be beneficial.
- brushing with a fluoridated dentifrice twice daily (sensory issues cause the taste or texture of fluoridated toothpaste to be intolerable, therefore a toothpaste without sodium laurel sulphate to eliminate foaming nature, a fluoridated mouthrinse, or an alternative (e.g., casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) may be applied with the toothbrush).
- toothbrush can be modified to enable individuals with physical disabilities to brush their own teeth.
- electric toothbrushes and floss holders may improve patient compliance.
- caregivers should provide the optimal oral care when the patient is unable to do so adequately.

Recommendation 10

- Oral health education intervention adjunct with social stories may be considered in promoting oral health-related behaviours among young children with special healthcare needs to prevent early childhood caries.

5.4 Interdisciplinary Cooperation in Preventive Oral Hygiene Programme

Children with congenital heart disease are one of the most common group of children seen by the dentist. These children are at increased risk of life-threatening infective endocarditis from oral bacteria, highlighting the importance of preventive dental oral care.[70]

An interdisciplinary cooperation between paediatric cardiologist and dentist in a preventive oral hygiene programme (POHP) in improving ECC among Congenital Heart Disease Group (CHG) versus Healthy Control Group (HCG) at two follow-up intervals of 3 to 6 months showed:[71] level II-1

- decreased caries prevalence (8.9%, $p<0.05$) in the CHG group
- statistically significant lower plaque reduction using Quigley Hein Index (QHI) at:
  - first follow-up (mean plaque value=2.16 ± SD 0.66, $p<0.001$) compared to baseline (mean plaque value=2.59 ± SD 0.81)
  - second follow-up (mean plaque value=1.87 ± SD 0.64, $p< 0.001$)
- statistically significant lower Loe & Silness Gingival Index (GI) of the Index (QHI) at:
  - first follow-up GI score was 35.48% ($p<0.001$)
  - second follow-up GI score was 54.8% ($p<0.001$)

Recommendation 11
- Interdisciplinary cooperation among paediatric cardiologist, paediatrician, paediatric dental specialist and dentist should be implemented to prevent early childhood caries effectively among children with congenital heart disease.

5.5 Motivational Interviewing

Motivational interviewing (MI) is a collaborative communication style that is person-centred and aimed at improving health behaviours by invoking intrinsic motivation to make long-term behavioural changes and has been used in the prevention of ECC.

A recent meta-analysis in young children comparing MI-based approach versus no treatment or other types of oral health education, demonstrated a significant improvement in prevention of dmfs among children with high caries experience (dmfs= 3.15, 95% CI -6.14 to -0.17). However, in children with low caries experience, there were NS differences between the groups.[(72) level I] The included eight RCTs were of low risk bias, but the duration of follow up ranged from 4 weeks to 3 years.

In a large RCT comparing effectiveness of prevailing health education (PE) with MI and/or caries risk assessment(CRA) among children aged 3 to 4 years old at six to 12 months follow up showed:[(73) level I]
- plaque score reduction was greater in:
  - PE + MI group (β=-0.077, 95% CI -0.106 to -0.048)
  - PE + MI + CRA group (β=-0.075, 95% CI -0.113 to -0.036)
- caries increment reduction in:
  - PE + MI group (β=-0.717, 95% CI -1.035 to -0.398)
  - PE + MI + CRA group (β=-0.600, 95% CI -0.793 to -0.407)695

However, there was neither segregation of recruits based on severity of caries in the statistical analysis performed nor was there any mention of allocation concealment in this study.

Recommendation 12

- Motivational interviewing should be conducted on parents of children with high risk for early childhood caries by trained oral health professionals.

5.6 Anticipatory Guidance

Anticipatory guidance (AG) is a proactive development counselling that addresses physical, emotional, psychological and developmental changes in children during the interval between health supervision visits. It also complements a risk assessment that addresses protective factors aimed at preventing oral health problems.

Parents and caregivers as the primary role model have a major influence on children's oral health and dietary practices.

Anticipatory guidance through an oral health promotion program (OHPP) is a community-based preventive approach for improving oral health in preschool children.

A cohort study in Austria conducted a five-year follow-up with mothers starting from the birth of their child, providing them with detailed oral hygiene instructions through brief MI and AG methods.The results among the children of mothers who underwent the MI and AG versus the control group (mothers who did not participate) showed significantly:(74) level II-2

- lower caries prevalence (33.2% vs 42.6%, $p<0.05$)
- lower caries experience (mean dmfs= 3.2 ± 7.4 vs 5.2 ± 6.4; mean dmft = 1.5 ± 2.5 vs 2.4 ± 4.1, $p<0.05$)
- higher care index (12.1% vs 6.5%, $p<0.05$)
- started tooth brushing at a younger age ($p<0.00$)
- more often use of fluoride toothpaste ($p<0.00$) and fluoride salt ($p=0.015$)
- supervised tooth brushing ($p<0.000$)

Another quasi-experimental study in two dental clinics in Batu Pahat district assessing effectiveness after three years of anticipatory guidance in Family Dental Wellness Programme (FDWP) among mother-child-siblings trios showed:(40) level II-1

- 2-3 years old children (0.24 ± SD 0.8) had a significantly lower caries increment compared to the control group (0.75 ± SD1.2).
- 4-6 years old siblings (0.20 ± SD 0.7) had a significantly lower caries increment compared to the control group (0.55 ± SD0.9).
- children aged 2-3 years old had a lower incidence rate of white spot lesion (12%) than the control group (25%).

- higher magnitude of change for oral health literacy of mothers (mean score) in FDWP group (7.70 ± 0.4) than the control group (0.46 ± 0.5).

An RCT assessing effectiveness of dental home visit's (DHV) in 5 to 6 years old children of low income families in Selangor at 24 months follow up showed significantly:(75) level I

- higher incidence of new caries development in the control group compared to DHV group (OR=8.2, 95% CI 4.3 to 15.8)
- lower number of primary molars developing new caries (OR=0.2, 95% CI 0.1 to 0.3) tooth per child in the DHV group as compared to control group (OR=1.1, 95% CI 0.8 to 1.3)

The loss of follow up was due to relocation, unable to contact or change in contact number and withdrawal from the study.

According to Early Childhood Care Guidelinesis the process of AG is guided by some key trigger questions and based on the answers given the relevant information or advice is provided.(76)

AAPD recommends providing anticipatory guidance for parents/ caregivers of all children from ages 6 months to 6 years.(18)

Recommendation 13

- Anticipatory guidance should be given to all parents and caregivers of children as early as after birth to prevent early childhood caries.

5.7 Caries Risk Assessment Models

Caries risk assessment is a procedure carried out to assess the susceptibility of an individual to developing dental caries and to institute appropriate preventive measures. Risk assessment models for early childhood caries considers a combination of factors such as diet, fluoride exposure, a susceptible host, and oral microflora and how they intertwine with a variety of social, cultural and behavioural factors that either results in disease progression or resolution.

A recent meta-analysis of 22 studies assessing the predictive performance of different caries risk assessment models such as the Cariogram, the National University of Singapore Caries Risk Assessment (NUS-CRA) model, and Dentoprog-Method model and four qualitative models (Caries Management By Risk Assessment (CAMBRA) model, the Caries-risk Assessment Tool (CAT), the Public Dental Service (PDS) guidelines, and the University of Michigan School of Dentistry Caries Risk Assessment (UMSD-CRA) model. Among the seven CRA models, Cariogram, CAMBRA, NUS-CRA, and CAT had both full and reduced versions. It was revealed that:(77) level II-2

- both the full cariogram AUC=0.78, 95 % CI 0.68 to 0.85 and the reduced cariogram AUC=0.72, 95 % CI 0.67 to 0.77 had acceptable ability to discriminate children at risk to ECC with calibration irrespective of bias. When full cariogram was compared to reduced cariogram, the discrimination of full cariogram AUC=0.80, 95% CI 0.47 to 1.38 was similar to reduced cariogram AUC=0.89, 95% CI 0.61 to 1.31 with the reduced cariogram showing better calibration compared to full cariogram
- the full version of CAMBRA had low ability to discriminate children at risk
  - full version had AUC=0.62, 95% CI 0.32 to 0.85
  - following acceptable calibration AUC=0.83, 95% CI 0.54 to 1.28
- reduced version of CAMBRA's ability to discriminate children at risk was not assessed
- the other CRA models were not assessed due to insufficient number of high-quality studies
- the other CRA models were not assessed due to insufficient number of high quality studies.

The AAPD 2022 CRA recommends that the dental caries risk assessments be based on the child's age, social, biological, and protective factors, clinical risk factors, along with clinical disease indicators and should be part of routine oral examination.[78] Refer to **Appendix 3** for AAPD Caries-risk Assessment Form for 0-5 year olds, **Appendix 4** for AAPD Caries-risk Assessment Form for >6 year olds and, **Appendix 5** for caries risk management pathway for 0-5 years old and **Appendix 6** for caries risk management pathway for ≥6 years old. At present the MOH services record CRA based on the clinical record card L.P.8-1 Pin.8/2019 (**Refer Appendix 7**).

The CPG DG members opine that all children aged six years old and below have to be assessed for risk of developing ECC regardless of the assessment tool used.

Recommendation 14
- Caries risk assessment should be done for children aged six years old and below.

5.8 Topical Fluoride

Fluoride varnish has been the mainstay prevention of ECC.

A Cochrane SR of 21 RCTs assessing the effectiveness of fluoride varnishes in preventing dental caries among children under six years of age found that:[79] level I

- fluoride varnish substantially prevented caries in a fraction of 37% (95% CI 24% to 51%) of surfaces in primary dentition (dmfs).
- flouride varnish prevented caries in a fraction of 65% (95% CI 48% to 82%) of carious teeth of primary dentition (dmft).

All papers included were of low risk of bias and moderate quality.

A meta-analysis of 16 RCTs on the effectiveness of fluoride varnish in reducing dentinal caries in children below six years of age revealed that:[80] level I

- fluoride varnish conferred protection against dentinal caries (RR=0.88, 95% CI 0.81 to 0.95) when compared to usual care and placebo. The numbers needed to treat (NNT) was 17.
- there was NS difference in the incidence of fluorosis in children followed up for 5 years.

The included studies were of low risk of bias.

A recent network meta-analysis of 15 moderate quality RCTs assessed the different forms of professionally applied topical fluoride in preventing ECC among children under six years of age revealed:[81] level I

- with direct comparisons
  - 5% Sodium Fluoride (NaF) varnish applied two times per year showed significant prevention (mean=-1.52, 95% CI -2.70 to -0.41) as compared to placebo
  - 0.9% Diflourosilane (DFS) varnish applied four times per year showed significant prevention (mean=-5.10, 95% CI -8.45 to -1.75) as compared to placebo
  - 0.9% DFS applied four times per year showed significant prevention (mean=-5.00, 95% CI -9.43 to -0.58) as compared to 0.9% DFS applied two times per year
  - 0.9% DFS applied four times per year showed significant prevention (mean=3.54, 95% CI 0.01 to 7.08) as compared to 5% NAF applied two times per year
- with indirect comparisons network meta-analysis and surface under cumulative ranking (SUCRA) in descending order:
  - 0.9% DFS 3 monthly
  - 0.5% amine fluoride 1 monthly
  - 1% amine fluoride 2 monthly
  - 0.5% amine fluoride 2 monthly
  - 5% NaF 6 monthly and yearly as well as 1.23% APF 6 monthly
  - 0.9% DFS 6 monthly

A more recent network meta-analysis of 32 moderate quality RCTs assessed various agents in the forms of professionally applied agents and self-applied agents or combinations of both in preventing ECC among children under six years of age revealed:[82] level I

- with indirect comparisons network meta-analysis and SUCRA in preventing caries increment in descending order:

  - fluoride foam (87.1%)
  - fluoride salt (82.8%)
  - probiotic milk and low fluoride toothpaste (76.8%)
- With indirect comparisons network meta-analysis and SUCRA in preventing caries incidence in descending order:
  - probiotic milk and low fluoride toothpaste (90.4%)
  - fluoride foam (81.6%)
  - probiotics with xylitol tablets (66.5%)

In terms of adverse reaction to topical fluorides, a network meta-analysis identified three SRs that reported adverse effects which were minor, self-limiting and potentially related to allergic reactions towards some of the ingredients in the agents used. With regards to fluorosis, the same network meta-analysis could not draw any conclusions as none of the studies reported on fluorosis affecting primary teeth.[81]

Key messages
Frequency of topical fluoride application for prevention of caries should be based on caries risk assessment of the patient.[78] (Refer to **Appendix 5**).

Recommendation 15
- Diflourosilane (0.9%) three monthly or sodium fluoride varnish (5%) six monthly application should be used in children below the age of six for prevention of early childhood caries.

5.9 Fissure Sealant

Fissure sealants are used on the grooves and pits of primary molars to prevent the ingress of nutrient and bacteria. The following materials can be used for the purpose of sealing fissures:[84]

- Resin based sealants which can either be polymerised via chemical activation-initiation (auto polymerisation) or light-activation system (light-cured)
- Glass ionomer which has fluoride releasing properties
- Polyacid modified resin (compomers) combine resin based material with the fluoride releasing and adhesive properties of glass ionomer
- Resin modified glass ionomer (RMGIC) which are essentially glass ionomer material with addition of resin components to allow for light polymerisation

A meta-analysis with 22 RCT's of moderate quality assessed the effectiveness of fissure sealant in children with primary or mixed dentition.[85] level I

- Fissure sealant vs non placement of sealant
  - 76% reduction in risk of developing caries within 2-3 years (OR= 0.24, 95% CI 0.19 to 0.30), pooled results from 9 RCTs
  - 79% reduction in risk of developing new caries within 4-7 years (OR=0.21, 95% CI 0.10 to 0.44), pooled results from 3 RCTs
- Fissure sealant vs fluoride varnish
  - 73% reduction in risk of developing new caries within 2-3 years (OR= 0.27, 95% CI, 0.11 to0.69), pooled results from 3 RCTs
  - 81% reduction in risk of developing new caries within 4-7 years (OR=0.19, 95% CI 0.07 to 0.51), pooled results from only 2 RCTs
- Different types of materials used as fissure sealants
  - Retention of sealant
    - glass ionomer sealants had a 5 times greater chance of being dislodged compared with resin based sealants (OR=5.06, 95% CI 181 to 14.13).
    - glass ionomer sealants had 3 times greater chance of being dislodged compared with resin modified glass ionomer sealants (OR=3.21, 95 %CI; 1.87 to 5.51).
  - There were significant difference in risk of developing new caries between:
    - glass ionomer sealants vs resin-based sealants
    - glass ionomer sealants vs resin-modified glass ionomer sealants
    - resin-modified glass ionomer vs polyacid-modified resin sealants
    - polyacid-modified resin sealants vs resin-based sealants

One of the adverse effects commonly associated with resin based fissure sealants is the leaching of Bisphenol A (BPA). BPA is known to have estrogen-like effects which may place patients at risk. However, evidence does not support the transient effect of the small amount of BPA on patient's health.[84]

AAPD Guidelines (2016) recommends the use of sealants in primary and first permanent molars with sound occlusal surfaces. If a tooth can be well isolated, a resin based sealant is recommended as it has a better long-term retention. In situations where it is difficult to achieve good isolation, a more hydrophilic material such as GIC would be preferable.[84]

Caries risk assessment facilitates the selection of appropriate intervention based on the risk assessed.[78] (**Refer to Appendix 5**)

Key message
Consideration for placement of fissure sealant in primary molar amongst patients with ECC is based on:

- caries risk assessment
- plaque control
- ability to isolate tooth effectively
- patient cooperation

5.10 Casein phosphopeptide-amorphous calcium phosphate

Casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) is a topical cream that is water-based and free of sugar. It contains milk protein derived from casein.

An RCT examining the effects of daily application of a 10% weight per volume (w/v) CPP-ACP paste combined with regular tooth brushing using a fluoride toothpaste, did not show any significant additional benefits in preventing tooth decay (caries) on high-risk pre-school children with primary dentition for a period of one year.[86] level I

Although there is insufficient evidence on the effectiveness of CPP-ACP in preventing caries in primary teeth, its use can be considered as an adjunct to brushing with fluoride toothpaste.

5.11 Other preventive agents

Non-fluoride agents such as xylitol, chlorhexidine, arginine-containing mint confections, and triclosan varnish have been used to prevent ECC.

A SR examining available non-fluoride agents in preventing ECC revealed that only one study supported the daily use of xylitol wipes in controlling caries. In another study in the same SR found that Arginine-containing mint confection and 0.3% triclosan varnish had the potential to reduce caries development in primary teeth but the evidence was at high risk of bias.[52] level I However, the results had to be interpreted with caution as the included studies did not specify statistical measures.

The AAPD only supports the use of xylitol for use as a non-cariogenic sugar substitute and not as a remineralizing agent in ECC.[87]

5.12 Water fluoridation

Water fluoridation, a public health initiative plays a crucial role in preventing early childhood caries.

The effectiveness of water fluoridation on deciduous dentition is well-documented in a Cochrane SR. The review found that fluoridated water:[88] level I

- reduced the prevalence of caries in children by 35% and reductions in dmft of 1.81 (95% CI 1.31 to 2.31)
- increased caries free children by 15% (95% CI 11% to 19%)

However, the primary studies were mostly conducted before 1975, a time before the widespread adoption of fluoride toothpaste and before other major shifts in oral health practices and public health measures.

The benefits of water fluoridation extend across all segments of a community, regardless of socioeconomic status. The Center for Disease Control and Prevention USA (CDC) has recognized water fluoridation as one of the ten great public health achievements of the 20th century, highlighting its role in significantly enhancing dental health across populations, including substantial benefits for children from low-income families.[89]

The WHO endorses water fluoridation as a safe and effective public health measure to prevent dental caries, provided that fluoride levels are maintained within recommended limits.[90]

In consideration of Malaysia's warm climate, which may elevate water consumption, the Ministry of Health Malaysia has established the fluoride concentration in public water supplies to be optimally maintained between 0.4 and 0.6 parts per million (ppm),[91] for effective caries prevention.

6.0 TREATMENT MODALITIES

The treatment modalities in ECC incorporates both non-invasive and invasive modalities thus ensuring a comprehensive approach and holistic care to this disease.

6.1 Non-Invasive Methods

The non-invasive methods are aimed at managing non-cavitated lesions. It is also sometimes used on cavitated lesions to arrest the caries where treatment cannot be done immediately.

6.1.1 Non-Fluoride Remineralising Agents

a. Hydroxyapatite

There has been a recent focus on biomimetic and bio-inspired agents for preventing dental caries. One such biomimetic agent is particulate hydroxyapatite (HAP), which is a calcium phosphate mineral. Hydroxyapatite is a similar component to human hard tissues such as teeth and bones. These agents aim to promote remineralization of dental hard tissues and inhibit their demineralization.

A recent RCT evaluating the effectiveness of daily use of 10% microcrystalline HAP toothpaste in preventing early childhood caries over a one year period, found that HAP was comparable to toothpaste containing 500 parts per million (ppm) fluoride.(92) level I However, in this study, higher concentrations of fluoride toothpaste (1000-1450 ppm) were not investigated.

6.1.2 Remineralizing Fluoride

a. Silver Diamine Fluoride

Silver diamine fluoride (SDF) is a colourless liquid containing silver particles and 38% (44,800 ppm) fluoride ion recently used in managing cavitated carious lesions.

In a meta-analysis of 4 good RCTs assessing the effectiveness of SDF (12-38% SDF) in controlling caries progression in primary teeth showed that SDF was more effective (RR=1.89, 95% CI 1.49 to 2.38) than other treatments (atraumatic restorative treatment (ART), 5% fluoride varnish or no treatment).(93) level I

According to AAPD 2023 (Fluoride Therapy), SDF is safe to use in children and adults when delivered in accordance to its dosing and application regime.(83)

Key Message
The patient/parent should be cautioned on the resultant dark discolouration of the carious teeth with the use of SDF.

b. Fluoride Varnish
Fluoride varnish on application in early carious lesions leads to release of fluoride ions that are absorbed into demineralized enamel leading to remineralization.

The SDCEP 2018 advocates non-restorative site-specific prevention to stop enamel caries from progressing and to promote remineralization. This is performed by effectively brushing the lesion with fluoridated toothpaste and dietary advice coupled with the application of fluoride varnish on the lesion four times a year. The site and extent of the lesion is to be recorded and monitored for progression.

In local setting, fluoride varnish is applied on non-cavitated lesions according to caries risk assessment of patients with ECC.

6.1.3 Fissure Sealant
AAPD Guidelines (2016) recommends the use of sealants in primary molars with non cavitated occlusal lesions.

6.1.4 Resin Infiltration
In the resin infiltration technique, tiny pores within the body of the carious lesions are infiltrated and sealed with resins. In a meta-analysis of four RCTs on the effectiveness of resin infiltration in preventing initial caries progression at 12-24 months follow-up showed that resin infiltration technique was significantly preventing initial caries progression in primary teeth with RR=0.434, 95% CI 0.311 to 0.605 compared with control groups.[(94) level I]

6.1.5 Sealing with Composite Resin
One small RCT compared caries sealing procedure using composite resin without caries removal versus partial caries removal for managing cavitated occlusal caries limited to 1.5 mm in diameter and outer half of the dentine in primary molars showed:[(95) level I]

- the sealing procedure had a significantly shorter chair time than the partial caries removal procedure (9.03 ± 1.91 vs 17.13 ± 5.26 min; p=0.002)
- at 24-month review, both treatment approaches had comparable outcomes in terms of hindering caries progression radiographically and preventing secondary caries occurrence.

Recommendation 16

- For non-invasive treatment of caries in early childhood caries:
  - silver diamine fluoride may be used to control caries progression in the primary dentition.
  - fluoride varnish should be applied according to caries risk assessment.
  - fissure sealant should be used in primary molars with non-cavitated occlusal lesions.
  - resin infiltration may be used on non-cavitated carious lesions.
  - sealing with composite resin may be considered for cavitated lesions limited to 1.5 mm in diameter and outer half of the dentine in primary molars.

6.2 Invasive Methods

6.2.1 Dental Caries Removal Technique

The removal of dental caries is crucial for treating ECC as it stops decay from spreading and preserves the affected tooth. The effectiveness of different approaches for dental caries removal has been studied on teeth with normal pulp or reversible pulpitis. Therefore, an accurate diagnosis of pre-operative pulpal status is critical to ensure a successful outcome.[92] There are three main methods for removing deep caries lesions and maintaining pulp health:[97,98]

a. **Stepwise excavation (SWE)** involves removing carious tissue in two stages:
   - first stage: complete removal of caries and decayed tissue around the edges of a cavity and leaving softened dentine close to the pulp, followed by a restoration
   - second stage: after a gap of several months, the cavity is reopened and more of the softened dentine is removed, followed by a final restoration.

b. **Selective caries removal (SCR)** involves the complete removal of decayed tissue around the edges of a cavity and leaving soft dentine close to the pulp, followed by a definitive restoration in one visit.

c. **Non-selective caries removal (NSCR)** is a conventional method that involves removing all carious dentin or complete caries removal.

An RCT comparing effectiveness between SWE versus SCR in primary molars among 72 children with deep carious lesions showed NS differences between the two groups in terms of success rates (absence of restorative/endodontic complications or pulp exposures) at 2 years follow-up after a composite restoration. The mean cost of treatment

was significantly higher (p<0.001) for SWE at 186 Euro (SD: 61 Euro) compared to SCR at 100 Euro (SD: 59 Euro).[(99) level I] However, this study was conducted on a small sample size.

A multicentre RCT which evaluated the effectiveness of NSCR and SCR on posterior deciduous teeth of children aged 4-8 years followed by composite resin restoration showed NS difference in terms of pulp vitality and survival rate of the adhesive restorations over a 33-month follow-up period. The study also found that there was NS difference in the risk of pulpal failure between the two techniques, and that the pulpal survival rates were similar for both (97.8% for NSCR and 96.5% for SCR). There were no differences in the failure risk according to the treatment group, center, and all the clinical and demographic variables, regardless of outcome.[(100) level I]

A Cochrane SR of eight RCTs found no difference in pulpal symptoms between SCR and NSCR after 12 months in primary teeth. However, there was a significant risk reduction of pulpal exposure in:[(101) level I]

- SCR compared to NSCR with RR=0.24, 95% CI 0.06 to 0.90
- SWE compared to NSCR with RR=0.31, 95% CI 0.17 to 0.57

The multicentre RCT[(100) level I] citation mentioned earlier also reported the specific technique used for SCR, which involved removing caries until leathery consistency was reached, while the Cochrane SR did not report the texture of the caries to which excavation was stopped. Despite these differences, both studies found that SCR can result in a significant reduction in the risk of pulpal exposure compared to NSCR.

Recommendation 17

- Selective removal of caries may be the preferred approach for managing deep caries lesions in vital primary teeth for early childhood caries.

6.2.2 Pulp Therapy

Pulp therapy is aimed at maintaining the vitality of the pulp in primary teeth with deep caries or preventing the spread of infection from the pulp into the periradicular tissues. Depending on the pre-operative status of the pulp, pulp therapy can be categorised into two types: vital pulp therapy and non-vital pulp therapy.

a. Vital Pulp Therapy

Vital pulp therapy (VPT) refers to three different treatment approaches used for primary teeth affected by deep caries with reversible pulpitis and without radiographic sign of infection or pathologic resorption. The goal of VPT is to maintain the vitality of the pulp and promote the overall health of the affected teeth. The specific type of VPT chosen depends

on factors such as the extent of caries removal and the size of the pulpal exposure. After performing either one of the three VPT procedures (**Refer Table 7**), the tooth is sealed with a durable restoration to prevent microleakage.

Table 7. Summary of three vital pulp therapy procedures.[102]

Vital Pulp Therapy	Indication	Procedure
Indirect pulp capping (IPC)	• A primary tooth with deep caries • Exhibits no pulpitis or with reversible pulpitis • Pulp is judged by clinical and radiographic criteria to be vital	Purposefully leaves the deepest caries adjacent to the pulp undisturbed to avoid pulp exposure. Subsequently, the caries- affected dentin is lined with a biocompatible protective liner.
Direct pulp capping (DPC)	• Primary tooth with a normal pulp following a small pulpal exposure of one millimeter or less • Exhibits normal pulp or reversible pulpitis • No radiographic signs of pathology	A small pulpal exposure of one milimeter or less during cavity preparation or following a traumatic injury is covered with a biocompatible pulp capping agent.
Pulpotomy	• When caries removal results in pulp exposure in a primary tooth • Exhibits a normal pulp or reversible pulpitis • No radiographic signs of pathology	The coronal pulp is amputated when caries removal results in pulpal exposure or after a traumatic pulp exposure. After hemostasis is achieved, a biocompatible material is placed over the remaining radicular pulp.

Adapted from: American Academy of Pediatric Dentistry. Pulp therapy for primary and immature permanent teeth. The Reference Manual of Pediatric Dentistry. Chicago, Ill.: American Academy of PediatricDentistry; 2021:399-407.

The success of VPT is indicated by the absence of any signs and symptoms clinically and radiographically following treatment. Factors that may influence the outcome of VPT are accurate pre-operative pulpal diagnosis, the practice of aseptic technique, adequate removal of infected dentine, and adequate sealing of the tooth with an appropriate restorative material.[103] level I

A meta-analysis of 41 RCTs determining the overall (clinical and radiographic) success rate of IPC, DPC and pulpotomy, regardless of

the medicament used in vital primary teeth with deep caries at 24-month review showed:[104]level I

- 94.4% for IPC (95% CI 84.9 to 98.0)
- 88.8% for DPC (95% CI 73.3 to 95.8)
- 82.6% for pulpotomy (95% CI 75.8 to 87.8)

Due to the lack of studies directly comparing these three interventions, no clear recommendation can be made regarding the superiority of any VPT. Therefore, the choice of pulp therapy in vital primary teeth with deep carious lesions should be guided by a biological approach to caries-affected dentine removal, the presence and extent of pulp exposure, reported adverse effects, clinical expertise, and patient preferences.[105] level I

Currently, there is insufficient evidence to directly compare the effectiveness of different types of VPT for vital primary teeth affected by deep caries. However, DG members believe that the choice of VPT intervention should be limited to either IPC or in the case of pulpal exposure is pulpotomy.

Recommendation 18

- The following treatment should be considered for deeply carious primary teeth with normal pulp or reversible pulpitis in early childhood caries:
  - indirect pulp capping
  - pulpotomy

Materials for Vital Pulp Therapy

i. Indirect Pulp Capping Agents

Studies comparing the effectiveness of various IPC agents showed NS difference in the success rate of IPC at a follow-up of:

- 12-months:
  - Calcium hydroxide versus MTA versus glass ionomer cement[106] level I
- 24-months:
  - Calcium hydroxide versus adhesive system versus resin modified glass ionomer cement[107] level 1
  - Calcium hydroxide versus bonding agent[104] level I
  - Dycal versus Biodentine versus Theracal LC[108] level I

Recommendation 19
- For indirect pulp capping amongst patients with early childhood caries, agents that may be used are Biodentine, calcium hydroxide, Theracal LC, Dycal, bonding agent liners, mineral trioxide aggregate, glass ionomer cement and resin modified glass ionomer cement.

ii. Pulpotomy Agents

The common agents used in pulpotomy of primary teeth are CaOH, MTA, formocresol and ferric sulphate (FS).

Calcium Hydroxide

A meta-analysis on pulpotomy of primary teeth reported that the success rates for MTA, formocresol and FS pulpotomies were all significantly better than CaOH pulpotomy at 24 months showed:[104] level I
- MTA versus CaOH pulpotomy (RR=1.96, 95% CI 1.52 to 2.53) from three RCTs.
- Formocresol versus CaOH pulpotomy (RR=1.76, 95% CI 1.40 to 2.23) from four RCTs.
- FS versus CaOH pulpotomy (RR=1.57, 95% CI 1.19 to 2.06) from two RCTs.

The quality of the included primary papers was of moderate risk of bias.

Mineral Trioxide Aggregate

Two meta-analyses comparing MTA and formocresol pulpotomy found statistically NS difference between the two agents at 24-month follow-up, in terms of success rates [104] level I and failure rates[109] level I among 2-13 years old children.

Formocresol

A Cochrane SR compared the effectiveness of two formocresol concentrations versus MTA used in pulpotomy at 24-months follow-up:[109] level I
- full strength formocresol (cresol 35% and formaldehyde 19%) versus MTA showed:
  - NS difference in clinical failures between the groups
  - significantly more radiological failure (RR=0.2, 95% CI 0.06 to 0.67) in the formocresol group
- 1:5 diluted formocresol versus MTA showed NS difference in clinical and radiological failures between the two groups

The overall quality of the evidence was of moderate certainty.

A more recent meta-analysis compared the effectiveness of formocresol pulpotomy versus CaOH pulpotomy. The findings at the 24-month follow-up showed CAOH pulpotomy had significantly higher clinical and

radiographic failure, respectively (RR=4.13, 95% CI 1.22 to 13.99 and RR=3.51, 95% CI 1.50 to 8.21). (103) level I

Due to concerns about the potential toxicity of formocresol, its usage in pulpotomy procedures has been discouraged, despite its clinical effectiveness being comparable to MTA. Nevertheless, two observational studies conducted on healthy children who underwent multiple pulpotomies under general anesthesia found that the use of formocresol as the medicament did not result in significant changes in plasma levels of formaldehyde or cresol during or after the procedures.(110) level III; (111) level III Based on the above observational studies, two other authors suggest that the amount of formaldehyde released during formocresol pulpotomies does not pose significant health risks to children.(112) level III; (113) level III

AAPD recommends only MTA and formocresol as the medicament of choice for teeth expected to be retained for 24 months or more.(100)

Key Message
Formocresol should be used by applying 1:5 diluted formocresol for 1 to 3 minutes on the exposed pulp.

Ferric Sulphate
Two meta-analyses assessed the effectiveness of MTA versus ferric sulphate (FS) as pulpotomy agents and found NS difference in terms of clinical and radiological outcomes at 24-months.(109) level I; (104) level I However, Coll et al. (2017) reported that MTA had a significantly better number needed to treat (NNT= 9).(102) level I

Biodentine
Two meta-analyses comparing the effectiveness of MTA versus Biodentine as pulpotomy agents found NS difference in terms of clinical failure(109) level I, radiological failure(109) level I and overall success(109) level I at the 12-month review.

Recommendation 20
- For pulpotomy amongst patients with early childhood caries:
  - mineral trioxide aggregate and formocresol should be used as pulpotomy agents.
  - Biodentine and ferric sulphate may be considered as pulpotomy agents.
  - calcium hydroxide should not be used.

b. Non Vital Pulp Therapy
In cases where a carious lesion in primary teeth leads to irreversible

inflammation or necrosis of the pulp, a root canal procedure may be necessary to preserve the tooth and restore oral health while maintaining space integrity of the arch. Two non-vital pulp therapy (NVT) options are commonly used: pulpectomy and Lesion Sterilisation and Tissue Repair (LSTR)[114] level I (**Refer Table 8**). These treatments aim to reduce the bacterial load within the root canal and prevent the infection from spreading into the surrounding tissues. After both pulpectomy and LSTR procedures, the treated tooth is restored with a definitive restoration that effectively prevents microleakage. The success of NVTs is indicated by the absence of any signs and symptoms clinically and radiographically following treatment.

Table 8. Non Vital Pulp Therapy

Non Vital Pulp Therapy	Procedure
Pulpectomy	• Involves mechanical and chemical debridement of the root canal, followed by obturation with a resorbable root canal filler.
Lesion Sterilisation and Tissue Repair (LSTR)	• Employs placing an antibiotic mixture in the pulp chamber, often without instrumentation of the root canals. • The antibiotic mixture commonly contains metronidazole, minocycline, and ciprofloxacin, and some mixtures may replace the minocycline with other non-tetracycline antibiotics.

i. Pulpectomy

The success of pulpectomy is dependent on the pre-operative root status and the choice of root canal fillers. Two meta-analyses assessed these factors below in terms of:

- Pre-operative root status:
  There was a significantly higher success rate for teeth without pre-operative root resorption than those with root resorption at 24-months (88% versus 59%; $p< 0.001$) based on two RCTs.[114] level I
- Root canal fillers:
- zinc oxide-eugenol (ZOE) versus CaOH:
  - There was no statistically significant difference in the radiological failure and pain between ZOE and CaOH at 6-months based on two RCTs.[109] level I
  - However, ZOE was found to have significantly higher success rate than CaOH at 12-months based on only one RCT (RR=1.36, 95%CI 1.19 to 1.57; NNT=4).[114] level I
- ZOE versus CaOH plus iodoform:

- There was NS difference in the success rates between ZOE versus CaOH plus Iodoform (Metapex and Vitapex). However, ZOE had a significantly better NNT of 12.(114) level I
- In another meta-analysis, when ZOE was compared to Metapex and Vitapex separately, there was NS difference in terms of the overall failure at 12-months between the groups.(109) level I

○ ZOE versus Endoflas
- There was NS difference in the success rates using ZOE versus Endoflas (a combination of ZOE, iodoform and CaOH) at 18-months.(114) level I

○ Endoflas versus CaOH plus iodoform
- There was NS difference in the success rates between Endoflas versus CaOH plus iodoform at 18-months but Endoflas had a significantly better NNT of 7.(114) level I

With regard to other factors, there was NS difference in the success rate of pulpectomy in terms of:(114) level I

- the method of obturation (lentulo spiral versus hand pluggers versus syringe)
- the number of visits (single versus two visits)
- the method of root length determination (apex locator versus radiographs)
- the type of irrigants used (NaOCl only versus NaOCl and saline)

Key Messages
For carious teeth within six months of exfoliation, both ZOE and CaOH can be used as fillers for pulpectomy.

ii. Lesion Sterilization Tissue Repair

A SR comparing the overall success of LSTR versus pulpectomy in primary teeth with deep caries at a 12-month follow-up reported that treatment outcomes were influenced by the presence of external or internal root resorption:(112) level I

- When root resorption was present, LSTR had a significantly higher success rate than pulpectomy (76% vs 47%; RR=1.65, 95% CI 1.31–2.08).
- When root resorption was absent, there was NS difference in success between LSTR and pulpectomy (65% vs 92%). Nevertheless, when the tooth is anticipated to remain in situ for more than 12 months, cases treated with LSTR should be carefully monitored for potential signs of failure, with follow-up recommended at least annually.

The same SR reported that success of LSTR was not influenced on whether root canals were instrumented prior to placement of the antibiotic mixture.

However, the included studies were of low to moderate quality of evidence.

Key message
For teeth treated with LSTR that are expected to remain in situ for more than 12 months, close monitoring is recommended, with follow-up assessments at least annually to detect any signs of failure.

Traditionally, pulpectomy has been indicated for carious primary teeth exhibiting signs of irreversible pulpitis. However, emerging evidence suggests that pulpotomy may represent a conservative alternative for such cases.[115] When irreversible inflammation is confined to the coronal pulp, tooth vitality may be maintained by preserving healthy radicular pulp via pulpotomy.

Despite these promising signals, stronger evidence—specifically, larger, well-designed randomised clinical trials with longer follow-up, is needed to substantiate the effectiveness of pulpotomy for primary teeth with irreversible pulpitis. Moreover, long-term outcomes are likely influenced by rigorous case selection, strict aseptic protocols, and operator experience, among other factors.

In view of these considerations, the DG members opine that primary teeth with irreversible pulpitis are best managed with non-vital pulp therapy modalities, or referred to a paediatric dental specialist when appropriate.

Recommendation 21
- For teeth with irreversible pulpitis or necrotic pulp in children with early childhood caries:
  - Pulpectomy and Lesion Sterilisation Tissue Repair may be considered when pre-operative root resorption is absent
  - Lesion Sterilisation Tissue Repair may be considered when pre-operative root resorption is present
  - Endoflas, zinc oxide-eugenol and calcium hydroxide plus iodoform may be considered as pulpectomy fillers

6.3 Restorative Material

Choosing an appropriate restorative material is crucial for the treatment of carious primary teeth to halt caries progression, prevent the development of secondary caries, and restore the tooth's function. Material selection is influenced by factors such as lesion extent, operative technique, and the cooperation of the child and parents. A restoration is considered successful when it does not require repair or replacement within a specified follow-up period for the restorative material used.

6.3.1 Direct Restorations

Composite resin is a technique-sensitive material that requires strict moisture control for the longevity of the restoration. When bonded correctly, composite resin's adhesive and sealing capability allows for a more conservative approach to cavity preparation, thus preserving tooth structure.

Glass ionomer cement (GIC) is an adhesive material that bonds chemically to tooth structure, and its placement is less technique-sensitive and less time-consuming than composite resin. This makes GIC an alternative to composite resin when patient compliance is limited. The two commonly used GICs are the conventional GIC and resin-modified GIC (RMGIC) (**Refer Table 9**).

Table 9. Type of GIC and Its Characteristics[116]

Type of GIC	Advantages	Disadvantages
Conventional GIC	• Adhesive • Aesthetic • Fluoride releasing	• Brittle • Susceptible to erosion and wear • Technique sensitive
High-viscosity GIC	• Adhesive • Aesthetic • Fluoride releasing • Simple to handle • Higher compressive strength and wear resistance than conventional GICs	• Water absorption • Colour not as good a match as composite resins, compomers and other GICs • Mechanical properties improving and approaching those of compomers or composites
RMGIC	• Adhesive • Aesthetic-better translucency than conventional GICs • Fluoride releasing • Command set • Simple to handle	• Water absorption • Significant wear • Technique sensitive

Adapted from Handbook of Pediatric Dentistry by Angus C Cameron and Richard P Widmer, Fifth Edition, [114 level III]

A SR examining the clinical performance of GIC versus other direct restorations in carious primary molars showed:[117] level I

- in Class II restorations, RMGIC performed significantly better than composite resin in preventing secondary caries (RD=0.06, 95% CI

0.02 to 0.11) based on the meta-analysis of nine moderate-quality RCTs.
- NS difference was observed between GIC (conventional and RMGIC) versus composite resin in Class II cavities regarding:
  - quality of marginal adaptation
  - marginal discoloration
  - anatomic form

A network meta-analysis (NMA) of 17 RCTs in Class I and Class II restorations showed that conventional GIC exhibited significantly higher risk of failure compared to:(118) level I
- RMGIC (RR=3.25, 95% CI 1.58 to 7.96)
- composite resin (RR=3.27, 95% CI 1.55 to 8.13)
- compomer (RR=2.64, 95% CI 1.29 to 6.27)
- amalgam (RR=2.25, 95% CI 1.17 to 5.35)

There was NS difference in the clinical performance between RMGIC, composite resin, compomer, and amalgam. However, RMGIC (0.4472) ranked the lowest in the probability of failure, followed by composite resin (0.4358), compomer (0.0898), and amalgam (0.0265), whereas conventional GIC (0.0005) had the highest probability of failure.

In a small RCT comparing clinical performance of composite strip crowns (SCs) and zirconia crowns (ZCs) on primary maxillary incisors affected by early childhood caries over 18 months follow-up showed:(119) level I
- ZCs had better performance ($p< 0.05$) in terms of retention, restoration failure and colour match.

However, NS difference in terms of secondary caries, pulpal and gingival health.

Despite this finding, DG members opine that composite SCs may be a viable treatment option for multi-surface lesions of primary anterior teeth.

Atraumatic Restorative Treatment (ART) is a minimally invasive technique to restore and prevent the progression of caries in populations with little access to conventional dental treatment. The technique involves caries excavation using hand instruments followed by restoration with various restorative materials, whereas in conventional treatment, rotary burs with or without hand instruments are used for caries removal.

An umbrella review investigating the performance of ART with high-viscosity GIC (HVGIC) showed:(120)
- at one year follow up, the ART technique on single-surface lesions, had a higher success rate (95-100%) than on multi-surface lesions (73-100%)

- at three year follow up, the ART technique on single-surface lesions had a higher success rate (86%) than in multi-surface lesions (48.7-88%)

The umbrella review covers 18 SRs with a weak Corrected Covered Areas (CCA) while the primary studies were mainly high risk of bias.

A Cochrane SR compared the restoration failure of ART versus conventional method using the same restorative material in both arms in primary dentition reported:[121] level I

- at 12-24 months follow up, using HVGIC showed a higher risk of failure in the ART group when:
  - all types of cavity surfaces were combined (OR=1.60, 95% CI 1.13 to 2.27)
  - applied in multi-surface cavities (OR=1.62, 95% CI 1.03 to 2.55)
- at 24 months follow-up, there was NS difference between both groups using composite resin in multi-surface lesions.

However, the included primary papers in this study were of high risk of bias and low quality.

Based on a qualitative analysis from a SR, besides the type of restorative materials, other factors that affected the longevity of direct restorations in carious primary teeth were:[122] level I

- number of tooth surfaces involved:
  - Class I restorations had a higher success rate (92.4%) compared with Class II (85.3%), irrespective of the filling material
- rubber dam isolation:
  - restorations placed under rubber dam showed better success rate (93.6%) versus without rubber dam (77.5%)

Dental amalgam is a clinically well-proven and durable filling material. However, concerns regarding mercury's effect on the environment have led to the increasing use of mercury-free alternative material. Based on environmental concern, the Malaysian Dental Council supports a gradual phase-down in the use of amalgam.[123]

Key Message
In ECC, alternative restorative materials should be prioritised over amalgam.

6.3.2 Indirect Restoration

Primary molar crowns function to strengthen weakened teeth and offer a longer-lasting restoration compared to direct fillings. These crowns are prefabricated and made from stainless steel, referred to as preformed metal crowns (PMCs) or stainless steel crowns (SSCs). Additionally, aesthetic crowns made of white ceramic material are also

an option. Depending on the preparation of the affected tooth, there are two methods of crown placement (**Refer Table 10**).

Table 10. **Crown Placement Technique**

Crown Placement Technique	Procedure
Conventional Technique	Involves caries removal and tooth reduction under local anaesthetic before the crown is placed.
Hall Technique	Involves cementation of the crown without local anaesthetic, carious tissue removal or tooth reduction. Thus, essentially sealing the caries underneath the crown.

Invariably, studies evaluated the outcome of preformed crowns by conducting clinical and radiographic examinations to identify the presence of signs and symptoms indicative of pulpal and periapical pathology, which are recognised as major failures.

Three SRs comparing the performance of preformed crowns versus direct filling materials for primary molars with caries or following pulpal treatment, reported favorable outcomes for crowns as follows:

- based on three RCTs with a follow-up between 12-48 months, crowns had a significantly lower risk of major failure than fillings (RR=0.18, 95% CI 0.06 to 0.56).(124) level I
- based on two RCTs with a follow-up between 12-24 months, crowns were less likely to cause pain than direct fillings (RR=0.15, 95% CI 0.04 to 0.67).(124) level I
- SSCs exhibited the highest success rate (96.1%) compared to various direct fillings (RMGIC, compomer, conventional GIC, amalgam, composite resin) in Class I and II cavities for at least six months after intervention.(122) level I
- based on a network comparison of two RCTs on vital teeth with deep caries, the Hall Technique had the highest probability (78%) for the best clinical outcome compared to NSCR and SCR with direct restorations.(125) level I

In regards to the crown placement technique between the conventional versus the Hall Technique in multi-surface carious primary molars, two small RCTs provided moderate-quality evidence that showed:

- comparable clinical and radiographic outcomes between the two techniques.(126, 127) level I
- significantly shorter treatment time with the Hall technique ($p < 0.01$):
  - 4.5652 min ± 1.47 versus conventional technique 28.26 min ± 17.04(125) level I
  - 8.4 min ± 4.9 versus conventional technique 17.3 min ± 5.1(124) level I

- the decrease in canine overbite associated with the Hall Technique had significantly resolved (p<0.001) and the occlusion re-established between the 3-month and 12-month follow-up periods.(126) level I

According to SDCEP, Hall technique is recommended for advanced proximal caries in primary molars without clinical or radiographic signs of pulpal involvement.(55)

The CPG DG opines both Hall Technique or the conventional technique are acceptable methods for crown placement. However, Hall Technique may be the technique of choice due to reduced chair time and to avoid iatrogenic damage to adjacent teeth.

Key Messages
According to SDCEP, for a child with a carious lesion in a primary tooth, choose the least invasive, feasible caries management strategy, taking into account:SDCEP, 2018
- the time to exfoliation
- the site and extent of the lesion
- the risk of pain or infection
- the absence or presence of infection
- preservation of tooth structure
- the number of teeth affected
- avoidance of treatment induced anxiety.

Recommendation 22
In early childhood caries:
- resin-modified glass ionomer cement, composite resin and compomer may be used for Class I and II cavities.
- atraumatic restorative treatment with high-viscosity glass ionomer cement may be used in Class I cavities when patient cooperation or treatment resources are limited.
- for multi-surface cavities and following pulpal treatment, preformed crowns should be considered over direct fillings.
- Hall Technique may be considered for advanced proximal caries in primary molars.

6.4 Extraction and Space Maintenance
6.4.1 Extraction
Extraction of primary teeth is one of the treatment options in managing children with S-ECC although the clinician should try to avoid dental extractions during the child's first visit. The decision to extract should only be made after considering both general and local factors below.(46)

i. General factors
- Patient's cooperation
- Medical condition
- Dental infection - may increase patient's morbidity

ii. Local factors
- Restorability
- Extent of caries which may involve the pulp and roots
- Potential for malocclusion of disturbances in development of the dentition, extractions may be considered

a. Effect of Premature Loss of Primary Teeth

Premature loss of primary teeth has been considered an oral health problem. These may lead to various complications as listed below.

i. Malocclusion

In a SR with 25 observational studies assessing the consequences of developing dentition following premature extraction of primary teeth (PEPT) showed:(128) level II-2
- increase frequency of at least one feature of malocclusion (maxillary overjet ≥6 mm, Class II or III malocclusion of at least half unit, space discrepancy of at least 2 mm)
- increase frequency of crowding in the permanent dentition
- space loss on the affected side of the arch
- the loss of lower primary canines bilaterally led to reduced arch perimeter

A meta-analysis assessing the effect of premature loss of primary teeth (PLPT) in children of mixed dentition on the prevalence of malocclusion in permanent dentition, provides evidence for an increase in malocclusion following PLPT specifically for Class III malocclusion. It also showed an increase in Class I and Class II malocclusion following early loss of primary teeth, however statistical significance was not observed.(129) level I

ii. Need for Orthodontic Treatment

In a case control study investigating association of PEPT with orthodontic needs noted an increase of total number of teeth extracted led to a significant increase in orthodontic need with OR=1.18, 95% CI 1.01 to 1.37.(153) level II-2

iii. Phonation

It is known that teeth play an important role during the production of certain speech sounds. Consequently, loss of anterior teeth may result in speech disorders, characterised by difficulty of articulating words such as distortion, omission and substitution.

A meta-analysis evaluating the consequences in children's speech and arch integrity following premature loss of primary anterior teeth compared to those without premature losses, found that children's phonation significantly had higher risk of distortion and interdental lisping RR=2.06, 95% CI 1.21 to 3.5. However, the included primary papers were of high heterogeneity I^2=83%. The same study found NS differences between the two groups in terms of speech omission and substitution.(130) level II-2

b. Balancing and Compensating Extraction

The effects of PEPT is an important consideration when discussing treatment options for carious teeth in the primary and mixed dentitions.

According to Royal College of Surgeons England 2006 (RCSEng) balancing extraction is defined as the removal of a tooth from the opposite side of the same arch, designed to minimise centreline shift, whilst compensating extraction is the removal of a tooth from the opposing quadrant to the enforced extraction. Radiographic screening is desirable before extracting primary molars to check for the presence, position and correct formation of the crowns and roots of successional teeth. Compensating extraction are never considered in the primary dentition. For balancing, RCSEng recommendations are summarised in the table below:(131)

Dentition	Situation	Balancing Extraction
Primary canines and primary first molars	Crowded dentition	Considered
	Centreline shift with spacing remaining mesial to the extraction site	Monitor for tooth movement and seek orthodontic assessment
	Centreline shift with complete space closure	Delay until orthodontic assessment
	No centreline shift	Not indicated
Primary incisors	Not indicated	
Second primary molars	Not indicated	

6.4.2 Space maintainer

Premature loss of deciduous teeth increases malocclusion and crowding and leads to space loss and reduction in arch perimeter.(128) Primary teeth are considered the best space maintainer under normal physiological conditions.(132) However, in cases with premature loss of primary teeth, space maintainers are applicable dental devices specifically designed to maintain or to create an additional space that was lost due to premature loss of primary teeth.(133)

There are several types of space maintainers and it can be designed as fixed (unilateral or bilateral) or removable. This table below is adopted from Watt et al., 2018, modified by the DG members (**Refer Table 11**).[134]

Table 11. Different types of space maintainers designed as fixed or removable

Different types of space maintainers	
Fixed	
Unilateral	**Bilateral**
Band and loop (BL)	Nance
Crown and loop (CL)	Transpalatal arch (TPA)
Distal end shoe (DES)	Lingual arch (LLA)
Direct bonded (DB)	
Glass fiber reinforced composite resin (GFRCR)	
Removable	
Hawley appliance (modified)	
Removable partial dentures (RPD)	
Pressure formed retainers (PFR)	

In a recent meta-analysis of RCTs with high risk of bias, comparing fibre reinforced composite resin (FRCR) with band and loop (BL) space maintainer in children aged 3-12 years old who had premature loss of primary molars showed NS difference in terms of failure rate at 6 months and 12 months.[135] level I

In another meta-analysis comparing the survival rate (6 to 18 months) of BL space maintainer in children less than 10 years with:[136] level I

- FRCR and crown and loop (CL) showed NS difference
- direct bonding (DB) showed a significant difference, with a tendency to use the BL (RR=0.5, 95% CI 0.32 to 0.8).

However, included RCTs were of high risk of bias.

An RCT comparing the effectiveness of space maintenance of the deciduous second molar using a vacuum-formed passive appliance (VF) and BL found that there was significant reduction in the mesiodistal width of the extraction space (mean= -0.32, 95% CI -0.53 to -0.10) in the VF group during the first three months (T1-T0), which was significantly greater than in the banded maintainers with mean (-0.01) and 95% CI -0.15 to -0.13. In the last observation period 3 - 6 months after installation (T2-T1), NS extraction space change was observed. However, although space loss was statistically significant, it was restricted to the first trimester and was not clinically significant (0.3 mm).[137] level I

In a small RCT assessing the effectiveness of conventional BL with modified space maintainers among patients with freshly extracted single primary molars bilaterally at 9 months follow up in terms of:[138] level I

- gingival health of abutment tooth using Loe and Sil index showed bonded loop, bonded tube loop and conventional tube loop had significantly healthier gingiva ($p<0.05$)
- survival time showed NS difference between all the groups

There are few factors to be considered prior to construction of a space maintainer:

- adverse effects associated with space maintainers include:
  - dislodged, broken, and lost appliances
  - plaque accumulation
  - increase in microorganisms and increase in periodontal index scores
  - caries
  - damage or interference with successor eruption
  - undesirable tooth movement
  - inhibition of alveolar growth
  - soft tissue impingement
  - pain

To aid clinicians in deciding when and how to space maintain, refer to table below. However, practitioners may refer for specialist orthodontic opinion for the need of provision of a space maintainer and assessment of the developing malocclusion, whenever in doubt.[134]

Premature loss of tooth	Situation	Space maintainer	Types of space maintainer
E	Bilaterally with 6s fully erupted	Indicated	Upper: TPA or Nance Lower: Lingual arch
	Unilaterally with 6s fully erupted	Indicated	Upper/lower: BL, GFRCR or DB
	Unilaterally with 6s unerupted or partially erupted	Indicated	Distal end shoe
D	Well aligned arch	Not indicated	
	Severe crowding (>3.5mm) per quadrant	Indicated	BL, CL
A,B,C		Usually not indicated	

Key Message
Selection of the space maintainers depends on several factors. These factors to consider space maintenance when primary teeth are loss prematurely among patients with ECC:[132]

- specific tooth lost
- time elapsed since tooth loss
- occlusion and space assessment
- dental age
- dental arch involved
- status of the teeth adjacent to the lost teeth
- presence and root development of permanent successor
- amount of alveolar bone covering permanent successor
- patient's health history and medical status
- patient's cooperative ability
- active oral habits
- oral hygiene

Recommendation 23
Space maintainer may be considered in cases with premature extraction of primary tooth as indicated in children with early childhood caries.

6.5 Sedation and General Anaesthesia

Behaviour guidance techniques are used to alleviate anxiety, nurture a positive dental attitude, and perform quality oral health care safely and efficiently for infants, children, adolescents, and persons with special health care needs (SHCN). A selection of pharmacological and non-pharmacological behaviour guidance techniques can be utilized to meet the needs of the individual patient based on the skills of the practitioner.[140] Very young and uncooperative children with ECC who cannot be managed at the chair side (CS) can be managed under sedation or general anaesthesia (GA) which are the pharmacological options available.

a. Conscious Sedation

A technique in which the use of a drug or drugs produces a state of depression of the central nervous system enabling treatment to be carried out, but during which verbal contact with the patient is maintained throughout the period of sedation. The drugs and techniques used to provide conscious sedation for dental treatment should carry a margin of safety wide enough to render unintended loss of consciousness unlikely. The level of sedation must be such that the patient remains conscious, retains protective reflexes, and is able to understand and to respond to verbal commands.[55]

Sedation either can be given by anaesthesiologist or non-anaesthesiologists. When performed by non-anaesthesiologists, the level of sedation should be kept at minimal to moderate. Deep sedation must be carried out by an anaesthesiologist or a physician with expertise in airway management.

Generally, the goals of sedation in the paediatric patients:[141]

- to guard the patient's safety and welfare
- to minimize physical discomfort and pain
- to control anxiety, minimize psychological trauma, and maximize the potential for amnesia.
- to modify behaviour and/or movement so as to allow the safe completion of the procedure
- to return the patient to a state in which discharge from medical/ dental supervision is safe, as determined by recognized criteria.

The advantages to both patients and the operating dentists are as follows:[142]

Advantages for child patient	Advantages for the dentists
• Reduce fear and perception of pain during the treatment • Facilitate coping with the treatment • Prevent development of dental fear and anxiety	• Facilitate accomplishment of dental procedures • Reduce stress and unpleasant emotions

Indications for sedation in dentistry:[55]

- dental anxiety and phobia
- a need for prolonged or traumatic dental procedures
- medical conditions potentially aggravated by stress
- medical or behavioural conditions affecting the patient's ability to cooperate
- special care requirements

Full assessment of patient's medical and dental history prior to sedation is vital to determine suitability and comprehensive treatment plan. In local settings, patients who are ASA Class I or Class II may be considered candidates for conscious sedation as outpatients. However, patients who are in ASA Class III and Class IV with special problems and require individual consideration shall be treated in a hospital environment, involving the assistance of anaesthetist or trained medical doctors.

- **Techniques**

Selection of the techniques and drugs in conscious sedation will depend on the availability of the drugs, the equipment at the premises and the knowledge and expertise of the operator in handling both.

Table 12 is the list of the routes of administration and drugs being used for sedation in paediatric dentistry as reviewed by group of anaesthetists. They concluded that knowledge of medications and the ability to address over sedation and side effects is essential for safe and effective outpatient procedural sedation.[143]

Table 12: Routes of administration and drugs in paediatric dental sedation

Routes of administration	Drugs
Inhalation	Nitrous Oxide and Oxygen, Sevoflurane
Intravenous/Intramuscular	Midazolam, Ketamine, Propofol, Hydroxyzine, Fentanyl, Sufentanil
Oral	Midazolam, Chloral Hydrate, Hydroxyzine, Promethazine
Rectal	Midazolam
Intranasal	Midazolam
Transdermal	Fentanyl
Transmucosal	Fentanyl

- **Drugs**

A recent Cochrane SR with 30 RCTs evaluated varieties of drugs, combinations of drugs and methods of delivery used in sedation for paediatric dentistry.[144]

- In terms of effectiveness in patient's behaviour:
  - six RCTs showed significant improvement with oral midazolam (0.25 mg/kg to 1 mg/kg) (SMD=1.96, 95% CI 1.59 to 2.33) as compared to placebo.
  - one RCT showed significant improvement with intravenous midazolam (SMD=1.21, 95% CI 0.24 to 2.18) as compared to placebo.
  - two RCTs showed significant improvement with nitrous oxide (20-50%) (SMD=0.69, 95% CI 0.13 to 1.26) as compared to placebo.
  - one RCT showed significant improvement with intramuscular Meperidine (RR= 5.33 95% CI 1.45 to 19.64) as compared to placebo.

- one RCT showed no significant difference between diazepam and placebo.
- one RCT showed no significant difference between with chloral hydrate combined with nitrous oxide as compared to nitrous oxide.

- In terms of safety associated with adverse effect:
  - chloral hydrate combined with nitrous oxide specifically had airway issues especially with high doses (> 50 mg/kg).
  - meperidine may cause nausea, vomiting and unmanageable behaviour.
  - oral midazolam may cause vomiting/hiccupping or amnesia.

However, the included studies were low to moderate level of certainty which may be due to limitations in inconsistency or imprecision of results.

EAPD recommends oral Midazolam 15-20 minutes before procedure for children undergoing dental treatment with dosage of 0.3 - 0.5 mg/kg for children under 25 kg and 10-12 mg for children more than 25 kg.[142]

Key Messages

Criteria for conscious sedation in ECC management:

- Procedure complexity - moderately invasive and potentially painful
- Suitable patients - medically stable, mild to moderate anxiety
- Competent operator- trained in sedation for paediatric patient
- Suitable facility - reliable emergency response system
- Adequate monitoring throughout procedure

Recommendation 24

- For patients requiring conscious sedation, the use of Oral Midazolam for the procedure may be considered for management of patients with early childhood caries.

b. General Anaesthesia

General Anaesthesia (GA) is a medical procedure defined as a controlled state of drug induced loss of consciousness during which patients cannot be aroused, even by painful stimuli, and lose their protective reflexes.[145]

Comprehensive dental treatment (CDT) under GA is one of the options in rehabilitation treatment for children with ECC. CDT consists of all treatment needs for the patients to achieve optimal dental well being.

A cross sectional study done in children aged 1–6 years in 2 periods of time (2002–2006 and 2007–2011) found dental rehabilitation under GA was done most in:[146] level III

- children with high caries experience associated with young age (OR=4.04, CI 95% 2.81 to 5.27)
- children with high caries experience associated with migration background (OR=4.26, 95% CI 0.89 to 7.62)

The CPG DG opines the main reasons for children with ECC indicated for CDT under GA are summarised as below:

- young patients
- uncooperative patients
- extensive dental treatment required
- children with healthcare needs
- parents' unwillingness to do behavioural control methods,
- better quality of work
- reduction in the number of treatment session
- preventing psychological trauma to patients
- deterring physical trauma due to uncooperativeness

The main advantage of dental treatment of ECC under GA using Early Childhood Oral Health Impact Scale (ECOHIS) questionnaire showed significant improvement (p<0.001) on Oral Health Related Quality of Life (OHRQoL) post treatment as reported in these studies.

- A prospective and longitudinal study in preschool children at 4 weeks follow up showed significant reduction (p<0.001):[147] level II-2
  - in child impact score with large effect size of 0.8
  - in family impact score with large effect size of 0.6
- A local prospective study in children at 6 months follow up also found significant reduction (p<0.001):[148] level II-2
  - in child impact score with large effect size of 0.82
  - in family impact score with large effect size of 0.74

Until 2015, Cochrane SR did not uncover compelling evidence to conclusively determine the choice between general anaesthesia and sedation for the management of ECC in children in terms of both morbidity and treatment effectiveness.[149] level I

A study in USA on cost effectiveness of treating S-ECC in GA compared to CS reported:[150]

- the average cost of treating S-ECC per child under GA is higher versus CS in 2011 (difference of $2,482) and 2015 (difference of $ 3,667) respectively
- in 2011, the Incremental Cost Effective Ratio (ICER) for GA treatment versus CS was $596 gained per caries-free month within a 2-year time horizon. In 2015, this ICER had increased to $881 per caries-free month. ICER measures the additional cost per unit of effectiveness gained.
- on average, each child treated under GA gained an additional 4 caries-free months over the 2 year time horizon.

Recommendation 25

- Comprehensive dental treatment (CDT) under General Anaesthesia should be considered as one of the options in rehabilitation treatment for children with early childhood caries.

7.0 REFERRAL

Most of the severe ECC cases are referred to paediatric dental specialists from primary care dentists, private practitioners and paediatricians.

Key Messages
Consideration for referral of an ECC case to paediatric dental specialist should be taken:

- after failure to provide care using non pharmacological behaviour technique
- due to the medical status of the child patient
- based on complexity of the treatment

8.0 FOLLOW-UP

A follow-up or recall appointment in dentistry is a crucial visit for patients previously assessed as having good oral health to monitor, offer preventive care, and tackle any new issues early. Recall appointment is an important session for routine oral examination to reinforce oral education, continue the preventive measures, detection of new caries lesions or other anomalies and assess the success of the treatment rendered.[151]

A small longitudinal study comparing effectiveness recall strategy for children after rehabilitation under general anaesthesia at 3 monthly versus 6 monthly showed:[152 level II-2]

- reduction of caries risk in the 3 month recall group (p=0.021)
- NS difference in new caries incidence in both groups

The recall strategy includes dental examination, caries risk assessment, prophylaxis, topical fluoride varnish and motivation interviewing were performed for both groups during recall visits. However, the study duration was short.

There is no good quality retrievable evidence for specific follow up. The CPG DG opines that for high-risk ECC children or those with active caries, a 3-month recall is advised for close monitoring and early intervention while children at lower risk may be seen every 6 months, allowing for effective, albeit less frequent, preventive care and monitoring.

According to AAPD 2022, 6 monthly dental check up was generally recommended for all children.[151] Despite that, in 2023 the AAPD recommended using risk assessment to set the frequency of recall visits, suggesting every 3 months for children at high risk and every 6 months for those at lower risk. Care strategies are tailored according to each child's risk of caries (**refer Appendix 5**), age, and compliance with preventive measures, directing the timing of follow-ups and preventive actions.

Key Messages

To ensure the effectiveness of follow-up appointments for ECC, the following tasks should be performed:

- to reinforce oral hygiene and dietary habits.
- to continue the preventive measures regularly.
- to ensure a comprehensive dental record and new care plan according to the needs.
- to check the success of previous treatment such as restorations and fissure sealants.
- to monitor caries control or progression of early lesions including radiograph if necessary.

Recommendation 26

- Patients with early childhood caries should be followed up every:
  - 3 monthly for high caries risk
  - 6 monthly for moderate risk
  - 6 to 12 monthly for low caries risk

9.0 IMPLEMENTING THE GUIDELINES

It is important to standardise the management of early childhood caries at all healthcare levels in Malaysia using an evidence-based CPG in order to manage it appropriately. Clinicians are required to keep abreast with knowledge through continuing professional education as well as understanding of patients' expectations.

Therefore, it is important for these guidelines to be disseminated to all healthcare professionals in primary and secondary healthcare facilities. This can be facilitated through the development of appropriate training modules and quick references. Several factors may affect the implementation of the recommendations of the CPG.

9.1 Facilitating and limiting factors

Existing facilitators for the application of the recommendations in the CPG include:

a. wide dissemination of the CPG to healthcare professionals and teaching institutions via printed and electronic copies
b. continuing professional education on the management of early childhood caries for healthcare professionals
c. adequate facilities at the primary and secondary care level for diagnosing and treating early childhood caries

Existing barriers for the application of the recommendations of the CPG include:

a. lack of understanding or limited knowledge on the management of early childhood caries
b. variation in skills and treatment practices
c. constraints in equipment and facilities

9.2 Potential resource implication

To implement the CPG, there must be strong commitment to:

a. ensure widespread distribution of the CPG in hard and soft copy to healthcare professionals in primary and secondary healthcare facilities
b. strengthen training of healthcare professionals to ensure knowledge and information are up to date
c. empower the funding of consumables purchasing in managing early childhood caries

9.3 Proposed Clinical Audit Indicators

To assist in the implementation of the CPG, the following are proposed as clinical audit indicators for quality management of early childhood caries:

Percentage of caries free children under six years of age at primary dental clinic Target: ≥30%	Total number of children under 6 years with caries free at 6-month follow-up at the primary dental clinic ——————————— Total number of children under 6 years attending 6-month follow-up at the primary dental clinic	X	100%

Appendix 1

EXAMPLE OF SEARCH STRATEGY

Clinical Question: What are the effective and safe treatments for ECC?

- Pulpotomy

Database: Ovid MEDLINE(R) ALL <1946 to January 31, 2024>

1. Dental Caries/ (50857)
2. (caries, dental or carious dentin or carious dentins or carious lesion or carious lesions or cavities, dental or cavity, dental or decay, dental or dental caries or dental cavities or dental cavity or dental decay or dental white spot or dental white spots or dentin, carious or dentins, carious or lesion, carious or lesions, carious or spot, dental white or spots, dental white or white spot, dental or white spots, dental).mp. (67534)
3. (early childhood adj2 caries).tw. (2163)
4. rampant caries.tw. (236)
5. pulpotomy/ (1772)
6. (pulpotomies or pulpotomy).mp. (2300)
7. 1 or 2 or 3 or 4 (67914)
8. 5 or 6 (2300)
9. 7 and 8 (428)
10. limit 9 to (english language and humans and yr=”2012 - 2024” and (“all infant (birth to 23 months)” or “newborn infant (birth to 1 month)” or “infant (1 to 23 months)” or “preschool child (2 to 5 years)”)) (59)

Appendix 2

CLINICAL QUESTIONS

1. What are the risk factors of early childhood caries (ECC)?
2. What are the clinical presentations of ECC?
3. What are the accurate methods used for diagnosis of ECC?
   - Visual
   - Radiographs
   - ICDAS
   - Other modes of diagnosis
4. What are the safe and effective preventive measures for ECC?
   - Diet advice
   - Plaque control
   - Oral Health Education
   - Behaviour guidance
   - Motivational Interviewing
   - Caries Risk Assessment
   - Topical F
   - Fissure sealant
   - Water Fluoridation
5. What are the effective and safe treatments for ECC?
   - Non-Invasive
   - Invasive
6. What are the referral criteria for ECC?
7. What is the follow-up protocol for ECC?

Appendix 3

Table 1. Caries-risk Assessment Form for 0-5 Years Old

Use of this tool will help the health care provider assess the child's risk for developing caries lesions. In addition, reviewing specific factors will help the practitioner and parent understand the variable influences that contribute to or protect from dental caries.

Factors	High risk	Moderate risk	Low risk
Risk factors, social/behavioral/medical			
Mother/primary caregiver has active dental caries	Yes		
Parent/caregiver has life-time of poverty, low health literacy	Yes		
Child has frequent exposure (>3 times/day) between-meal sugar-containing snack or beverages per day	Yes		
Child uses bottle or nonspill cup containing natural or added sugar frequently, between meals and/or at bedtime	Yes		
Child is recent immigrant		Yes	
Child has special health care needs[α]		Yes	
Risk factors, clinical			
Child has visible plaque on teeth	Yes		
Child presents with dental enamel defects	Yes		
Protective factors			
Child receives optimally-fluoridated drinking water or fluoride supplements			Yes
Child has teeth brushed daily with fluoridated toothpaste			Yes
Child receives topical fluoride from health professional			Yes
Child has dental home/regular dental care			Yes
Disease indicators[β]			
Child has non cavitated (incipient/white spot) caries lesions	Yes		
Child has visible caries lesions	Yes		
Child has recent restorations or missing teeth due to caries	Yes		

[α] Practitioners may choose a different risk level based on specific medical diagnosis and unique circumstances, especially conditions that affect motor coordination or cooperation

[β] While these do not cause caries directly or indirectly, they indicate presence of factors that do.

Instructions: *Circle "Yes" that corresponds with those conditions that apply to a specifie patient. Use the circled responses to visualize the balance among risk factors, protective factors, and disease indicators. Use this balance or imbalance, together with clinical judgment, to again a caries risk level of low, moderate, or high based on the preponderance of factors for the individual. Clinical judgment may justify the weighting of one factor (e.g., heavy plaque on the teeth) more than others.*

Overall assessment of the dental caries risk: **High** ❒ **Moderate** ❒ **Low** ❒

Appendix 4

Table 2. Caries-risk Assessment Form for ≥6 Years Old[25]
(For Dental Providers)

Use of this tool will help the health care provider assess the child's risk for developing caries lesions. In addition, reviewing specific factors will help the practitioner and patient/parent understand the variable influences that contribute to or protect from dental caries.

Factors	High risk	Moderate risk	Low risk
Risk factors, social/behavioral/medical			
Patient has life-time of poverty, low health literacy	Yes		
Patient has frequent exposure (>3 times/day) between-meal sugar-containing snack or beverages per day	Yes		
Child is recent immigrant		Yes	
Patient uses hyposalivatory medication(s)		Yes	
Patient has special health care needs[α]		Yes	
Risk factors, clinical			
Patient has low salivary flow	Yes		
Patient has visible plaque on teeth	Yes		
Patient presents with dental enamel defects	Yes		
Patient wears an intraoral appliance		Yes	
Patient has defective restorations		Yes	
Protective factors			
Patient receives optimally-fluoridated drinking water			Yes
Patient has teeth brushed daily with fluoridated toothpaste			Yes
Patient receives topical fluoride from health professional			Yes
Patient has dental home/regular dental care			Yes
Disease indicators[β]			
Patient has interproximal caries lesion(s)	Yes		
Patient has new noncavitated (white spot) caries lesion	Yes		
Patient has new cavitated caries lesions or lesions into dentin radiographically	Yes		
Patient has restorations that were placed in the last 3 years (new patient) or in the last 12 months (patient of record)	Yes		

[α] Practitioners may choose a different risk level based on specific medical diagnosis and unique circumstances, especially conditions that affect motor coordination or cooperation

[β] While these do not cause caries directly or indirectly, they indicate presence of factors that do.

Instructions: *Circle "Yes" that corresponds with those conditions that apply to a specific patient. Use the circled responses to visualize the balance among risk factors, protective factors, and disease indicators. Use this balance or imbalance, together with clinical judgment, to again a caries risk level of low, moderate, or high based on the preponderance of factors for the individual. Clinical judgment may justify the weighting of one factor (e.g., heavy plaque on the teeth) more than others.*

Overall assessment of the dental caries risk: **High** ❒ **Moderate** ❒ **Low** ❒

Appendix 5

Table 3. Example of Caries Management Pathways for 0-5 Years Old

Risk category	Diagnostics	Preventive interventions			Restorative interventions
		Fluoride	Dietary counseling	Sealants	
Low risk	- Recall every six to 12 months - Radiographs every 12 to 24 months	- Drink optimally -fluoridated water - Twice daily brushing with fluoridated toothpaste	Yes	Yes	- Surveillance
Moderate risk	- Recall every six months - Radiographs every six to 12 months	- Drink optimally -fluoridated water (alternatively, take fluoride supplements with fluoride-deficient water supplies) - Twice daily brushing with fluoridated toothpaste - Professional topical treatment every six months	Yes	Yes	- Active surveillance of non-cavitated (white spot) caries lesions - Restore cavitated or enlarging caries lesions
High risk	- Recall every three months - Radiographs every six months	- Drink optimally -fluoridated water (alternatively, take fluoride supplements with fluoride-deficient water supplies) - Twice daily brushing with fluoridated toothpaste - Professional topical treatment every three months - Silver diamine fluoride on cavitated lesions	Yes	Yes	- Active surveillance of non-cavitated (white spot) caries lesions - Restore cavitated or enlarging caries lesions - Interim therapeutic restorations (ITR) may be used until permanent restorations can be placed

Notes for caries management pathways table:

Twice daily brushing: Parental supervision of a "smear" amount of fluoridated toothpaste for children under age three, pea-size amount

For children ages three through five.

Surveillance: Periodic monitoring for signs of caries progression; active surveillance: active measures by parents and oral health professionals to reduce cariogenic environment and monitor possible caries progression.

Silver diamine fluoride: Use of 38 percent silver diamine fluoride to assist in arresting caries lesions; informed consent: particularly highlighting expected staining of treated lesions.

Scalants: The decision to seal primary and permanent molars should account for both the individual-level and tooth-level risks.

Appendix 6

Table 4. Example of Caries Management Pathways for ≥6 Years Old

Risk category	Diagnostics	Preventive interventions			Restorative interventions
		Fluoride	Dietary counseling	Sealants	
Low risk	- Recall every six to 12 months - Radiographs every 12 to 24 months	- Drink optimally -fluoridated water - Twice daily brushing with fluoridated toothpaste	Yes	Yes	- Surveillance
Moderate risk	- Recall every six months - Radiographs every six to 12 months	- Drink optimally -fluoridated water (alternatively, take fluoride supplements with fluoride-deficient water supplies) - Twice daily brushing with fluoridated toothpaste - Professional topical treatment every six months	Yes	Yes	- Active surveillance of non-cavitated (white spot) caries lesions - Restore cavitated or enlarging caries lesions
High risk	- Recall every three months - Radiographs every six months	- Drink optimally -fluoridated water (alternatively, take fluoride supplements with fluoride-deficient water supplies) - Brushing with 0.5 percent fluoride gel/paste - Professional topical treatment every three months - Silver diamine fluoride on cavitated lesions	Yes	Yes	- Active surveillance of non-cavitated (white spot) caries lesions - Restore cavitated or enlarging caries lesions - Interim therapeutic restorations (ITR) may be used until permanent restorations can be placed

Notes for caries management pathways table:

Twice daily brushing: Parental supervision of a pea-size amount of fluoridated toothpaste for children six years of age.

Surveillance: Periodic monitoring for signs of caries progression; active surveillance: active measures by parents and oral health professionals to reduce cariogenic environment and monitor possible caries progression.

Silver diamine fluoride: Use of 38 percent silver diamine fluoride to assist in arresting caries lesions; informed consent: particularly highlighting expected staining of treated lesions.

Sealants: Although studies report unfavorable cost/benefit ratio for sealant placement in low caries-risk children, expert opinion favors sealants in permanent teeth of low-risk children based on possible changes in risk over time and differences in tooth anaotomy. The decision to seal primary and permanent molars should account for both the individual-level and tooth-level risks.

Appendix 7

H. PENILAIAN RISIKO KARIES (Tandakan ✓ jika berkaitan)

Langkah 1: Penilaian Pengalaman Karies Semasa

Pemeriksaan	Sound (Kod 0)	Karies Awal (Kod E)	Karies (Kod 1)
Tandakan Kod yang Tertinggi			

Langkah 2: Penilaian Faktor Risiko

- ☐ Plak yang Boleh Dilihat (Gred C dan E)
- ☐ Kesesakan Gigi
- ☐ Terdapat Aplians Pergigian
- ☐ Tidak Terdedah Kepada Fluorida
- ☐ Ambil Makanan Bergula Antara Waktu Makan
- ☐ Kompromi Perubatan / Kesihatan
- ☐ Ibu / Adik-beradik Mempunyai Riwayat Karies
- ☐ Mulut Kering

Langkah 3: Petunjuk Risiko Karies
Bulatkan: Rendah/Sederhana/Tinggi

Bilangan Faktor Risiko	Sound (Kod 0)	Karies Awal (Kod E)	Karies (Kod 1)
☐ 0	Rendah	Sederhana	Sederhana
☐ 1-2	Rendah	Sederhana	Tinggi
☐ 3 atau lebih	Sederhana	Tinggi	Tinggi

Langkah 4: Lawatan Susulan

☐ 3 Bulan ☐ 6 Bulan ☐ 12 Bulan

LIST OF ABBREVIATIONS

AAPD	American Association Paediatric Dentistry
AGREE	Appraisal of Guidelines for Research and Evaluation
AI	Artificial Intelligence
ART	Atraumatic Restoration Treatment
ASA	American Society of Anaesthesiologists
AUC	Area under Curve
AUROC	Area Under the Receiver Operating Characteristic curve
BL	Band and Loop
BPA	Bisphenol A
CAMBRA	Caries Management by Risk Assessment
CaOH	Calcium Hydroxide
CAT	Caries -risk Assessment Tool
CCA	Corrected Covered Areas
CDC	Centre for Disease Control and Prevention
CDT	Comprehensive Dental Treatment
CHD	Congenital Heart Disease
HCG	Healthy Control Group
CI	Confidence Interval
CL	Crown and Loop
CPG	Clinical Practice Guidelines
CPP-ACP	Casein phosphorpeptide- amorphus calcium phosphate
CQ	Clinical Questions
CRA	Caries Risk Assessment
CS	Chair Side
D1	Outer third dentine
D3	Inner third dentine
DB	Direct Bonding
DES	Distal End Shoe
DFS	Difluorosilane
DG	Development Group
DHV	Dental Home Visit
DI-S	Debris Index Score
dft	Decayed, filled teeth
Dmfs	Decayed, missing, filled surfaces
Dmft	Decayed, missing, filled teeth
DPC	Direct Pulp Capping
EAPD	European Association of Paediatric Dentistry
ECC	Early Childhood Caries
ECOHIS	Early Childhood Oral Health Impact Scale
ERK	Ekstrand-Ricketts-Kidd
FMS	Family Medicine Specialist
FDWP	Family Dental Wellness Programme
FRCR	Fibre Reinforced Composite Resin
FS	Ferric Sulphate
GA	General Anaesthesia
GFRCR	Glass Fibre Reinforced Composite Resin
GI	Gingival Index
GIC	Glass Ionomer Cement
GPC	Glycerophospocholine
GRADE	Grading, Recommendations, Assessment, Development and Evaluation

HAP	Hydroxy Apatite
RPD	Removable Partial Dentures
HR	Hazard Ratio
HTA	Health Technology Assessment
HVGIC	High Viscosity Glass Ionomer Cement
ICDAS	International Caries Detection and Assessment System
ICER	Incremental Cost Effectiveness Ratio
IPC	Indirect Pulp Capping
IR	Internal Reviewer
IRR	Incidence Rate Ratio
LBW	Low Birth Weight
LLA	Lower Lingual Arch
LSTR	Lesion Sterilization and Tissue Repair
MaHTAS	Malysia Health Technology Assessment Section
MD	Mean Difference
MGI	Modified Gingival Index
MI	Motivational Interviewing
MoH	Ministry of Health
MTA	Mineral Trioxide Aggregate
NaF	Sodium Fluoride
NaOCL	Sodium Hypochlorite
NCD	Non Communicable Disease
NHS	National Health system
NMA	Network Meta Analysis
NMR	Nuclear Magnetic Resonance
NNT	Number Needed toTreat
NOHPS	National Oral Health Survey of Preschool Children
NS	Not Significant
NSCR	Non Selective Caries Removal
NUS-CRA	National University of Singapore Caries Risk Assessment
NVT	Non Vital Pulp Therapy
OHE	Oral Health Education
OHPP	Oral Health Promotion Programme
OHRQoL	Oral Health Related Quality of Life
OR	Odds Ratio
PDS	Public Dental Service
PE	Prevailing Health Education
PEPT	Premature Extraction of Primary Teeth
PF	Pooled prevented fraction
PFR	Pressure Fixed Retainer
PHCP	Primary Health Care Provider
PLPT	Premature Loss of Primary Teeth
PMCs	Preformed Metal Crowns
POHP	Preventive Oral Health Programme
POHPS	Pre school Oral Health Programme
Ppm	Parts per million
QHI	Quigley Health Index
RCSEng	Royal College of Surgeons England
RCT	Randomised Clinical Trials
RD	Relative Standard Deviation
RDOR	Relative Diagnostic Odds Ratio
RMGIC	Resin Modified Glass Ionomer Cement

ROC	Receiver Operating Characteristics
RPD	Removable Partial Dentures
RR	Risk Ratio
SCR	Selective Caries Removal
SD	Standard Deviation
SDCEP	Scottish Dental Clinical Effectiveness Programme
SDF	Silver Diamine Fluoride
S-ECC	Severe Early Childhood Caries
SIGN	Scottish Intercollegiate Guidelines Network
SIMSP	Senyuman Indah Milik Semua
S.Mutans	*Streptococcus Mutans*
MD	Standard Mean Difference
SR	Systematic Review
SSCs	Stainless Steel Crowns
SUCRA	Surface Under the Cumulating Ranking
SWE	Stepwise Excavation
TPA	Transpalatal Arch
TTS	Temporary Tooth Separation
UMSD-CRA	University of Michigan School of Dentistry Caries Risk Assessment
VF	Vacuum-formed Passive Appliance
VPT	Vital Pulp Therapy
WHO	World Health Organisation
w/v	Weight Per Volume
ZOE	Zinc Oxide Eugenol

ACKNOWLEDGEMENT

The members of the development group of these guidelines would like to express their gratitude and appreciation to the following for their contributions:

- Panel of internal and external reviewers who reviewed the draft
- Technical Advisory Committee for CPG for their valuable input and feedback
- HTA and CPG Council for approval of the CPG
- Dr Mohd Aminuddin bin Mohd Yusof, CPG Unit, Malaysian Health Technology Assessment Section, Medical Development Division, Ministry of Health Malaysia
- Dr. Maryana Bt Musa, Dr. Sofiah Mat Ripen and Dr. Aina NajwaBt Mohd Khairuddin, Oral Health technology Section, Oral Health Programe, Ministry of Health Malaysia
- Dr. Menaga Balakrishnan, Department of Paediatric Dentistry, Hospital Sultan Idris Shah for process involved in the publication.
- Dr. Yew Yun Qing, Department of Special Care Dentistry Unit, Hospital Seberang Jaya for illustrating the background of the CPG cover
- All those who have contributed directly or indirectly to the development of the CPG

DISCLOSURE STATEMENT

The panel members of both DG and IR have completed disclosure forms. None held shares in pharmaceutical firms or acts as consultants to such firms. Details are available upon request from the CPG Secretariat.

SOURCE OF FUNDING

The development of the CPG on Management of Early Childhood Caries (Third Edition) was supported financially in its entirety by the MoH Malaysia.

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