



ICCMS™
CARIES MANAGEMENT
International Caries Classification and Management System

ICCMS™ Guide for Practitioners and Educators

Nigel B. Pitts, FRSE BDS PhD FDS RCS (Eng) FDS RCS (Edin) FFGDP (UK) FFPH¹

Amid I. Ismail, BDS, MPH, Dr. PH, MBA²

Stefania Martignon, BDS, PhD^{1,3}

Kim Ekstrand, BDS, PhD⁴

Gail V. A. Douglas, BMSc, BDS, MPH, FDS, PhD, FDS (DPH) RCS⁵

Christopher Longbottom, BDS, PhD¹

Contributing co-authors*

Christopher Deery, University of Sheffield, UK

Roger Ellwood, University of Manchester, UK

Juliana Gomez, University of Manchester, UK

Justine Kolker, University of Iowa, USA

David Manton, University of Melbourne, Australia

Michael McGrady, University of Manchester, UK

Peter Rechmann, University of California San Francisco, USA

David Ricketts, University of Dundee, UK

Van Thompson, Kings College, London, UK

Svante Twetman, University of Copenhagen, Denmark

Robert Weyant, University of Pittsburgh, USA

Andrea Ferreira Zandona, University of North Carolina, USA

Domenick Zero, Indiana University School of Dentistry, USA

On behalf of the Participating Authors of the International Caries Classification and Management System (ICCMS™) Implementation Workshop, held June 2013**

December 2014

¹King's College London Dental Institute, Dental Innovation and Translation Centre, Guy's Hospital, London, UK

²Maurice H. Kornberg School of Dentistry, Temple University, Philadelphia, USA

³UNICA Caries Research Unit, Universidad El Bosque, Bogotá, Colombia

⁴University of Copenhagen, Denmark

⁵School of Dentistry, University of Leeds, UK



ICDAS
FOUNDATION
International Caries Detection and Assessment System

GCCM

Global Collaboratory for
Caries Management



Directed by ICDAS and its ICCMS™

*Contact details for all authors and contributing co-authors can be found in Appendix A1.

**For a list of contributors from the ICCMS™ Implementation Workshop and development meetings since, please see Appendix A2.

Amid Ismail and Nigel Pitts are the co-Directors of ICDAS/ICCMS™ and are assisted by Stefania Martignon, the ICCMS™ Coordinator. Modifications, questions, and suggestions relating to the ICCMS™ Consensus Core resource document and this ICCMS™ Guide for Practitioners and Educators should be directed to Stefania Martignon (stefania.martignon@kcl.ac.uk) who also works with the current ICDAS coordinator Gail Douglas (g.v.a.douglas@leeds.ac.uk) as well as the ICDAS Coordinating Committee and the Global Collaboratory for Caries Management (GCCM), formed at King's College London under the supervision of Professor Nigel Pitts, with the aim of initiating comparative studies of the proposed systems and evaluate the process and outcomes of its implementation. Further details can be found in the webpages www.icdas.org and www.kcl.ac.uk/sspp/kpi/projects/healthpolicy/global-caries-management.aspx.

Acknowledgements

The Authors are indebted to the marvelous contributions made by all of the internationally mixed groups who attended the launch meeting of the Global Collaboratory for Caries Management at Kings College London in June 2013 and the many who have helped since at meetings in Liverpool, Seattle, Philadelphia, London, Capetown, Greifswald, Delhi and Tokyo to drive this initiative forward. We are also exceedingly grateful to all the Organisations and Companies who have supported this work and enabled the progress to date. A list of Supporting Organisations and Companies can be found in Appendix M.

Correspondence:

Stefania Martignon
King's College London Dental Institute, Dental Innovation and Translation Centre
Guy's Hospital
Room 38, Tower Wing
SE1 9RT, London, UK
stefania.martignon@kcl.ac.uk

Note: ICCMS™ is trademarked by the ICDAS Foundation in order that the International Caries Classification and Management System can remain open and available to all.

TABLE OF CONTENTS

	Page
Overview	5
Introduction	6
1. History and Development of the ICCMS™	9
1.1 ICCMS™'s Goals for Caries Management	10
1.2 Principles for Implementing ICCMS™	11
1.3 ICCMS™ Caries Management Pathway	12
2. ICCMS™ Elements and the supporting evidence	13
2.1 Element 1- History-: Patient Level Caries Risk Assessment	14
2.2 Element 2- Classification: Caries Staging and Lesion Activity Assessment	15
2.2.1 Assessment of Caries Risk Factors Intraorally	16
2.2.2 Staging lesions	18
2.2.2.1 Staging coronal caries lesions clinically	18
2.2.2.2 Staging coronal caries lesions radiographically	20
2.2.2.3 Combining clinical and radiographic information	22
2.2.2.4 Lesion activity assessment	22
2.3 Element 3- Decision Making: Synthesis of information to reach Diagnoses	24
2.3.1 ICCMS™ caries diagnosis	24
2.3.2 ICCMS™ caries risk analysis to assess likelihood of new lesions or caries progression	25
2.4 Element 4- Management: Personalised Caries Prevention, Control & Tooth Preserving Operative Care	27
2.4.1 Managing a patient's risk factors	28
2.4.2 Managing individual lesions	30
2.5 Recall interval, Monitoring and Review	33
3. Outcomes of Caries Management using ICCMS™	34
4. ICCMS™ in Practice	35
5. Related Developments	35
5.1 New Evidence on Current or Emerging Technology	35
5.2 Research Agenda for ICCMS™ and the GCCM	36
5.3 Integrated eLearning and Data Management Software	37
5.4 Implementation for ICCMS™ – GCCM	37
References	38

List of Tables

Table 1. Risk status of the patient	17
Table 2. Definition of ICCMS™ Caries categories (merged codes)	19
Table 3. ICDAS/ICCMS™ radiographic scoring system	21
Table 4. Combination of clinical and radiographic information	22
Table 5. Characteristics of lesion activity across the ICCMS™ coronal caries stages	23
Table 6. ICCMS™ caries diagnosis (staging and activity status per lesion)	25
Table 7. ICCMS™ Caries Risk and Likelihood Matrix	25
Table 8. Managing individual lesions in permanent teeth	31
Table 9. Managing individual lesions in primary teeth	32

List of Figures

Figure 1. Identification of the ICCMS™ Practice and Education Domains relating to this Manual	7
Figure 2. Overview of the ICCMS™ Elements and Outcomes	8
Figure 3. The Four Elements of ICCMS™ linked by risk based recall	12
Figure 4. Detailed overview of ICCMS™ Elements and their components	13
Figure 5. Element 1- History- Patient-level Caries Risk Assessment	14
Figure 6. Element 2- Classification: Caries Staging and Lesion Activity Assessment with Intraoral Caries Risk Factors	16
Figure 7. Element 3- Decision Making: Synthesis of information to reach Diagnoses and Risk Status	24
Figure 8. Element 4- Management: Personalised Caries Prevention, Control & Tooth Preserving Operative Care	27
Figure 9. Managing patient's risk factors	29
Figure 10. Detailed Outcomes of Caries Management using ICCMS™	34

List of Boxes

Box 1. Patient level caries risk factors	15
Box 2. Intraoral level caries risk factors	16

List of Appendices

Appendix A: List of Contributing and Participating Authors	47
Appendix B: Scottish Intercollegiate Guidelines Network's (SIGN) Grading of the Evidence	50
Appendix C: Patients' caries risk factors. A consideration	51
Appendix D: Full Definition of ICCMS™ Caries categories (merged codes)	54
Appendix E: Root caries: Staging of lesions clinically, activity assessment and management options	55
Appendix F: Some considerations on Caries Associated with Restorations or Sealants (CARS) and Non carious changes	58
Appendix G: Evidence considerations for managing patients' risk factors	60
Appendix H: Level of evidence for individual lesions' interventions	62
Appendix I: New Evidence on Current or Emerging Technology	63
Appendix J: Glossary for key words	64
Appendix K: ICCMS™ Caries Staging Photographs and Radiographs	66
Appendix L: ICCMS™ Clinical Case Example	77
Appendix M: Supporters of ICCMS™ and the Global Collaboratory for Caries Management	84

Overview

The aim of this Guide is to describe the structure and facilitate the implementation of the International Caries Classification and Management System (ICCMS™), which the authors propose to be used in the daily handling of our patients for caries prevention and management and also in the teaching undertaken at dental schools around the world.

The ICCMS™ is a health outcomes focused system that aims to maintain health and preserve tooth structure. Staging of the caries process and activity assessment is followed by risk-adjusted preventive care, control of initial non-cavitated lesions, and conservative restorative treatment of deep dentinal and cavitated caries lesions.

There are four elements in the ICCMS™, the two key aspects are:

- **Classification - Caries Staging & Activity Assessment:** this comprises (i) staging of caries lesion severity ('initial'/'moderate'/'extensive') and (ii) caries activity assessment (likelihood of progression or arrest/reversal of lesions: 'active'/'inactive'). [Note that during the intraoral assessment phase information is also collected on oral risk factors; e.g. oral hygiene, dry mouth]
- **Management - Personalised Caries Prevention, Control & Tooth Preserving Operative Care:** The dental team, together with the patient, devise a Personalised Caries Care Plan to manage the caries risk status of the patient as well as managing caries lesions appropriately. (i) Management of the risk status is based on both home care advice, as well as clinical activities; those with low risk getting general information on how to maintain teeth as sound, those with moderate and high risk with increasing focus on behaviour changes and short periods between recalls to the clinic. (ii) The management of the lesions is related to the diagnosis of the individual lesions: 'initial' active lesions in general are managed with non-operative care (NOC) whilst moderate/extensive lesions are in general managed operatively with tooth preserving operative care (TPOC).

In order to devise an optimal Personalised Caries Management Plan, two other elements are also needed (please note that the chronological sequence and the method of integration of patient and clinical information may vary according to local preferences):

- **History - Patient-level Caries Risk Assessment:** collation of risk information at the patient level (to be integrated with clinical and tooth level information).
- **Decision Making - Synthesis and Diagnoses:** (i) classification of individual lesions combining information about their stage and activity (e.g. 'initial' active lesion), and (ii) an overall caries risk likelihood status combining information about presence/absence of active lesion/s and patient's risk ('low', 'moderate' or 'high' risk of getting future caries and/or of lesion progression).

The risk-based recall interval, including monitoring and review, then allows this caries management pathway to become a cycle, facilitating the achievement of optimal long-term health outcomes.

- **Outcomes** - are considered across: health maintenance, disease control, patient-centred quality metrics, as well as the wider impacts of using the ICCMS™ System.

The authors hope that this Guide will be useful in bringing the International Caries Classification and Management System - ICCMS™- to the attention of many more clinicians and educators around the world. We also hope that it will provide an indication of one way to operationalise the System. The characteristics of ICCMS™ are the delivery of effective, risk based caries care that prevents new lesions, controls initial caries non-operatively and preserves tooth tissue at all times.

The authors gratefully acknowledge the tremendous contributions of all the many parties who have contributed to both the ICDAS Foundation and to the development of ICCMS™.

Introduction

The International Caries Classification and Management System - ICCMS™ - deliberately incorporates a range of options designed to accommodate the needs of different users across the ICDAS (International Caries Detection and Assessment System) domains of clinical practice, dental education, research and public health (see Figure 1). The ICCMS™ system seeks to provide a standardised method for comprehensive caries classification and management, but recognises fully that there are different ways for implementing such systems locally. ICCMS™ builds on the evidence-based ICDAS system for the staging of caries. It also maintains the flexible approach of the ICDAS “wardrobe” which provides several approved options for categorising the disease according to local and/or specific needs, preferences and circumstances.

It must be appreciated that this Guide relates only to the use of the System in the domains of **Practice** and **Education**; there are a range of considerations and applications of ICDAS/ICCMS™ in Research and in Public Health that are important, but are beyond the scope of this Guide (see Figure 1).

The system outlined in this document is based on best evidence and consensus. The methodology used was wherever possible to use “SIGN” grading of the evidence with rapid reviews and then to use expert consensus to get recommendations based on the best available evidence. We hope that the expanding Global Collaboratory for Caries Management (GCCM) will provide a network to allow implementation of the ICCMS™ in ways that work locally. We also invite wider participation in the GCCM in order to secure continuous quality improvement as we implement, refine and localise this Guide.

For a long time, the field of caries detection, risk assessment, diagnosis, and management has been dominated by dogma and lack of translation of the best evidence into clinical practice¹. Therefore, over the last decade an international group of cariologists, epidemiologists and clinicians has worked to develop protocols for promoting appropriate management of caries based upon the best biological and clinical evidence.

The International Caries Classification and Management System - ICCMS™ - is linked to ICDAS. While ICDAS provides flexible and increasingly internationally adopted methods for classifying stages of the caries process and the activity status of lesions, ICCMS™ provides options to enable dentists and the dental team to integrate and synthesise tooth and patient information, including caries risk status, in order to plan, manage and review caries in clinical practice.

This document provides an international guide to the ICCMS™ System. The authors are aware of the need to focus on the key concepts and the cycle of caries management, but also to not be too prescriptive. We invite and anticipate local adaptation with flexibility which flows from the ICDAS “wardrobe” concept. The essential steps in delivering ICCMS™ are the four elements (specifically including the staging of lesions and assessment of caries activity) used to plan and deliver effective, risk based caries care that prevents new lesions, controls initial caries non-operatively and preserves tooth tissue at all times. Please note that a range of preferred risk assessment tools can be used with ICCMS™.

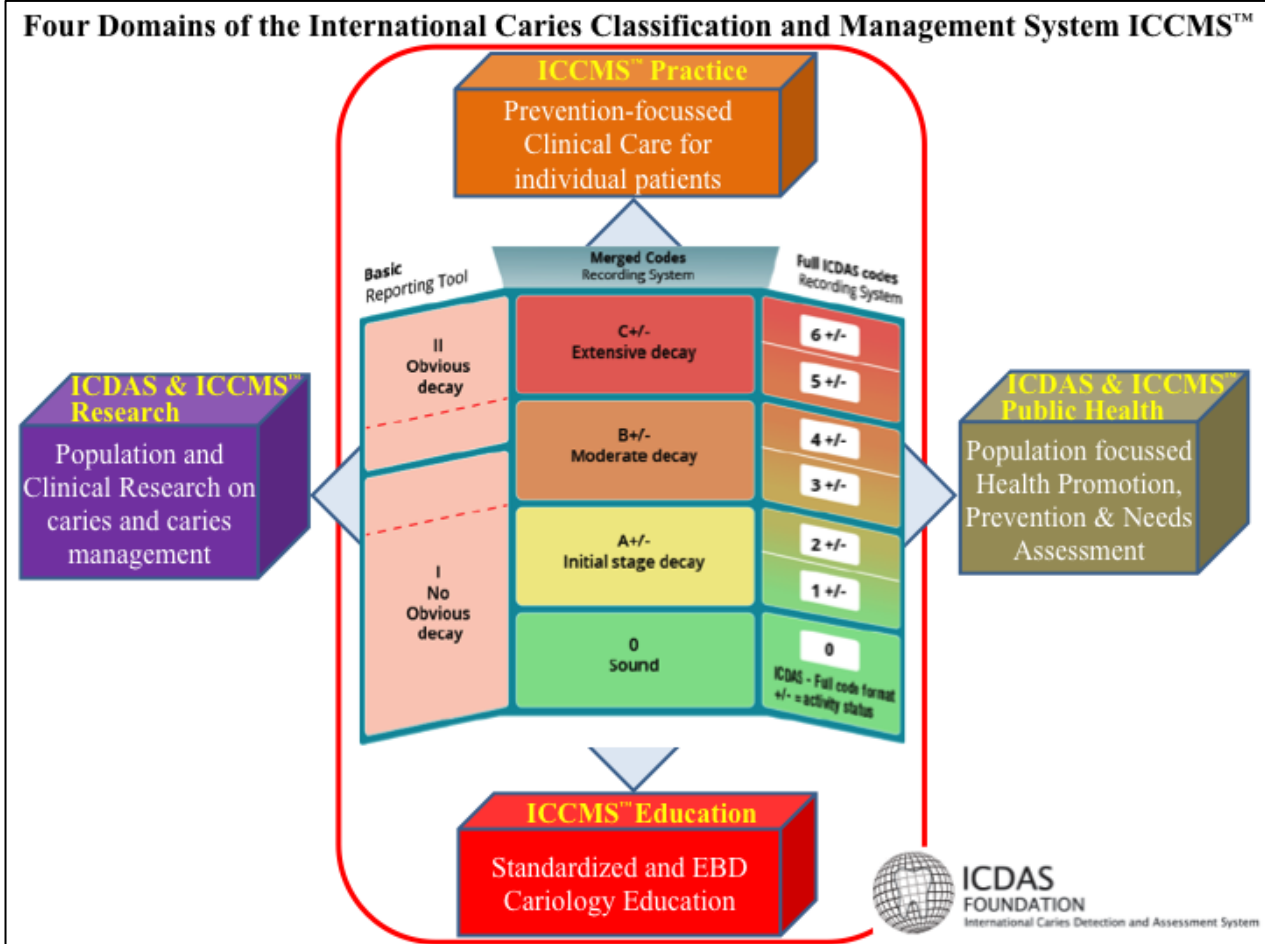


Figure 1. Identification of the ICCMS™ Practice and Education Domains relating to this manual (ICCMS™ Research and public health domains are beyond the scope of this manual).

The International Caries Classification and Management System - ICCMS™ is a health outcomes focused system that aims to maintain health and preserve tooth structure. Staging of the caries process and activity assessment is followed by risk-adjusted preventive care, control of initial non-cavitated lesions, and conservative restorative treatment of deep dentinal and cavitated caries lesions.

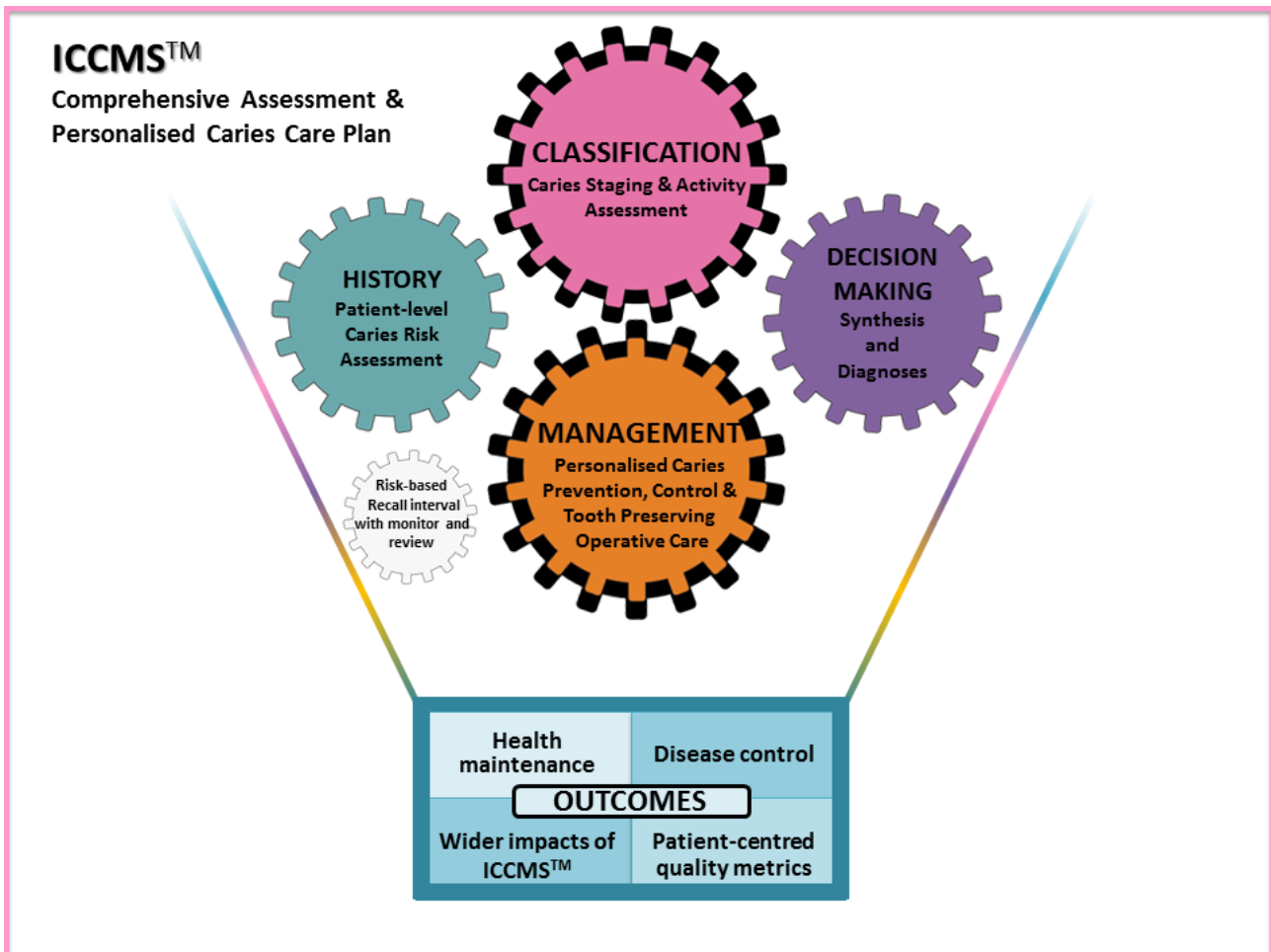


Figure 2. Overview of ICCMS™ Elements and Outcomes.

Figure 2 provides an overview of how ICCMS™ uses a simple form of the ICDAS Caries **Classification** model to stage caries severity and assess lesion activity in order to derive an appropriate, personalised, preventively biased, risk-adjusted, tooth preserving **Management** Plan. The ICCMS™ System is delivered as a cycle, which includes patient level Caries Risk Assessment along with Decision Making, which synthesises both clinical and patient level information; it is then repeated according to risk-based recall intervals. The outcomes of using this systematic approach are assessed in terms of health maintenance, disease control, patient centred quality metrics as well as wider impacts away from individual patient care.

The ICCMS™ development group have learned useful insights into routine clinical decision making and how to minimise unconscious diagnostic and treatment planning errors from Dr. Pat Croskerry (Division of Medical Education, Dalhousie University, Canada). His important work in this field began with researching decision making systems in emergency medicine, however his theories and teachings on heuristics are now being applied in many medical disciplines including caries diagnosis and management.

Heuristics are mental shortcuts that allow people to solve problems and make judgments efficiently in everyday life. They dominate our day-to-day clinical reasoning and are practical and effective, but can sometimes lead to cognitive errors in complex environments. (<http://www.improvediagnosis.org/?CognitiveError>). Most of the time clinicians (be they dentists, physicians or surgeons) use the so-called ‘System 1’ decision-

making tactic. System 1 is fast, autonomous, reflexive and inexpensive, but vulnerable to error. The experienced clinician devises set scripts and can move rapidly through routine repetitive tasks and arrive at good and appropriate decisions. However, he/she will recognise an atypical pattern when something doesn't quite fit and will then slow down and use 'System 2'. This is slow, deliberate, methodical but costly; it makes fewer errors and can allow the clinician to come up with a suitable care plan in complex or unusual cases.

In this Guide we have responded to this philosophy - Overview figures (with pink borders) show the key aspects of what should be done to deliver the ICCMS™ in 'System 1' type situations, which is typical of an experienced dentist working in a busy dental office or clinic. These figures communicate the key elements of ICCMS™. They can be viewed as a form of check-list. Detailed figures (with blue borders) are also provided and these show what is needed for situations where 'System 2' may be utilized and the clinician wants to slow down and move step by step through a more detailed pathway. The information summarized in the more detailed pathway diagrams is also useful for educators and for specifying outcomes. We hope that readers will use their judgement to choose which would be the appropriate decision making 'System' to use in different situations.

This document, named ICCMS™ Guide for Practitioners and Educators, focuses on the theoretical background that supports and facilitates the implementation of ICCMS™ and its practical applications in clinical practice and education. ICCMS™ has been developed by the ICDAS Foundation², with the help of a number of additional experts. It includes a comprehensive set of clinical protocols (drawn up based on the best available evidence) to support history taking, clinical examination, risk assessment and personalised care planning in order to enable improved long-term caries outcomes³.

1. History and Development of ICCMS™

The start point for the development of this system came in 2002, when groups of interested individuals from a number of international academic centres harmonised global evidence around caries detection and assessment to create the International Caries Detection and Assessment System (ICDAS). They have since maintained and developed the system with an increasing number of collaborators from around the world. The ICDAS Foundation was formed linking core centres in Dundee, Michigan, Indiana and Copenhagen. The current ICDAS foundation links many of the same core academic staff currently at the Universities of Kings College London, Temple, Indiana, Copenhagen, Dundee, Leeds, Michigan, Sheffield and many other academics and universities making up the ICDAS coordinating committee². The FDI World Dental Federation and researchers from the US National Institute for Dental and Craniofacial Research (NIDCR) have also contributed over the years. In recent years, the Alliance for a Cavity-Free Future (ACFF) and its chapters have also helped to promote ICDAS and ICCMS™.

The recognition of the then urgent need for a more standardised and robust method of classifying caries (with a focus on more than just the dentinal or cavitation stages of caries

as a threshold for making the decision to treat) came from an International Consensus Workshop on Caries Clinical Trials⁴⁻⁶.

The ICDAS Group recognised caries as an ever-changing challenge for both clinicians and epidemiologists/researchers. The group elected to merge a range of existing caries classification systems, which had been tested and reviewed by some of its members^{5,6}. These systems include a number of key papers linking clinical visual assessment of lesion extent and activity to histological validation^{7,8}, in order to produce an integrated caries classification system⁹. This system and the International Caries Classification and Management System (ICCMS™), which has been subsequently built upon it, has been the subject of a large number of peer reviewed papers from around the world².

The development of the ICCMS™ system came through a series of international Workshops and symposia. It has been based on a contemporary understanding of the evidence on and around cariology¹⁰, international agreements on current caries terminology¹¹ and how best to advance tooth preserving caries management pathways¹².

The System has also been linked to the development and implementation of the European Core Curriculum on Cariology^{13,14}. The FDI World Dental Federation serving as the principal representative body for more than one million dentists worldwide has published the FDI Caries Matrix which recognises ICDAS in two of its three “levels”¹⁵

<http://www.fdiworldental.org/media/11674/2011.ga.resolution.on.principle.of.caries.classification.and.management.matrix.pdf>). Further, the FDI agreed (Hong Kong 2012) a policy statement on caries classification and management systems, which recommends that the elements of classification are kept distinct from those of management.

1.1 ICCMS™’s Goals for Caries Management

The mission of the International Caries Classification and Management System (ICCMS™) is to translate the current international understanding of the pathogenesis, prevention and control of dental caries in a holistic way through a comprehensive assessment and personalised caries care plan. This is in order to:

- prevent new lesions from appearing
- prevent existing lesions from advancing further
- preserve tooth structure with non-operative care at more initial stages and conservative operative care at more extensive caries stages

This should be done while managing risk factors through all of the elements in the caries management cycle and recalling patients at appropriate intervals, with periodic monitoring and reviewing.

The authors recommend that delivering these goals should be the driver for future remuneration systems and that outcome data should include these aspects.

A fundamental guidance statement relating to treatment decisions around operative intervention was agreed by all participants early in the development process and remains central to ICCMS™- this is to:

Preserve tooth structure and restore only when indicated.

Preservation of tooth structure in its widest sense drives all decisions in the ICCMS™, as a patient-centered and biologically compatible system which is evidence-based (within the limitations of current knowledge), preventively oriented and safe for tooth structure. The system is focused on providing better care and better health at a lower cost and this philosophy has already shown some examples of important benefits in implementation¹⁶. Furthermore, the ICCMS™ is compatible with modern International Educational conventions (such as the ORCA/ADEE Cariology Curriculum in Europe and the new CODA standards in the USA) which facilitates its implementation through undergraduate and continuing education. This approach has recently been demonstrated in the consensus on cariology teaching for undergraduate students achieved in the Colombian dental schools¹⁷ and progress being made across all dental schools in Malaysia.

1.2 Principles for Implementing ICCMS™

There are a number of key principles which underlie both the design and implementation of ICCMS™:

1. ICCMS™ aims to preserve tooth structure as there is a professional responsibility to avoid preventable removal of sound tooth tissue.
2. ICCMS™ aims to prevent caries from developing, to control the disease process if and when it occurs and to reverse existing lesions in order to limit the long-term damage to healthy sound tooth structure.
3. ICCMS™ maintains and improves the dental health “trajectory” of patients on a continuum of caries and dental health scale, with strong emphasis on both primary and secondary prevention across the life-course.
4. ICCMS™ is based around pragmatic and updated risk analysis and clinical risk management for the individual patient.
5. ICCMS™ is based around staging of the caries process and lesion activity.
6. ICCMS™ aims to prevent the development of new caries lesions and prevent existing initial caries from progressing.
7. ICCMS™ care involves the use of caries lesion-defined preservative cavity preparations, cut only when operative intervention is clearly indicated and as a last resort. The guiding philosophy is to “preserve dental tissues first and restore only when indicated”.
8. ICCMS™ care involves the use of regular and patient specific recalls based on the current risk status.

1.3 ICCMS™ Caries Management Pathway

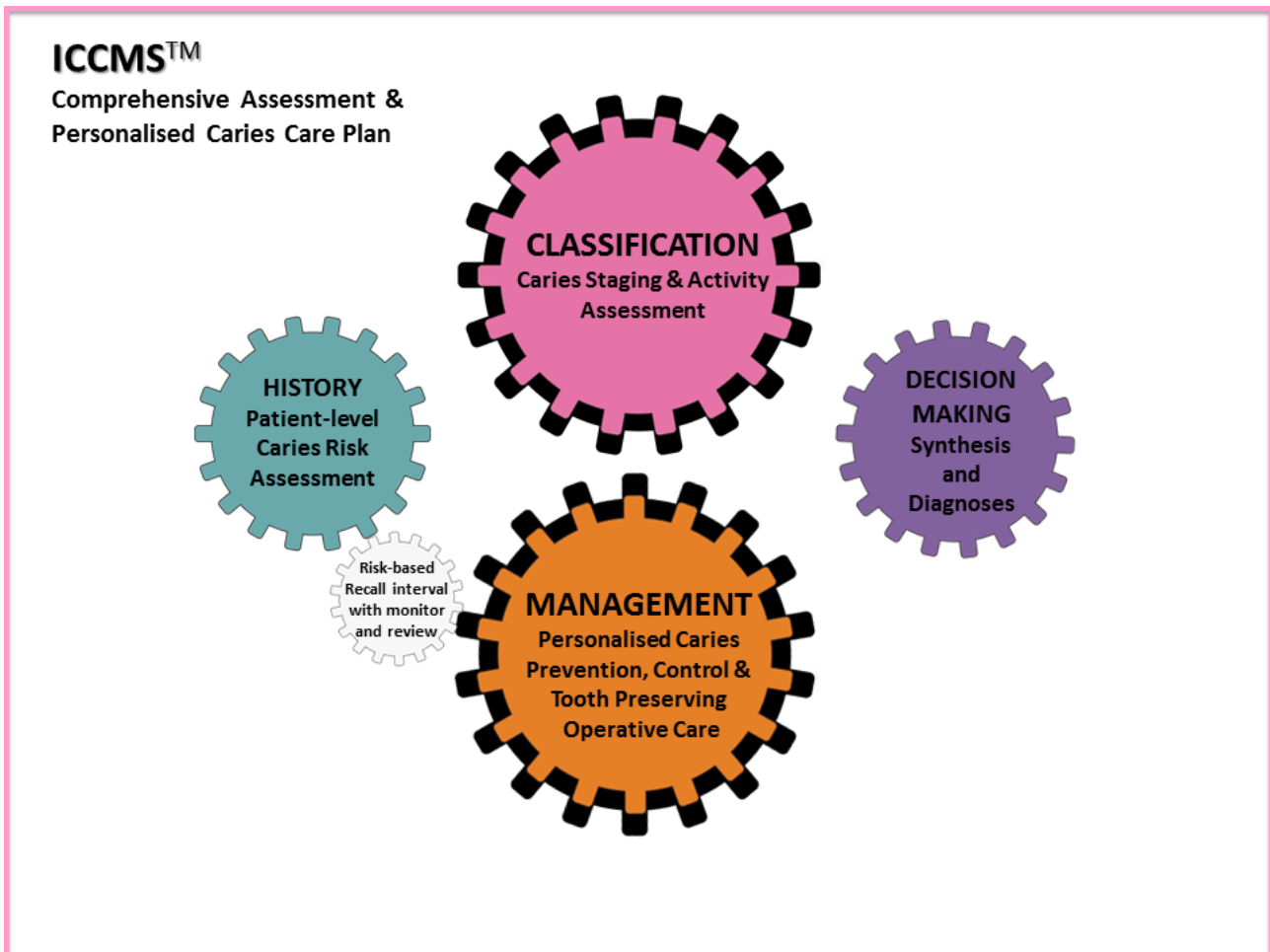


Figure 3. The Four ICCMS™ Elements, linked by risk-based recall.

The principles which the ICCMS™ is using are depicted in a cyclic format in Figure 3 and include four key elements. The **First Element** involves collecting a history from patients on their chief medical and dental complaints, past dental and medical history, history of present complaints, symptoms and preference for outcomes and then assesses the patient level risk factors. This step is integrated with the **Second Element**, the Caries Classification step, that starts with conducting an assessment of plaque on the teeth, followed by the clinical visual examination of the teeth, which focuses on determining the caries categories (sound, initial, moderate, extensive) on each tooth and tooth surface, assesses the activity state of each lesion, radiographic analysis (when available), and evaluates the caries experience (including number of restorations, state of previous restorative work, teeth extracted due to caries reasons, and dental sepsis), as well as other intraoral risk factors. The data collected from the interview and clinical examination are analysed and synthesised in the **Third Element**, decision making, to synthesise and diagnose the risk of getting new lesions in the future and to diagnose each lesion in terms of whether or not they are active and if they are of initial, moderate or extensive severity.

To help in these procedures the ICCMS™ works with a matrix for Caries Risk and Likelihood at the patient level and information about staged caries severity & activity at the lesion/surface level (see 2.3.2). An important factor in developing a Patient Care Plan is

the patient’s preferences in terms of the outcomes of different caries management options. The **Fourth Element**, management, is to develop a Personalised Caries Care Plan to prevent sound tooth surfaces from developing caries, prevent initial lesions from progressing to cavitated stages and manage “deep dentinal” and cavitated lesions following with Tooth Preserving Operative Care (TPOC), within an individual risk management plan that includes the recall interval, the monitoring of the status of caries lesions and the reviewing of the patient behavioural change plan (Figure 4).

Please note that the Caries Management Pathway is cyclical as each element follows on in turn. Additional detail is given in Figure 4 in order to demonstrate a recommended method of implementation. The cycle restarts after each risk based recall interval.

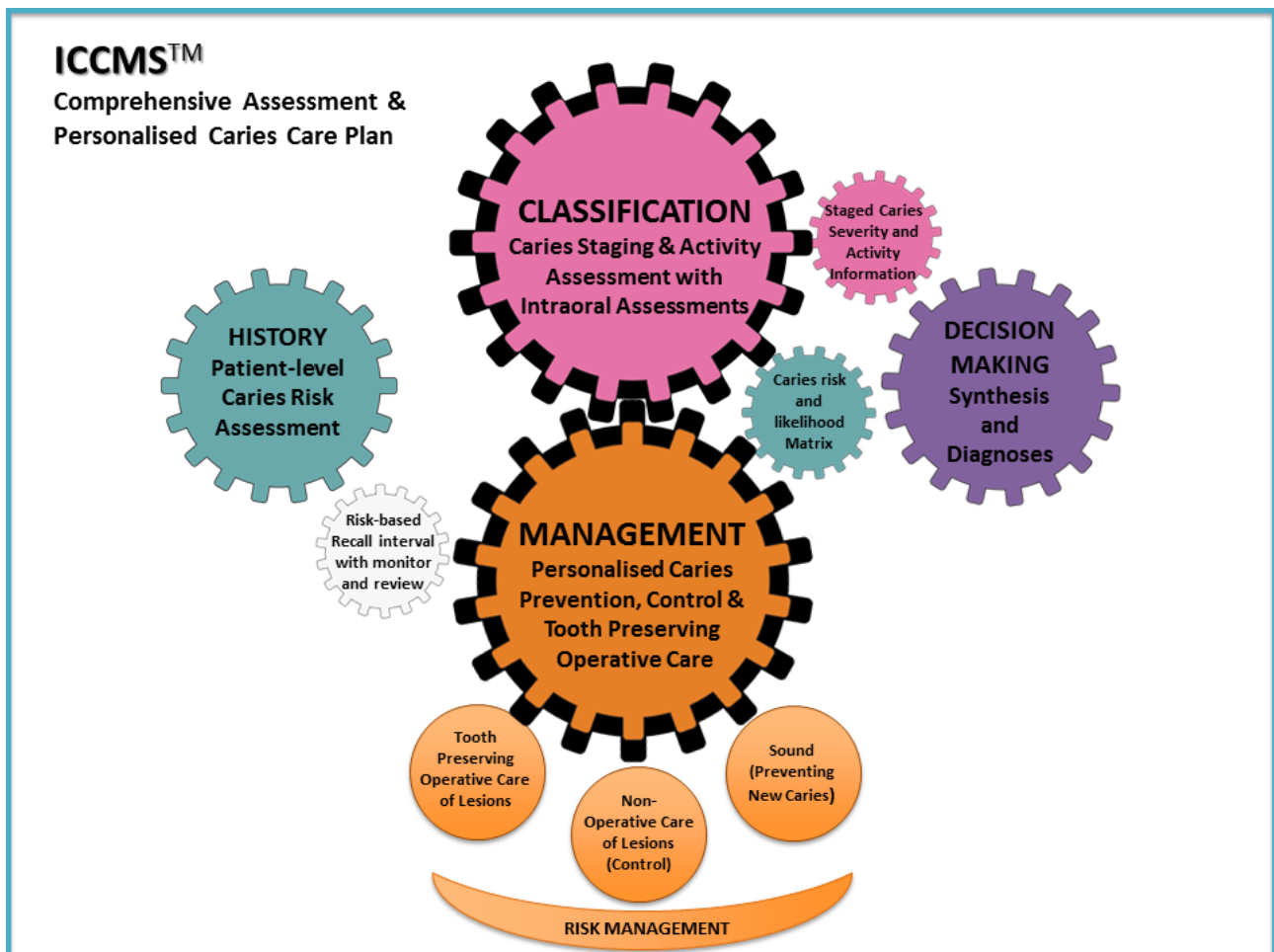


Figure 4. Detailed overview of ICCMS™ elements and their components.

2. ICCMS™ Elements and the supporting evidence

The four elements of ICCMS™ are described following the order in which the practitioner would typically proceed with the Caries Management Pathway. The classification and management Elements are distinctive and essential to ICCMS™.

2.1 Element 1- History- Patient-Level Caries Risk Assessment

The evidence base describes risk factors, risk indicators and risk predictors, and there are specific definitions to support each of these. However for the purpose of this document, we will call all of these “risk factors”. The authors are aware that, particularly for adults and older age groups, there are gaps in the evidence but hope that the Collaboratory will, in the future, provide better evidence in this area.

Prior to looking into the mouth, and having ensured that there are no urgent pain related issues, patient risk factors for caries are assessed (Figure 5).



Figure 5. Element 1- History- Patient-Level Caries Risk Assessment.

Listed below are the risk factors which may contribute towards an overall patient-level assessment of caries risk status. Further details and evidence can be found in Appendix C.

**Patient
level
caries
risk
factors**

- **Head and Neck Radiation**
- Dry mouth (conditions, medications/recreational drugs/self report)
- Inadequate oral hygiene practices
- Deficient exposure to topical fluoride
- High frequency/ amount of sugary drinks/ snacks
- Symptomatic-driven dental attendance
- Social-economic status/Health access barriers
- For children: high caries experience of mothers or caregivers

Box 1. Patient level caries risk factors.

Note: Risk factors in red denote a factor which will always classify an individual as high caries risk.

The patient-level risk factors are ascertained by taking a history to assess whether the patient has had radiation treatment, any use of medications, social background, dental attendance and to understand the patients diet.

2.2 Element 2- Classification: Caries Staging and Lesion Activity with Intraoral Caries Risk Assessments

This section describes the clinical caries assessment which stages caries severity and assesses caries activity (Figure 6). This step also includes the assessment of the intraoral caries risk factors.

Plaque assessment is essential for intraoral caries risk determination, but plaque has to be removed for accurate caries staging and lesion activity assessment. The assessment of caries will always be conducted by means of visual examination and when possible, combined with radiographic examination. This will lead to information about the stage of caries (in terms of initial, moderate or extensive) and its activity status at the lesion level (in terms of arrested or active).

The intraoral risk factors, together with the patient level risk factors will contribute towards the caries risk and likelihood matrix- see 2.3.2.

ICCMS™

Comprehensive Assessment &
Personalised Caries Care Plan

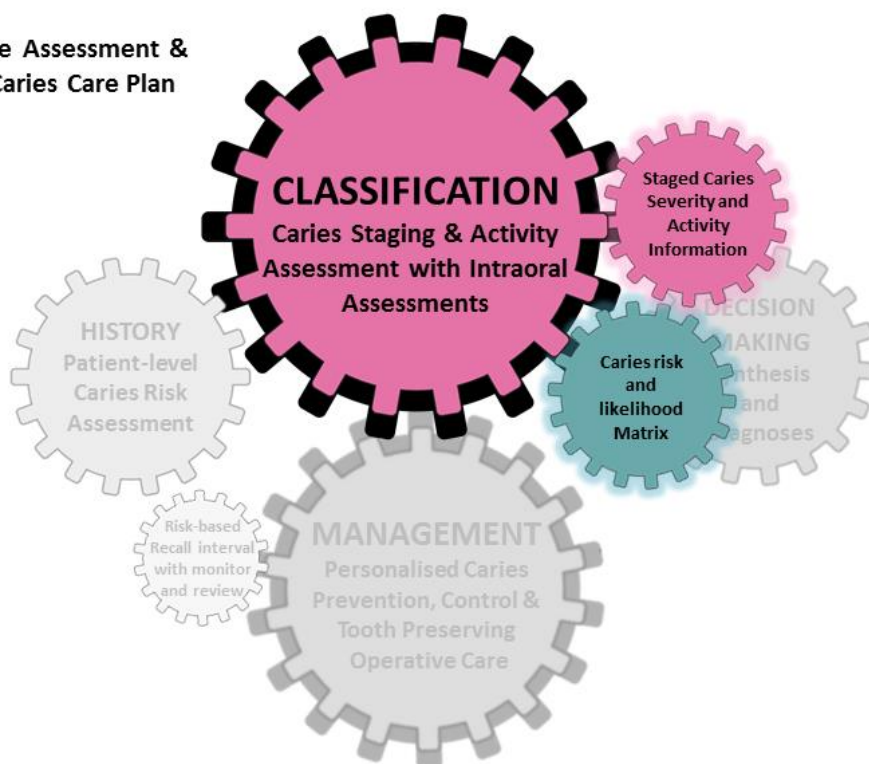


Figure 6. Element 2- Classification: Caries Staging and Lesion Activity Assessment with Intraoral Caries Risk Factors.

2.2.1 Assessment of Caries Risk Factors Intraorally

The ICCMS™ recommends assessing the following intraoral risk factors during the clinical examination of patients.

Intraoral level caries risk factors

- **Hypo-salivation/Gross indicators of dry mouth**
- **PUFA (Exposed Pulp, Ulceration, Fistula, Abscess) – Dental sepsis**
- Caries experience and active lesions
- Thick plaque: evidence of sticky biofilm in plaque stagnation areas
- Appliances, restorations and other causes of increased biofilm retention
- Exposed root surfaces

Box 2. Intraoral level caries risk factors.

Note 1: Risk factors in red denote a factor which will always classify an individual as high caries risk.

Note 2. For child patients, prolonged nursing or bottle feeding is considered an increased risk of caries, as are erupting permanent molar teeth.

Further detail and evidence can be found in Appendix C.

The risk factors mentioned above correspond to those with higher association with caries risk status, and are to be considered for risk assessment. The dentist/dental team's hunch is also considered to be important on the basis of several studies¹⁸⁻²⁰.

As for how to calculate the caries risk status of the patient there are currently a range of diverse tests available, as well as computer-based systems for the individual assessment of caries risk, ranging from national or local forms to forms from professional organisations and others. ICCMS™ embraces the CAMBRA²¹ (Caries Management by Risk Assessment) philosophy for risk assessment.

Some other examples of caries risk assessment methods are listed below:

- Cariogram²²
- ADA²³
- University of Michigan / University of Indiana²⁴
- University of North Carolina^{18,19}
- Dundee Risk Assessment Model²⁰
- Caries Management book' risk form²⁵
- The ICCMS™ risk factors listed in this document.

They take into account different risk factors combining medical and dental health, as well as behaviour and clinical data. While the evidence is still limited regarding which system to use, it is considered best clinical practice and best care for patients to assess individual caries risk taking into account local adaptations and age^{26,27}. Continuing research in this field is necessary, but until more complete evidence is available, existing methods should be used to support clinical practice according to local needs and preferences. Caries risk assessment systems typically assign three levels of risk, and the ICCMS™ development group (having reviewed the literature) defined low, moderate and high risk according to the criteria detailed in Table 1.

Patient's Risk Status	
Low risk status	Lack of any high caries risk factor (Box 1: red text) and other risk factors are within "safe" ranges (e.g. sugary snacks, oral hygiene practice, fluoride exposure).
Moderate risk status	A stage where the individual is not deemed to be definitely at Low risk or definitely at High risk of developing new caries lesions or of lesion progression.
High risk status	Presence of any of the high risk factors in Box 1 or caregivers with very high caries experience or where the level of several of the lower risk factors in Box 1 suggests a combination likely to lead to a high risk status – the number and levels of these factors will vary according to geographical location and the prevailing socio-economic conditions.

Table 1. Risk status of the patient

ICCMS™ considers that the likelihood of new caries lesions or the progression of existing lesions should result from the analysis of combining the patient's risk status (Elements 1 and 2) with the presence (or not) of active lesions. This combination is known as the Caries Risk and Likelihood Matrix. The outcome of this matrix can be used as part of the synthesis outlined in Element 3.

2.2.2 Staging lesions

The staging of caries lesions involves two steps of the caries diagnosis process⁴:

- Lesion detection (which implies an objective method of determining whether or not caries disease is present)
- Lesion assessment (which aims to characterise or monitor a lesion once it has been detected).

The summation and analysis of these will eventually lead to a third step, the caries diagnosis, which should imply a human professional summation of all available data. This will be considered in Element 3.

With the ICCMS™ system, following the ICDAS examination protocol²⁸, prior to the staging of caries lesions plaque should be removed in order to allow for an appropriate visual examination of the tooth surfaces (by means of professional prophylaxis, toothbrushing or cotton pellets) with appropriate light and the use of a ball-end probe (WHO probe).

At this point, the detection of lesions related other conditions (different to caries) should be disregarded, such as developmental defects of the enamel- DDE (hypoplasia and hypomineralisation), non-carious lesions (erosion, abrasion, abfraction), and the current status of the fillings (ditching, fracture) as these will not be considered in this document. Coronal primary caries will be fully described in this guide. For full definition of ICCMS™ categories see Appendix D. Root caries lesions will be described in Appendix E.

The examination should be conducted clinically, and where x-ray facilities are available together with a radiographic examination (in some countries radiographs could be assessed prior to the clinical assessment, depending on local regulations). Following this first step in staging lesion severity, the second step involves the activity assessment of the present lesions (see 2.2.2.4).

2.2.2.1 Staging coronal caries lesions clinically

For the purposes of this guide, the staging of coronal caries will include primary caries and caries associated with restorations/sealants (CARS) as one classification system. For the purpose of caries management, the ICCMS™ categorises the lesions with the ICDAS merged codes (Table 2). For full definitions of ICCMS™ categories see Appendix D.




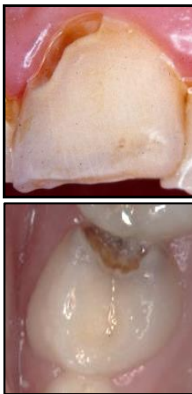
Definition of ICCMS™ Caries Merged categories		
Caries categories	<p>Sound surfaces (ICDAS™ code 0)</p>	 <p>Sound tooth surfaces show no evidence of visible caries (no or questionable change in enamel translucency) when viewed clean and after prolonged air-drying (5 seconds). 8-9</p> <p><i>(Surfaces with developmental defects such as enamel hypomineralisation (including fluorosis), tooth wear (attrition, abrasion and erosion), and extrinsic or intrinsic stains will be recorded as sound).</i></p>
	<p>Initial stage caries (ICDAS™ codes 1 and 2)</p>	 <p>First or distinct visual changes in enamel seen as a carious opacity or visible discolouration (white spot lesion and/or brown carious discolouration) not consistent with clinical appearance of sound enamel (ICDAS™ code 1 or 2) and which show no evidence of surface breakdown or underlying dentine shadowing.</p>
	<p>Moderate stage caries (ICDAS™ codes 3 and 4)</p>	 <p>A white or brown spot lesion with Localised enamel breakdown, without visible dentine exposure (ICDAS™ code 3), or an Underlying dentine shadow (ICDAS™ code 4), which obviously originated on the surface being evaluated.</p> <p><i>(To confirm enamel breakdown, a WHO/CPI/PSR ball-end probe can be used gently across the tooth area - a limited discontinuity is detected if the ball drops into the enamel micro-cavity/discontinuity).</i></p>
	<p>Extensive stage caries (ICDAS™ codes 5 and 6)</p>	 <p>A distinct cavity in opaque or discoloured enamel with visible dentine (ICDAS™ code 5 or 6).</p> <p><i>(A WHO/CPI/PSR probe can confirm the cavity extends into dentine).</i></p>

Table 2. Definition of ICCMS™ Caries categories (merged codes).

2.2.2.2 Staging coronal caries lesions radiographically

Radiographic information adds significantly to clinical findings in terms of finding lesions at different stages of progression²⁹⁻³². Radiographs help estimate the depth of caries demineralization into enamel and dentin. Depth is not always associated with the presence of cavitation, particularly on approximal surfaces.

Clinical investigations in a country with low caries progression rates revealed that, on average, 32% of radiographically visible lesions that extended into the outer third of the dentin manifested cavitation; in contrast, 72% of lesions extending into the inner 2/3 of the dentin were cavitated³³. Clinically cavitated lesions or lesions with obvious dentine radiolucency (deeper than the outer 1/3) on the occlusal surface are heavily infected in the dentin beneath the enamel dentin junction^{34,35}.

For establishing whether a lesion has progressed or not, two radiographs with a time lapse between are required.

If radiographs are available the first step is to grade coronal caries lesions on posterior teeth according to the scores in Table 3.

The ICCMS™ classifies posterior tooth surfaces radiographically^{36,37}. Both the reproducibility and accuracy of this scoring system has been reported to be substantial³³ to excellent³⁷.

The evidence indicates that the radiographic penetration depth, at which one can reliably predict that the tooth surface is cavitated and dentine is heavily infected, is in the region of radiolucency deeper than the outer third of the dentine^{7,34,35,38-40}. This corresponds to scores 4, 5 and 6 in the ICCMS™ radiographic scoring system. With faster caries progression rates, cavity formation can also be expected in cases scored as 3 in the above system.

It must be appreciated that different conventions exist in different countries for classifying the severity of lesions where operative care is required. More evidence is needed to reduce international variation on this issue.

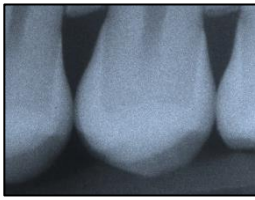
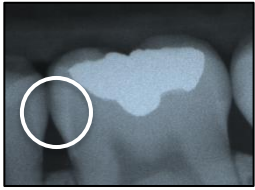
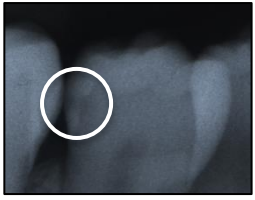
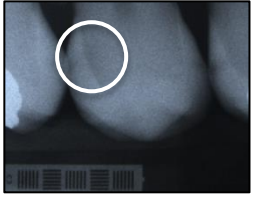



ICDAS Radiographic scoring system				
ICCMS™ Caries Categories	0	No radiolucency		No radiolucency
	RA: Initial stages	RA 1		Radiolucency in the outer ½ of the enamel
		RA 2		Radiolucency in the inner ½ of the enamel ± EDJ (enamel-dentine junction)
		RA 3		Radiolucency limited to the outer 1/3 of dentine
	RB: Moderate stages	RB 4		Radiolucency reaching the middle 1/3 of dentine
	RC: Extensive stages	RC 5		Radiolucency reaching the inner 1/3 of dentin, clinically cavitated
		RC 6		Radiolucency into the pulp, clinically cavitated

Table 3. ICDAS/ICCMS™ radiographic scoring system.

2.2.2.3 Combining clinical and radiographic information

Eventually, both the radiographic (when available and for posterior teeth) and the clinical assessment of the lesion severity end up classifying the lesion into the categories of initial, moderate or extensive.










ICCMS™ Categories (C)	Radiographic Categories (R)				
	<i>R₀</i> 	<i>RA₁₋₂</i> 	<i>RA₃</i> 	<i>RB</i> 	<i>RC</i> 
C_{Sound} 	Sound _{CR}	Initial _{CR}	Initial _{CR}	Moderate _{CR}	Extensive _{CR}
C_{Initial} 	Initial _{CR}	Initial _{CR}	Initial _{CR} or Moderate _{CR}	Moderate _{CR}	Extensive _{CR}
C_{Moderate} 	Moderate _{CR}	Moderate _{CR}	Moderate _{CR}	Moderate _{CR}	Extensive _{CR}
C_{Extensive} 	Extensive _{CR}	Extensive _{CR}	Extensive _{CR}	Extensive _{CR}	Extensive _{CR}

Table 4. Combination of clinical and radiographic information.

Note- most lesions confined to enamel are not seen on radiographs.

Once again, it is important to recognize the variation between countries in defining lesion severity and radiographic equivalence. More evidence should help reduce this variation.

2.2.2.4 Lesion activity assessment

Currently it is clear that caries lesions can be detected and assessed at an early stage as initial lesions^{2,3,8}. These, and also lesions at a further stage of severity, can be progressing at the moment of the clinical examination. Therefore, the next step after the severity assessment of the caries lesions is to judge if these, irrespective of stage, are inactive or active.

While there are no current valid biological or clinical tools to assess caries activity and no single variable predicts whether a lesion is active or arrested, clinicians should rely on clinical indicators^{1,8,41-44}. Clinical observations to be taken into consideration for assessing enamel lesion activity are based on the modifications of the Nyvad et al.^{45,46} and the Ekstrand et al.⁴⁷⁻⁴⁹ caries lesion activity assessment criteria and include visual appearance, tactile feeling, potential for plaque accumulation and, for lesions located near the gingivae, the gingival health/disease status (Table 5).

It is known that some lesions are at an inactive stage; e.g. initial caries lesions located in the middle third of the buccal surfaces of primary molars that also show signs of white spot lesions and are smooth when gentle tactile assessment is conducted with a probe; initial caries lesions located in the occlusal surface of a bicuspid/molar tooth that also shows signs of brown spot lesions and are smooth to gentle probing.

Current available evidence since the work of Baker-Dirks in the 1950's⁵⁰ demonstrates that inactive lesions are less likely to progress than active lesions. This leads to the need to assess the activity status of lesions as part of determining the likelihood of progression. It is also important to link likely future progression with the intensity of care planned, in order for cost effective management of the disease (health economic studies in this area are needed, and some are underway).

Evidence in this field is scarcer than that on severity staging of lesions, however it is of importance to record activity. Therefore the best available evidence so far is presented below.

The scientific definitions and characteristics of active and inactive lesions have been defined in an international glossary (Appendix J) and are described below:

- An **Active Lesion** is considered to have a greater likelihood of transition (progress, arrest or regress) than an inactive lesion (there is an increase in dynamic activity in terms of mineral movement).
- An **Inactive (arrested) Lesion** is considered to have a lesser likelihood of transition than an active lesion (there is less movement of mineral and the lesion stays at the same stage of severity.)

ICCMS™ Code	Characteristics of Lesion	
	Signs of Active Lesions	Signs of Inactive Lesions
ICCMS™ Initial and Moderate Caries Stage	Surface of enamel is whitish/yellowish; opaque with loss of luster, feels rough when the tip of the ball-ended probe is moved gently across the surface. Lesion is in a plaque stagnation area, i.e. in the entrance of pits and fissures, near the gingival margin or, for proximal surfaces, below or above the contact point. The lesion may be covered by thick plaque prior to cleaning.	Surface of enamel is whitish, brownish or black. Enamel may be shiny and feels hard and smooth when the tip of the ball-ended probe is moved gently across the surface. For smooth surfaces, the caries lesion is typically located at some distance from the gingival margin. Lesion may not be covered by thick plaque prior to cleaning.
ICCMS™ Extensive Caries Stage	Dentine feels soft or leathery on gentle probing.	Dentine is shiny and hard on gentle probing.

Table 5. Characteristics of lesion activity across the ICCMS™ coronal caries stages.

2.3 Element 3- Decision Making: Synthesis and Diagnosis

This element deals with the third step of the diagnosis process⁴ which involves the summation and analysis of information from the first two elements, regarding both the patient and the lesion level. The result will be the synthesis and diagnosis of the likelihood of new/progressing lesions in low, moderate or extensive risk status, and of each lesion in terms of whether or not they are active and if they are of initial, moderate or extensive severity.

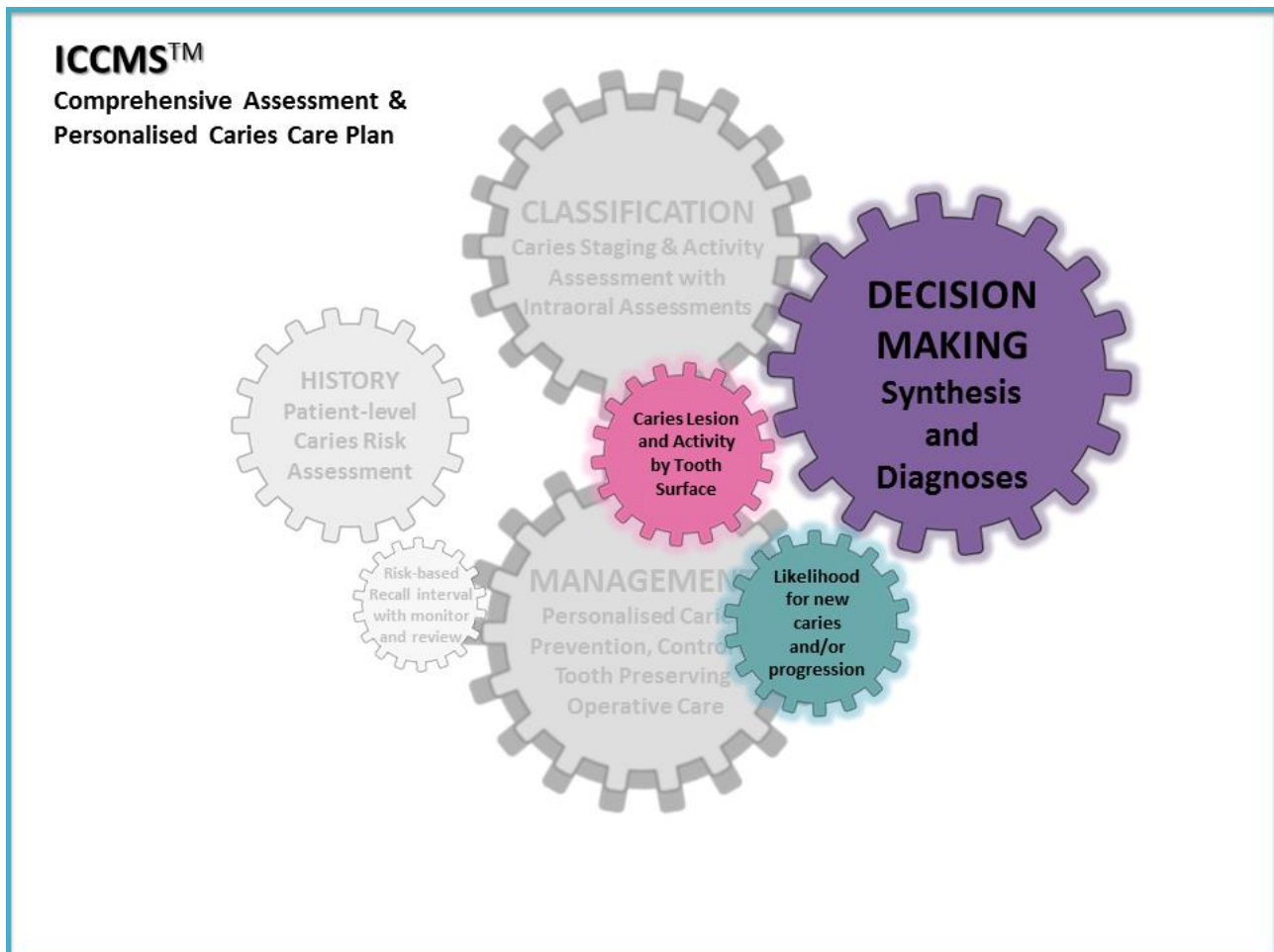


Figure 7. Element 3- Decision Making: Synthesis of information to reach Diagnosis and Risk Status.

2.3.1 ICCMS™ caries diagnosis

ICCMS™ caries diagnosis is the result of the analysis of the combination of clinical and radiographic information (the latter when available) plus the lesion activity assessment. Table 6 shows the ICCMS™ terminology for caries diagnosis. Please consider that as lesion activity can change, so can a recorded diagnosis.

ICCMS™ combined Categories	Activity status	
	Active lesions	Inactive lesions
ICCMS™ Sound	No lesion	No lesion
ICCMS™ Initial	Initial Active	Initial Inactive
ICCMS™ Moderate	Moderate Active	Moderate Inactive
ICCMS™ Extensive	Extensive Active	Extensive Inactive

Table 6. ICCMS™ caries diagnosis (staging and activity status per lesion).

2.3 2 ICCMS™ caries risk analysis to assess likelihood of new lesions or caries progression

Recommendations based on best evidence²⁷ state that individual caries risk analysis is an important step in caries management and for achieving the best overall outcomes for patients. The ICCMS™ agrees, even though the evidence on the predictive validity of current assessment tools in many age groups needs to be strengthened further. The consensus view is that risk assessment should be conducted as an integral part of the personalised caries care plan. It is hoped that the collection of data and evaluations from the Global Collaboratory of Caries Management will provide new evidence and insight to develop the evidence base in this area, and on the effectiveness and utility of the ICCMS™ Caries Risk and Likelihood Matrix outlined below. As stated previously (2.2.1) it is acceptable for groups to choose a locally acceptable caries risk assessment method to use with ICCMS™.

ICCMS™ caries risk analysis assesses the likelihood of new lesions or caries progression. It involves the stratification of individuals into low, medium, or high-risk status, irrespective of the tool used (Table 1), and the current caries activity status at the patient level. These two aspects are combined into a matrix, shown as Table 7 below.

		Current Caries Activity Status at the Patient Level		
		No active caries lesions*	Initial stage active caries lesions	Moderate- or extensive-stage active caries lesions
Risk status	Low risk	Low likelihood	Moderate likelihood	Moderate likelihood*
	Moderate risk	Low likelihood	Moderate likelihood	High likelihood
	High risk	Moderate likelihood	High likelihood	High likelihood

*Sound surfaces and/or inactive lesions

Table 7. ICCMS™ Caries Risk and Likelihood Matrix.

This matrix integrates three categories of current caries activity status at the patient level (none, initial, moderate/extensive) and the risk-status stratification (low, moderate, and high) into a likelihood matrix that stratifies individuals into low, moderate, or high likelihood of developing new caries lesions or the progression of existing lesions.

The current caries status at the patient level synthesises whether or not there are any active lesions (sound and/or inactive caries), whether active lesions at the patient level are initial stage caries, or whether active lesions at the patient level are at a moderate and/or extensive stage of severity.

***Note- the top right cell in the matrix, at the intersection of Low patient risk status and the presence of moderate or extensive-stage active lesions in a patient, covers a wide range of possibilities. The number of lesions detected in a patient could potentially range from one active moderate or extensive lesion through to many such lesions. In either case, the likelihood of developing new lesions or the progression of caries is judged to be moderate, even if the patient level risk status is judged to be low. Specific variations may also be needed when dealing with young caries active children and some advocate assessing the cleansibility of lesions as well.**

The way in which this matrix is generated and applied clinically can be understood further by reference to the Case Study outlined in Appendix L.

The core of the matrix represents nine colour coded cells where the likelihood of new lesions or progression have been grouped into colours reflecting a traffic light analogy, green being associated with the lower likelihood of new lesions or progression, yellow a moderate likelihood of new lesions or progression, and red a high likelihood of new lesions or progression. For each of these likelihood categories ICCMS™ has defined evidence-based preventive and management strategies to either keep the risk of caries low, or to lower the likelihood of caries lesion development. This novel approach provides a link between caries risk status and management of risk.

The Global Collaboratory for Caries Management is developing a series of implementation tools to help operationalise this matrix. We will be making available software apps and paper-based tools to support the preventive and management aspects of this system. Updates and information will be made available through the ICDAS website (www.icdas.org)².

2.4 Element 4- Management: Personalised Caries Prevention, Control & Tooth Preserving Operative Care

After defining the individual patient's likelihood risk status and the diagnosis for each lesion, ICCMS™ presents a management element to build a comprehensive patient care plan (Figure 8).

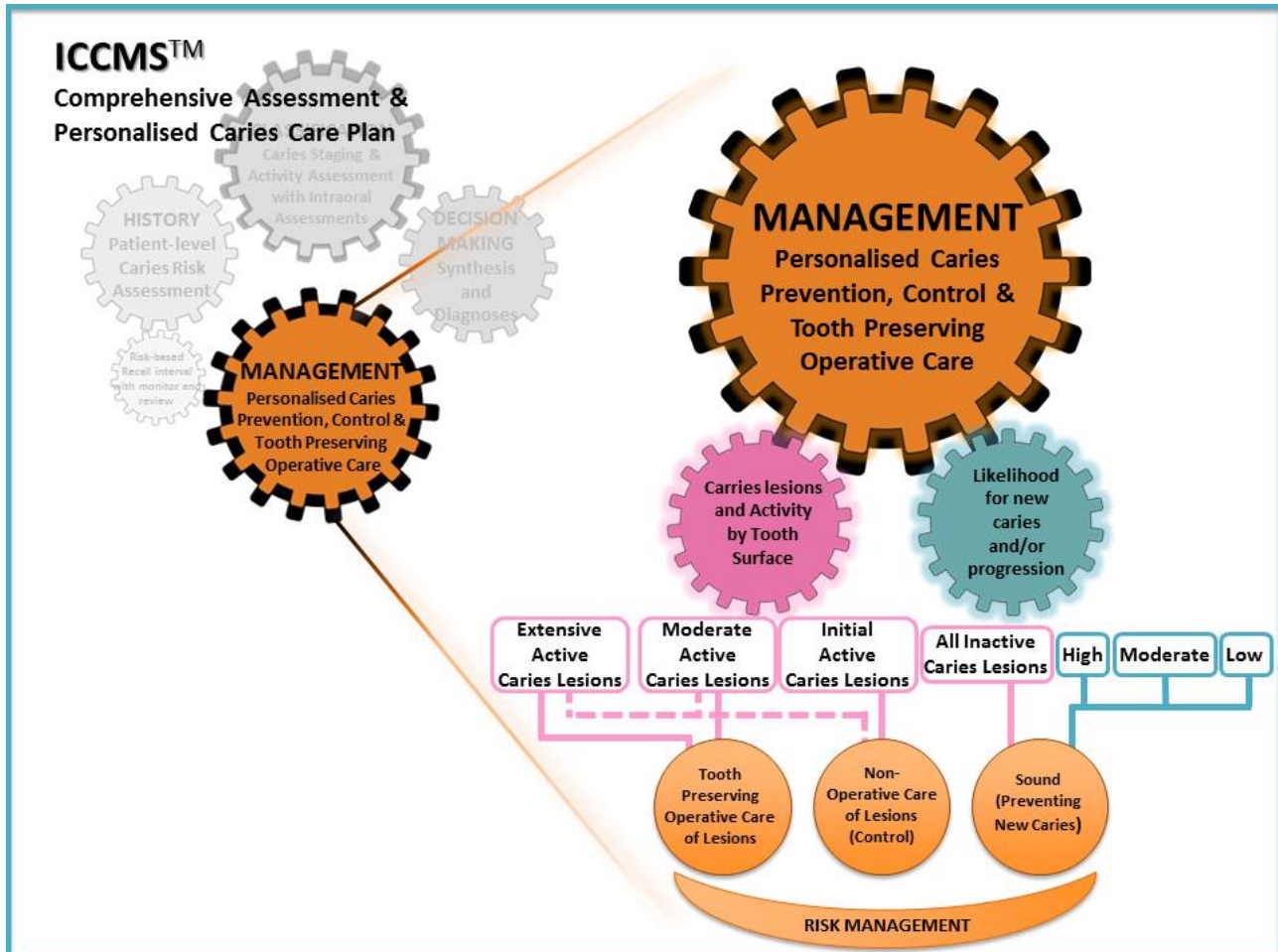


Figure 8. Element 4- Management- Personalised Caries Prevention, Control & Tooth Preserving Operative Care.

The Personalised Comprehensive Caries Care Plan involves and interconnects:

- Managing patient's likelihood for new caries and/or progression (risk status), whether low, moderate or extensive
- Managing individual caries lesions, with caries related treatment when they are active and defining different options according to their severity and taking into account if the dentition is primary or permanent for coronal caries.

The Management Element Includes:

- Preventing New Caries
- Non-Operative Care of lesions (NOC) (Control)
- Tooth Preserving Operative Care of lesions (TPOC),

As an integrated aspect, Risk Management applies to all of the above elements of the care plan.

Recall interval, Monitoring and Review will be considered at the end of this section. The risk-based review links to the start of the next cycle of the ICCMS™.

It is important to emphasise that if a patient presents with acute conditions and pain, these have to be managed as a priority before detailed care planning takes place.

The following subsections will describe the Comprehensive Caries Care Plan thoroughly, showing the best available evidence for recommendations.

2.4.1 Managing a patient's risk factors

The patient's caries risk factors management plan is tailored at the individual level and involves actions to protect sound tooth surfaces from developing new caries lesions, and all current active and inactive lesions from progressing. In addition, it aims to lower the risk status of the patient when moderate or extensive, and to maintain if low. A preventive plan should address both homecare and clinical interventions/approaches adjusted to the caries risk likelihood status of each patient. Based on the best available evidence, and depending on the caries risk likelihood status, ICCMS™ recommends the activities shown in Figure 9 (See Appendix G). Practitioners may choose from a package of preventive interventions based on caries risk likelihood status.

The intensity of the intervention is cumulative, so for patients with moderate caries risk likelihood all preventive interventions prescribed for patients with low caries risk likelihood should also be considered. Similarly for high caries risk likelihood patients all preventive interventions prescribed for low and moderate caries risk likelihood patients should also be considered in the patient's care plan. The ICCMS™ risk-based recall (re-care) interval for patients is described in subsection 2.5.

Note: Local adaptations may be required, for example according to varying levels of systemic fluoride concentration.

It is the ICCMS™ belief that prevention is an ongoing and dynamic process that involves engaging patients in reviewing their dietary and oral hygiene behaviors as well as clinical preventive care from the first dental visit.

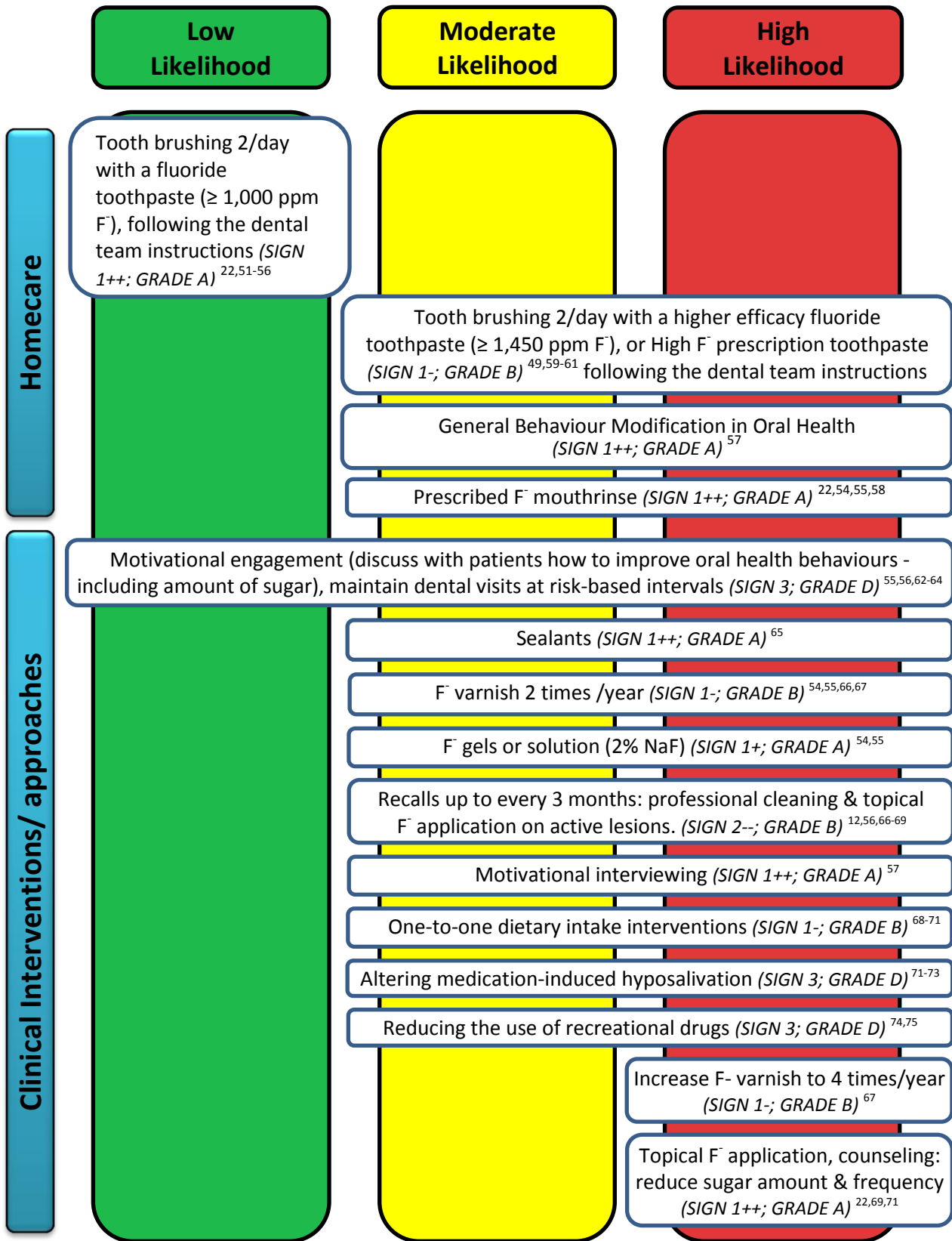


Figure 9. Managing patient's risk factors – core approach.

Note 1: In some countries, chlorhexidine may be considered as a preventive treatment option.

Note 2: This guide is provided as an overview for all age groups, however it is recognized that specific versions targeted for narrower age groups would be useful as later developments.

Note 3: Local regulatory requirements and professional recommendations may modify fluoride concentrations in topical products.

Note 4: Head & neck radiation, dry mouth – hyposalivation, and PUFA signs, indicate the need for special care, including additional measures.

Note 5: The frequency of preventive care should increase for the High Likelihood patients.

2.4.2 Managing Individual Lesions

The managing individual caries lesions plan is tailored at the lesion level. The ICCMS™ caries diagnosis (Table 6) is applicable to caries management decisions. The level of intervention depends on the clinical caries classification of the surface or tooth and the radiological extent (when information is available) of the lesion in enamel or dentine. The levels of clinical management recommended for active lesions are defined as follows:

M _{Initial} :	Initial caries management stage (Non-Operative care (NOC) - control)
M _{Moderate} :	Moderate caries management stage (in general TPOC)
M _{Extensive} :	Extensive caries management stage (in general TPOC)

For sound surfaces and inactive lesions, risk-based prevention is recommended.

The only treatment decision suggested by ICCMS™ review of the best available evidence which can be considered as locally modifiable is where the clinical examination classifies the lesion as moderate but radiographically as RA3 (radiolucency reaching the outer one-third of dentin). The clinical options here may be either to manage these lesions non-operatively or by TPOC.

The ICCMS™ tooth preserving operative principles should guide decisions for all restorative care. Surgical restorative interventions are only used as a last resort. The shape and extent of the cavity preparation is dictated by the spread of the caries lesions and presence of infected or affected dentine. Caries removal from the pulpal aspect of the cavity should be carried out to remove soft infected dentin and prevent exposure of a vital pulp (assessment of pulp vitality is an important consideration prior to managing lesions which may be close to the pulp). It is acceptable to leave discoloured carious dentin pulpally. In active extensive lesions where there is a risk of vital pulpal exposure, stepwise or partial excavation of caries should be carried out. Wherever possible, exposure of the dental pulp should be avoided.

With respect to Caries Associated with Restorations or Sealants (CARS) ICCMS™ recommends to either seal or repair defective or carious margins wherever possible. This also applies to defective or lost fissure sealants, which require maintenance/ repair only.

Based on best available evidence (See Appendix H) and depending on the caries category ICCMS™ recommends activities shown in Table 8 for permanent - and Table 9 for primary teeth, discriminating between surface type (See Appendix H for new evidence on individual lesions' interventions). Appendix E shows ICCMS™ recommended procedures for root caries.

Practitioners may choose from a package of non-operative care (NOC) and TPOC interventions. Sound surfaces and inactive (arrested) lesions are taken into consideration for risk management and inactive (arrested) moderate/extensive lesions for TPOC. ICCMS™ recall interval, monitoring and review of lesions is described in subsection 2.5.

For coronal caries in permanent dentition the caries management recommendations are defined as follows:

Surface ICCMS™ Stage	Pits and fissures	Mesial-distal (proximal)	Free smooth
M Sound	Risk-based Prevention (Refer to Previous Section)		
M Initial Active	NOC: Clinically applied topical fluoride (SIGN 1---) ^{67,76}		
	NOC: Oral hygiene with fluoridated dentifrice (≥1000 ppm) (SIGN 1---) ^{51,66}		
	NOC: Mechanical removal of biofilm (SIGN 3) ^{56,77}		
M Initial Active	NOC: Resin-based sealants (SIGN 1+,2--) ⁶⁵	NOC: Resin-based sealants/infiltrants (SIGN 2--) ⁷⁸	
	NOC: Glass ionomer sealants (SIGN 1---) ^{65,79}		
M Initial Inactive	No lesion specific treatment		
M Moderate Active	NOC: Resin-based sealants* (SIGN 2+) ⁸⁰⁻⁸²		
	TPOC (SIGN 1---) ^{83,84}	Determine cavitation for appropriate management options (teeth separation recommended) (SIGN 2+) ^{33,85,86} . If no cavitation: NOC, If cavitation: TPOC (SIGN 1---) ⁸³	TPOC (SIGN 1---) ⁸³
M Moderate Inactive	No treatment or TPOC if the lesion become a stagnation area (SIGN 1---) ⁸³	TPOC - Esthetic reasons (SIGN 1---) ⁸³	
M Extensive Active	TPOC (SIGN 1---) ⁸³		
M Extensive Inactive	TPOC if the lesion is a PSA or esthetically unacceptable (SIGN 1---) ⁸³	TPOC (SIGN 1---) ⁸³	

NOC = Non-Operative Care TPOC = Tooth-Preserving Operative Care PSA = Plaque stagnation area

*If preferred restorative care is NOT yet feasible because of patient or tooth factors, an alternative treatment is to apply a glass ionomer-based sealant.

Table 8. Managing individual lesions in permanent teeth.

For coronal caries in the primary dentition, caries management recommendations are dependent on the cooperation level of a child and time to exfoliation. The recommended management matrix is as follows:

Surface ICCMS™ Stage	Pits and fissures	Mesial-distal (proximal)	Free smooth
M_{Sound}	Risk-based Prevention (Refer to Previous Table)		
M_{Initial Active}	NOC: Clinically applied topical fluoride; fluoride varnish recommended for ≤ 6-yr. old children (SIGN 1---) ^{67,76}		
	NOC: Resin-based/glass ionomer sealant (SIGN 1+ / 1---) ^{65,79}	NOC: Resin-based sealants/infiltrants (SIGN 2--) ⁸⁷	
	NOC: Oral hygiene with fluoridated dentifrice (≥1000 ppm) when the first tooth erupts (SIGN 1---) ^{51,66}		
	NOC: Supervision is recommended at least until the age of 8 years (SIGN 1---) ⁸⁸		
M_{Initial Inactive}	No lesion specific treatment		
M_{Moderate Active}	NOC: Resin-based sealants* (SIGN 2+) ⁸¹		NOC: Resin-based sealants* (SIGN 2+) ⁸¹
	NOC: If sealant not feasible (teeth isolation difficulties) an option is a non-tooth preparation preformed metal/strip crown (SIGN 1---) ⁸³		NOC: If sealant not feasible (teeth isolation difficulties) an option is a non-tooth preparation preformed metal/strip crown (SIGN 1---) ⁸³
	TPOC: including placement of preformed metal or strip crowns (SIGN 1---) ^{80,83,84}	For appropriate management options determine cavitation status: Tooth separation (SIGN 2+) ^{67,79,80} . If no cavitation: NOC. If cavitation: TPOC (including preformed metal/strip crowns) (SIGN 1---) ⁸³	TPOC: including placement of preformed metal or strip crowns (SIGN 1---) ^{80,83,84}
M_{Moderate Inactive}	TPOC if the lesion is a PSA or the area is esthetically unacceptable (SIGN 1---) ⁸³		
M_{Extensive Active}	TPOC (including preformed metal/strip crowns) (SIGN 1---) ^{80,83,84}		
	If restorative care is not possible, consider the Hall Technique or extraction (SIGN 1---) ⁸³		
M_{Extensive Inactive}	TPOC if the lesion is a PSA or the area is esthetically unacceptable (SIGN 1---) ⁸³		

NOC = Non-Operative Care TPOC = Tooth-Preserving Operative Care PSA = Plaque stagnation area

*If preferred restorative care is not yet feasible because of patient or tooth factors, an alternative treatment is to apply a glass ionomer-based sealant.

Table 9. Managing individual lesions in primary teeth.

ICCMS™ recommends that review and monitoring visits (conventionally referred to as recalls) should be adjusted based upon the age of the patient and their risk status. ICCMS™ defines Recall as the duration of the personalised intervals between visits to review and monitor a patient's caries status. The frequency range for recall could be as high as once every three months for a child (under than 18 years old) with high likelihood of developing caries, to a low of once every two years for an adult with low likelihood of developing caries. Please be aware that the frequency used may also be adjusted for other conditions such as periodontal or mucosal health. The recall interval range should be reconsidered and either modified or re-used, based on the findings of review and monitoring.

ICCMS™ differentiates between recall intervals set for overall risk management, for assessing preventive interventions and the monitoring of initial lesions (to check their progression status) and reviews of behavioral and oral hygiene change plans.

ICCMS™ recommends that at every dental visit (both treatment visits and recall visits) some level of review should occur. It is essential to evaluate the patient's progress (or lack thereof) on the behavior modifications recommended in regards to the risk management plan. Modification of patient behavior goals should be considered and discussed, as necessary. While investigating the status of behavioral changes it is important to also maintain patient autonomy (patient value of oral health and treatment choices). It may be helpful to create a written statement of newly designed behavior modification goals for the patient to take home. It is important to maintain good documentation of the review and to record future behavior goals.

“Monitoring” in this context is the evaluation of the clinical status of the dentition (including ongoing treatment) and ascertaining whether previously identified lesions have progressed, regressed or have become arrested (inactive). Monitoring must be done at recall visits and may also be completed at treatment appointments. All teeth/surfaces are evaluated and compared to previous ICCMS™ caries categories. Radiographs are interpreted to evaluate possible caries progression. Additionally, in areas where sealants or restorations were placed without complete caries removal, bitewing/periapical radiographs should be evaluated to determine both the size and depth of lesion transition (and apical changes if appropriate), or lack thereof. Also the full range of detection assessment methods such as patient symptoms (pain, swelling, etc.) and clinical evaluation (including detection and activity assessment devices, as appropriate) should be completed.

The Recall interval is based on age (eruption pattern and other milestones) and risk (based on lesion level as well as overall patient level). There is little evidence supporting a specific recall interval to prevent dental caries⁸⁹. Additionally a systematic review found that there is weak evidence to support one specific interval (i.e. six months) for all individuals⁹⁰. The recall intervals were agreed upon by a group of participants at “The Global Collaboratory for Caries Management” and are supported by several published recommended recall intervals^{68,70,91-94} (Note: level 1++ is the highest level of evidence in these six cited references). At the recall visit both Reviewing and Monitoring take place.

3. Outcomes of Caries Management using ICCMS™

Comprehensive patient care plans should, by design, focus on achieving health outcomes for patients. It is also implicit that health promotion outcomes are desired and this is an important aspect at both the patient and community levels. The outcomes should be value-focused and not value-blind. Plans should be designed and evaluated to assess potential outcomes in health maintenance, disease control and patient-centred quality metrics, as well as around the wider impacts of using the ICCMS™ (Figure 10). Locally relevant outcome measures should also be developed and added to these lists, as appropriate. Measures should be sensitive to change over time and tooth surface level information is therefore desirable.

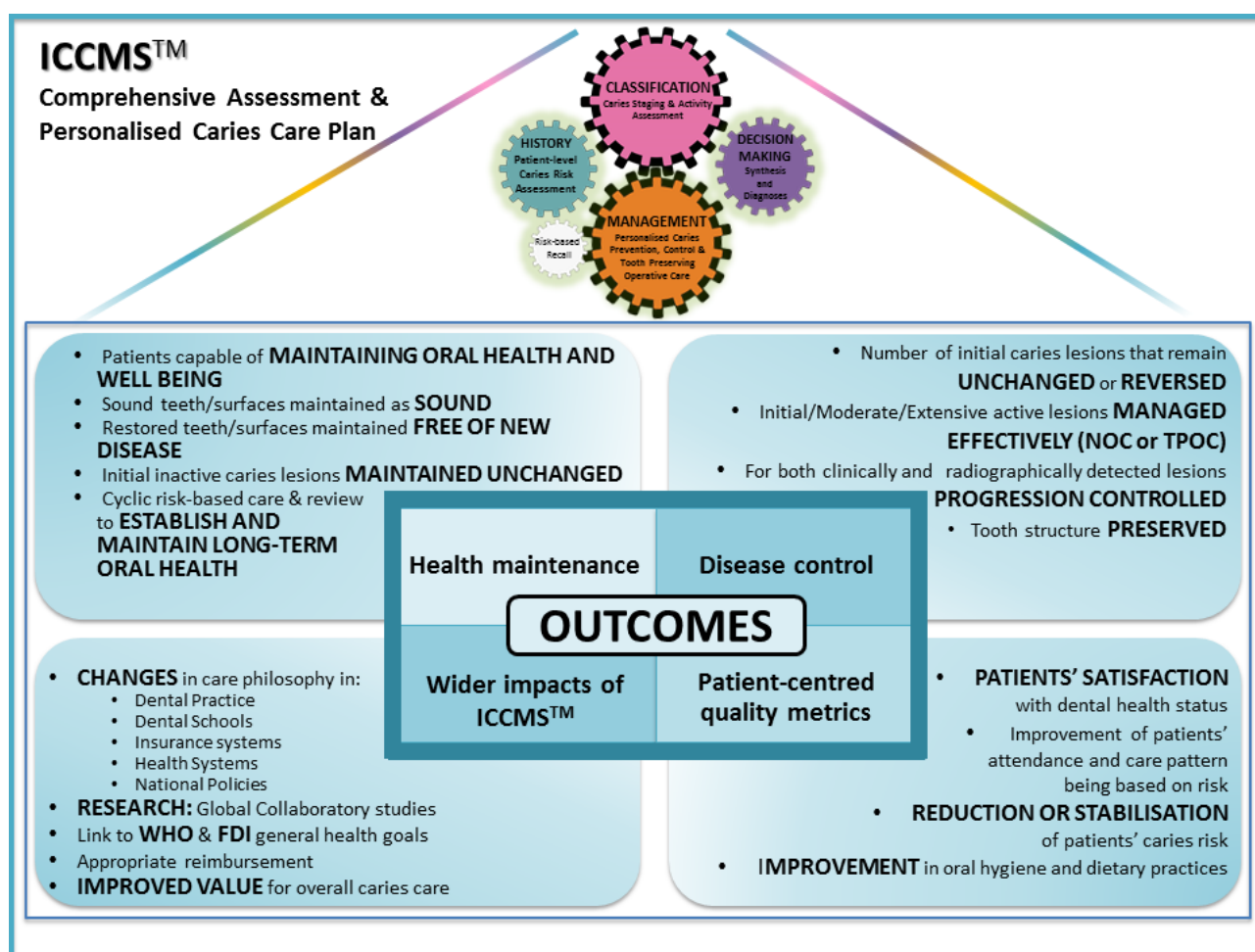


Figure 10. Detailed Outcomes of Caries Management using ICCMS™.

The use of this system should facilitate feedback on the success of care to patients and dental team as well as informing the reassessment and review of care. Outcomes data (and the recorded systematic use of the ICCMS™) may also help dentists in many countries demonstrate “quality” and protect them in terms of legal liability and challenge. Outcome information can also be used in research, evaluation and improvement of the ICCMS™. The analysis of the outcomes will also facilitate feedback to patients and to third-party payers.

4. ICCMS™ in Practice

While there have been no studies that have evaluated the ICCMS™ system so far, a Global Collaboratory for Caries Management (GCCM) has been formed at King's College London (www.kcl.ac.uk/sspp/kpi/projects/healthpolicy/global-caries-management.aspx) to initiate comparative studies of the proposed systems and evaluate the process and outcomes of its implementation. There have been several short term and less comprehensive studies in the past of novel management methods of dental caries that preserve tooth structure. Mertz-Fairhurst et al.^{95,96} have demonstrated that conservative enamel and dentin removal and sealing-in of caries can save tooth structure and have favorable outcomes. In addition to the scientific evidence that supports the different interventions proposed in this guide, additional evidence indicates that remineralisation is not only limited to enamel but can also occur in dentin⁹⁷. An early childhood caries management approach that focuses on home care, prevention, and restorative care can result in positive outcomes.

In practice, implementation of the ICCMS™ will require introducing decision tools and education programs to increase the comfort level among dentists that the proposed system is pragmatic, practical, and worthwhile to implement. ICCMS™ manages caries holistically as a disease process and not as a lesion⁹⁸. It enables a clinician to go step by step through an evidence-based care pathway.

5. Related Developments

This section provides signposts to four aspects which will help to take ICCMS™ forward. The details are beyond the scope of this manual but users should be aware that regular updates will assess any impact on changes in the evidence base and emerging technologies. The research agenda, both for ICCMS™ and for global implementation will be developed incrementally over time. We hope that a series of integrated e-learning and software applications will assist ICCMS™ users in the fields of education and practice, and the Global Collaboratory for Caries Management will promote and monitor the implementation of ICCMS™ worldwide.

5.1 New Evidence on Current or Emerging Technology

A total of 70 studies on current and emerging technologies to manage caries were reviewed by two members of the Global Collaboratory for Caries Management Workshop and a research assistant with training in public health. The primary clinical outcomes considered were caries incidence and increments, percentage of children with progression and/or inactive caries, odds ratio progression of caries, fluorescence loss/mean fluorescence values, and changes in lesion area/volume and lesion depth. Studies that assessed both non-cavitated and cavitated carious lesions were selected for this review. Data were extracted independently by at least two reviewers and confirmed by a third. The quality of the studies was independently reviewed using criteria based on the SIGN (Scottish Intercollegiate Guidelines Network) guidelines⁹⁹. A single well-conducted

systematic review or a large randomised clinical trial could support a recommendation for an intervention under the SIGN system. The evidence table was checked for consistency and corrections were made based on consensus. The recommendation for any intervention was based on synthesis of the quantity, quality and consistency, applicability, generalisability and clinical impact. Strength of evidence and level of recommendation for each emerging technology were rated using the American Dental Association guidelines and the SIGN system, respectively (See Appendix B).

5.2 Research Agenda for ICCMS™ and the GCCM

Advancing the application of ICCMS™ in practice and education will require that several gaps in the knowledge base are addressed. The research agenda should include a focus on:

- 1) Implementation- Science Research around both understanding the barriers to and how to facilitate the adoption and improvement of ICCMS™ in Clinical Practice and Dental Education - locally and globally.
- 2) Developing and evaluating valid and pragmatic methods for accurate assessment of caries risk in clinical practice.
- 3) Evaluating the validity and utility of the ICCMS™ Caries Risk and Likelihood Matrix in clinical practice.
- 4) Developing and evaluating new diagnostic aids to improve the accuracy of caries classification and activity assessment, especially the differentiation between stages of progression where non-surgical and surgical interventions are indicated.
- 5) Research on detection and management of active lesions on root surfaces and adjacent to restorations and sealants.
- 6) Research to evaluate the impact of using the holistic ICCMS™ Comprehensive Assessment and Personal Caries Care Plan on the future development of caries.
- 7) Developing and evaluating novel remineralising technologies that can inhibit the progression of initial caries lesions.
- 8) Research on restorative techniques and materials to preserve tooth structure and protect teeth from future caries development.
- 9) Ascertaining why some individuals with very high disease levels (current disease) do not respond to traditional primary prevention interventions (e.g., fluoride).
- 10) How the ICCMS™ approach needs to be tailored to specifically manage children with VERY high rates of caries in the primary dentition.
- 11) Ascertaining whether ICCMS™ can work as a sensitive measure of changes in disease in high disease level individuals (primary dentition) where the vast majority of their teeth are at the most severe end of the caries continuum.

5.3 Integrated eLearning and Data Management Software

In order to facilitate the implementation of ICCMS™ in clinical practice and educational settings, the system should be supported by well-designed and tested clinical management software in dental schools and in the dental office. One of the challenges in producing such electronic systems is compatibility with other clinical software, since most practices and educational settings will have at least some form of data capture and management program which may be related to payment. Hence, the best approach identified at the 2013 launch of the Global Collaboratory was to design the ICCMS™ as a software package (or App) that can be utilised as either a stand-alone package or alternatively be accessible from within existing software systems via interoperable bridges.

ICCMS™ software cannot assume all of the roles that full-blown dental practice systems fulfill, but should provide a supportive and educational platform for the logical and comprehensive assessment and subsequent management of dental caries. The software will also have to be designed to have the capacity to allow outcome assessment and quality improvements to be recorded and reported in order that improvements in dental health can be supported. Embedded within the ICCMS™ software there could be e-learning elements to support users in understanding the steps involved in data gathering, synthesis and care planning.

Development work is underway - at the end of 2014 ICCMS™ codes have already been made available to a number of US Dental Schools through “Axiom” software. On the dental practice side initial work to pilot these concepts is underway with the help of Dentrax software in the US and Software of Excellence EXACT software in Australia.

5.4 Implementation for ICCMS™ – GCCM

It is important to emphasise that the ICCMS™ is not static and it can and will be modified when new experiential or clinical research findings become available.

The ICCMS™ System will be supported by an increasing range of documents and tools which are currently under development. These include:

1. This ICCMS™ Guide to Practitioners and Educators.
2. The ICCMS™ Quick Reference Guide, which will correspond to a short “how to”.
3. The ICCMS™ Resource Book - which will cover the ICCMS™ and further supporting evidence and practical considerations in more detail.
4. ICDAS/ICCMS™ Updated E-learning tool (to be available by March 2015).
5. ICCMS™ iCaries Care practice support software APP.
6. ICCMS™ iCaries Care patient support software APP.
7. ICCMS™ Caries Care patient support paper-based tools.

Further Implementation tools should be produced and evaluated in due course as part of the Global Collaboratory for Caries Management initiative – supported by Kings College London and the other participating Universities and Associations in collaboration with supporting Companies.

References

1. Pitts NB. Implementation. Improving Caries Detection, Assessment, Diagnosis and Monitoring. *Monogr Oral Sci* 2009;21:199-208.
2. ICDAS Foundation: International Caries Detection and Assessment System, 2014. <http://www.icdas.org>.
3. Pitts NB, Ekstrand KR. International Caries Detection and Assessment System (ICDAS) and its International Caries Classification and Management System (ICCMS) - methods for staging of the caries process and enabling dentists to manage caries. *Community Dent Oral Epidemiol* 2013;41:e41-e52.
4. Pitts NB, Stamm J. ICW-CCT Statements. *Journal of Dental Research* 2004; 83: Spec. Iss:C125-C128.
5. Pitts N B. Modern Concepts of Caries Measurement. *Journal of Dental Research* 2004; 83: Spec. Iss: C: 43-47.
6. Ismail AI. Visual and Visuo-tactile detection of dental caries. *J Dent Res* 2004;83 Spec. Iss: C56-C66.
7. Ekstrand KR, Ricketts DN, Kidd EA: Reproducibility and accuracy of three methods for assessment of demineralization depth of the occlusal surface: an in vitro examination. *Caries Res* 1997;31:224-231.
8. Ekstrand KR, Ricketts DNJ, Kidd EAM, Qvist V, Schou S: Detection, diagnosing, monitoring and logical treatment of occlusal caries in relation to lesion activity and severity: an in vivo examination with histological validation. *Caries Res* 1998;32:247-254.
9. Ismail AI, Sohn W, Tellez M, Amaya A, Sen A, Hasson H, Pitts NB. The International Caries Detection and Assessment System (ICDAS): an integrated system for measuring dental caries. *Community Dentistry and Oral Epidemiology* 2007;35:170-178.
10. Selwitz RH, Ismail AI, Pitts NB. Dental caries. *Lancet* 2007;369:51-59.
11. Longbottom C L, Huysmans M C, Pitts N B, Fontana M. Glossary of key terms. *Monographs in Oral Science* 2009:209-16.
12. Ismail AI, Tellez M, Pitts NB, Ekstrand KR, Ricketts D, Longbottom C, Eggertsson H, Deery C, Fisher J, Young DA, Featherstone JDB, Evans RW, Zeller GG, Zero D, Martignon S, Fontana M, Zandona A. Caries management pathways preserve dental tissues and promote oral health. *Community Dent Oral Epidemiol* 2013;41:e12–e40.
13. Pitts N, Melo P, Martignon S, Ekstrand K, Ismail A. Caries risk assessment, diagnosis and synthesis in the context of a European Core Curriculum in Cariology. *Eur J Dent Educ* 2011;15:Suppl 1:23-131.
14. Schulte AG, Pitts NB, Huysmans MCDNJM, Splieth C, Buchalla W. European Core Curriculum in Cariology for undergraduate dental students. *Eur J Dent Educ* 2011;15:Suppl 1:9-17.
15. Fisher J, Glick M; FDI World Dental Federation Science Committee (Fernandes CP, Jin LJ, Meyer GB, Yücel T, Clarkson J, Jones D, Meyer D, Pitts N). A new model for caries classification and management: The FDI World Dental Federation Caries Matrix. *J AM Dent Assoc* 2012;143:546-551.
16. Kranz AM, Rozier RG, Preisser JS, Stearns SC, Weinberger M, Lee JY. Preventive Services by Medical and Dental Providers and Treatment Outcomes. *J Dent Res* 2014;93:633-638.
17. Martignon S, Marín LM, Pitts N, Jácome-Liévano S. Consensus on domains, formation objectives and contents in cariology for undergraduate dental students in Colombia. *Eur J Dent Educ* 2014;18:222-33.
18. Beck JD, Weintraub JA, Disney JA, Graves RC, Stamm JW, Kaste LM, Bohannon HM. University of North Carolina Caries Risk Assessment Study: comparisons of High Risk Prediction, Any Risk Prediction, and Any Risk Biologic models. *Community Dent Oral Epidemiol* 1992;20:313-321.
19. Disney JA, Graves RC, Stamm JW, Bohannon HM, Abernathy JR, Zack DD. The University of North Carolina Caries Risk Assessment study: further developments in caries risk prediction. *Community Dent Oral Epidemiol* 1992;20:64-75.
20. MacRitchie HMB, Longbottom C, Robertson M, Nugent Z, Chan K, Radford JR, Pitts NB. Development of the Dundee Caries Risk Assessment Model (DCRAM) – risk model development using a novel application of CHAID analysis. *Community Dent Oral Epidemiol* 2012;40:37-45.
21. Featherstone JD, Domejean-Orliaguet S, Jenson L, Wolff M, Young DA. Caries risk assessment in practice for age 6 through adult. *CDA Journal* 2007;35:703-13.
22. Bratthall D, Hänsel Petersson G. Cariogram—a multifactorial risk assessment model for a multifactorial disease. *Community Dent Oral Epidemiol* 2005;33:256-64.

23. American Dental Association Caries Risk Assessment Forms. (http://www.ada.org/sections/professionalResources/pdfs/topics_caries_instructions.pdf) [accessed on 25 August 2014].
24. Zero D, Fontana M, Lennon AM. Clinical applications and outcomes of using indicators of risk in caries management. *J Dent Educ* 2001;65:1126-32.
25. Paris S, Haak R, Meyer-Lueckel H. Diagnostics, treatment decision and documentation. In: Meyer-Lueckel H, Sebastian P, Ekstrand KR, eds. *Caries management – Science and clinical practice*. Stuttgart; Georg Thieme Verlag KG; 2013, pp 330-333.
26. Tellez M, Gomez J, Pretty I, Ellwood R, Ismail AI. Evidence on Existing Caries Risk Assessment Systems: Are they Predictive of Future Caries? *Community Dent Oral Epidemiol* 2012; 41:67–78.
27. Twetman S, Fontana M, Featherstone JDB. Risk assessment – can we achieve consensus? *Community Dent Oral Epidemiol* 2013; 41: 64-70.
28. ICDAS Foundation e-Learning Course. ICDAS E-Learning Course, 2014. <https://www.icdas.org/icdas-e-learning-course>.
29. Kidd EA, Pitts NB. A reappraisal of the value of the bitewing radiograph in the diagnosis of posterior approximal caries. *Br Dent J* 1990;169:195-200.
30. Pitts NB, Kidd EA. Some of the factors to be considered in the prescription and timing of bitewing radiography in the diagnosis and management of dental caries. *J Dent* 1992;20:74-84.
31. Poorterman JH, Aartman IH, Kalsbeek H. Underestimation of the prevalence of approximal caries and inadequate restorations in a clinical epidemiological study. *Community Dent Oral Epidemiol* 1999;27:331-337.
32. Wenzel A. Bitewing and digital bitewing radiography for detection of caries lesions. *J Dent Res* 2004;83:Spec No C:C72-C75.
33. Hintze H, Wenzel A, Danielsen B, Nyvad B. Reliability of visual examination, fibre-optic transillumination, and bite-wing radiography, and reproducibility of direct visual examination following tooth separation for the identification of cavitated carious lesions in contacting approximal surfaces. *Caries Res* 1998;32:204-209.
34. Thylstrup A, Qvist V. Principal enamel and dentine reactions during the carries progression. In: Thylstrup A, Leach SA, Qvist V, eds. *Dentine and dentine reactions in the oral cavity*. Oxford; IRL Press; 1987.
35. Ricketts DN, Ekstrand KR, Kidd EA, Larsen T. Relating visual and radiographic ranked scoring systems for occlusal caries detection to histological and microbiological evidence. *Oper Dent* 2002;27:231-7.
36. Agustsdottir H, Gudmundsdottir H, Eggertsson H, Jonsson SH, Gudlaugsson JO, Saemundsson SR. Caries prevalence of permanent teeth: a national survey of children in Iceland using ICDAS. *Community Dent Oral Epidemiol* 2010;38:299-309.
37. Ekstrand KR, Luna LE, Promisiero L, Cortes A, Cuevas S, Reyes JF, Torres CE, Martignon S. The reliability and accuracy of two methods for proximal caries detection and depth on directly visible proximal surfaces: an in vitro study. *Caries Res* 2011;45:93-9.
38. Ekstrand KR, Kuzmina I, Bjørndal L, Thylstrup A. Relationship between external and histologic features of progressive stages of caries in the occlusal fossa. *Caries Res* 1995;29:243-250.
39. Ekstrand KR, Ricketts DN, Kidd EAM. Occlusal caries: pathology, diagnosis and logical management. *Dent Update* 2001;28:380-387.
40. Buchalla W. Histological and clinical appearance of caries. In: Meyer-Lueckel H, Sebastian P, Ekstrand KR, eds. *Caries management – Science and clinical practice*. Stuttgart; Georg Thieme Verlag KG; 2013, pp 39-63.
41. Thylstrup A, Bruun C, Holmen L. In vivo caries models – mechanisms for caries initiation and arrestment. *Adv Dent Res* 1994;8:144-157.
42. Ekstrand KR, Bruun G, Bruun M. Plaque and gingival status as indicators for caries progression on approximal surfaces. *Caries Res* 1998;32:41-45.
43. Ekstrand KR, Zero DT, Martignon S, Pitts NB. Lesion activity assessment. *Monogr Oral Sci* 2009;21:63-90.
44. Ekstrand KR, Martignon S. Visual-Tactile Detection and Assessment. In: Meyer-Lueckel H, Sebastian P, Ekstrand KR, eds. *Caries management – Science and clinical practice*. Stuttgart; Georg Thieme Verlag KG; 2013, pp 69-85.
45. Nyvad B, Machiulskiene V, Baelum V. Reliability of a new caries diagnostic system differentiating between active and inactive caries lesions. *Caries Res* 1999;33:252-260.
46. Nyvad B, Machiulskiene V, Baelum V. Construct and predictive validity of clinical caries diagnostic criteria assessing lesion activity. *J Dent Res* 2003;82:117-122.

47. Ekstrand KR, Ricketts DNJ, Longbottom C, Pitts NB. Visual and tactile assessment of arrested initial enamel carious lesions: an in vivo pilot study. *Caries Res* 2005;39:173-177.
48. Ekstrand KR, Martignon S, Ricketts DJ, Qvist V. Detection and activity assessment of primary coronal caries lesions: a methodologic study. *Oper Dent* 2008;32:225-235.
49. Ekstrand K, Martignon S, Holm-Pedersen P. Development and evaluation of two root caries controlling programmes for home-based frail people older than 75 years. *Gerodontology*. 2008;25:67-75.
50. Baker-Dirks O, van Amerongen J, Winkler KC. A reproducible method for caries evaluation. *J Dent Res* 1951;30:346-359.
51. Wong MC, Clarkson J, Glenny AM, Lo EC, Marinho VC, Tsang BW, Walsh T, Worthington HV. Cochrane reviews on the benefits/risks of fluoride toothpastes. *J Dent Res* 2011;90:573-579.
52. Twetman S. Caries prevention with fluoride toothpaste in children: an update. *Eur Arch Paediatr Dent* 2009;10:162-167.
53. Wong MC, Glenny AM, Tsang BW, Lo EC, Worthington HV, Marinho VC. Topical fluoride as a cause of dental fluorosis in children. *Cochrane Database Syst Rev* 2010;CD007693.
54. Marinho VC, Higgins JP, Logan S, Sheiham A. Topical fluoride (toothpastes, mouthrinses, gels or varnishes) for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev* 2003;CD002782.
55. Marinho VC, Higgins JP, Sheiham A, Logan S. One topical fluoride (toothpastes, or mouthrinses, or gels, or varnishes) versus another for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev* 2004;CD002780.
56. Andlaw RJ. Oral hygiene and dental caries--a review. *Int Dent J* 1978;28:1-6.
57. Yevlahova D, Satur J. Models for individual oral health promotion and their effectiveness: a systematic review. *Aust Dent J* 2009;54:190-7.
58. Marinho VC, Higgins JP, Logan S, Sheiham A. Fluoride mouthrinses for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev* 2003; CD002284.
59. Nordström A, Birkhed D. Preventive effect of high-fluoride dentifrice (5,000 ppm) in caries-active adolescents: a 2-year clinical trial. *Caries Res* 2010;44:323-31.
60. Baysan A, Lynch E, Ellwood R, Davies R, Petersson L, Borsboom P. Reversal of primary root caries using dentifrices containing 5,000 and 1,100 ppm fluoride. *Caries Res* 2001;35:41-6.
61. Ekstrand KR, Poulsen JE, Hede B, Twetman S, Qvist V, Ellwood RP. A Randomized Clinical Trial of the Anti-Caries Efficacy of 5,000 Compared to 1,450 ppm Fluoridated Toothpaste on Root Caries Lesions in Elderly Disabled Nursing Home Residents. *Caries Res* 2013;47:391-8.
62. Ismail AI, Ondersma S, Jedele JM, Little RJ, Lepkowski JM. Evaluation of a brief tailored motivational intervention to prevent early childhood caries. *Community Dent Oral Epidemiol* 2011;39:433-48.
63. Cooper AM, O'Malley LA, Elison SN, Armstrong R, Burnside G, Adair P, Dugdill L, Pine C. Primary school-based behavioural interventions for preventing caries. *Cochrane Database Syst Rev* 2013;CD009378.
64. Weinstein P1, Harrison R, Benton T. Motivating parents to prevent caries in their young children: one-year findings. *J Am Dent Assoc* 2004;135:731-8.
65. Ahovuo-Saloranta A, Forss H, Walsh T, Hiiri A, Nordblad A, Mäkelä M, Worthington. Sealants for preventing dental decay in the permanent teeth. *Cochrane Database Syst Rev* 2013;CD001830.
66. Walsh T, Worthington HV, Glenny AM, Appelbe P, Marinho VC, Shi X. Fluoride varnishes for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev* 2010; CD007868.
67. Marinho VC, Worthington HV, Walsh T, Clarkson. Fluoride varnishes for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev* 2013; CD002279.
68. Beirne PV, Clarkson JE, Worthington HV. Recall intervals for oral health in primary care patients. *Cochrane Database Syst Rev* 2007;CD004346.
69. Harris R, Gamboa A, Dailey Y, Ashcroft A. One-to-one dietary interventions undertaken in a dental setting to change dietary behaviour. *Cochrane Database Syst Rev* 2012; CD006540.
70. Jenson L, Budenz AW, Featherstone JD, Ramos-Gomez FJ, Spolsky VW, Young DA. Clinical protocols for caries management by risk assessment. *J Calif Dent Assoc* 2007;35:714-23.
71. Bardow A, Lagerlöf F, Nauntofte B, Tenovuo J. The role of Saliva. In: Fejerskov O, Kidd E, eds. *Dental Caries: The Disease and its Clinical Management*. Oxford: Blackwell, Munksgaard; 2008;29:190-207.
72. Sreebny LM, Schwartz SS. A reference guide to drugs and dry mouth – 2nd edition. *Gerodontology* 1997;14:33-47.

73. Ship JA. Xerostomia: aetiology, diagnosis, management and clinical implications. In: Edgar M, Dawes C, O'Mullane D, editors. *Saliva and oral health*. London: British Dental Association; 2004. Chapter 4.
74. Klasser GD, Epstein J. Methamphetamine and its impact on dental care. *J Can Dent Assoc* 2005;71:759-62.
75. Madinier I, Harrosch J, Dugourd M, Giraud-Morin C, Fosse T. [The buccal-dental health of drug addicts treated in the University hospital centre in Nice]. [Article in French]. *Presse Med* 2003;32:919-23.
76. Tellez M, Gomez J, Kaur S, Pretty IA, Ellwood R, Ismail AI. Non-surgical management methods of noncavitated carious lesions. *Community Dent Oral Epidemiol* 2013; 41: 79–96.
77. Bellini HT, Arneberg P, von der Fehr FR. Oral hygiene and caries. A review. *Acta odontol. Scand* 1981;39:257-265.
78. Martignon S, Ekstrand KR, Gomez J, Lara JS, Cortes A. Infiltrating/Sealing Proximal Caries Lesions: A 3-year Randomized Clinical Trial. *J Dent Res* 2012;9:288-92.
79. Holmgren CJ, Lo ECM, Hu D. Glass ionomer ART sealants in Chinese schoolchildren - 6-year results. *J Dent* 2013;41:764-770.
80. Kidd EAM, Bjorndal L, Beighton D, Fejerskow O. Caries removal and the pulpo-dentine complex. In: *Dental Caries; the disease and its management*. Second Edition 2008. Blackwell Munksgaard, Oxford UK pp 367-383.
81. Griffin SO, Oong E, Kohn W, Vidakovic B, Gooch BF, Bader J, Clarkson J, Fontana MR, Meyer DM, Rozier RG, Weintraub JA, Zero DT. The Effectiveness of Sealants in Managing Caries Lesions. *J Dent Res* 2008;87:169-174.
82. Bakhshandeh A, Qvist V, Ekstrand KR. Sealing occlusal caries lesions in adults referred for restorative treatment. 2-3 years of follow-up. *Clin Oral Investig* 2012;16:521-529.
83. Ricketts D, Lamont T, Innes NP, Kidd E, Clarkson JE. Operative caries management in adults and children. *Cochrane Database Syst Rev* 2013;CD003808.
84. Schwendicke F, Dörfer CE, Paris S. Incomplete Caries Removal: A Systematic Review and Meta-analysis. *J Dent Res* 2013;92:306-14.
85. Pitts NB, Rimmer PA. An in vivo comparison of radiographic and directly assessed clinical caries status of posterior approximal surfaces in primary and permanent teeth. *Caries Res* 1992;26:146-152.
86. Bader JD, Shugars DA, Bonito AJ. A systematic review of selected caries prevention and management methods. *Community Dent Oral Epidemiol* 2001;29:399-411.
87. Ekstrand KR, Bakhshandeh A, Martignon S. Treatment of Proximal Superficial Caries Lesions on Primary Molar Teeth with Resin Infiltration and Fluoride Varnish versus Fluoride Varnish Only: Efficacy after 1 Year. *Caries Res* 2010;44:41-46.
88. Marinho VCC, Higgins JPT, Logan S, Sheiham A. Fluoride toothpastes for preventing dental caries in children and adolescents. *Cochrane Database of Systematic Reviews* 2003, Issue 1. Art. No.: CD002278.
89. Tomar SL. There is weak evidence that a single, universal dental recall interval schedule reduces caries incidence. *J Evid Base Dent Pract* 2011;11:89-91.
90. Patel S, Bay RC, Glick M. A systematic review of dental recall intervals and incidence of dental caries. *JADA* 2010;141:527-539.
91. American Academy of Pediatric Dentistry (AAPD). Guideline on caries-risk assessment and management for infants, children, and adolescents. Reference Manual V 34 / NO 6 12/13, revised 2011.
92. Clarkson JE, Amaechi BT, Ngo H, Bonetti D. Recall, reassessment and monitoring. *Monogr Oral Sci.* 2009;21:188-98.
93. National Health Service, National Institute for Clinical Excellence Guideline. Dental recall: Recall interval between routine dental examinations. London: NICE, 2004.
94. Ramos-Gomez FJ, Crystal YO, Ng MW, Crall JJ, Featherstone JD. Pediatric dental care: prevention and management protocols based on caries risk assessment. *J Calif Dent Assoc* 2010;38:746-761.
95. Mertz-Fairhurst EJ1, Adair SM, Sams DR, Curtis JW Jr, Ergle JW, Hawkins KI, Mackert JR Jr, O'Dell NL, Richards EE, Rueggeberg F, et al. Cariostatic and ultraconservative sealed restorations: nine-year results among children and adults. *ASDC J Dent Child* 1995;62:97-107.
96. Mertz-Fairhurst EJ1, Curtis JW Jr, Ergle JW, Rueggeberg FA, Adair SM. Ultraconservative and cariostatic sealed restorations: results at year 10. *J Am Dent Assoc* 1998;129:55-66.

97. ten Cate JM. Remineralization of caries lesions extending into dentin. *J Dent Res* 2001;80:1407-11.
98. Løe H. Changing paradigms in restorative dentistry. *J Am Coll Dent* 1995;62:31-36.
99. Scottish Intercollegiate Guidelines Network. SIGN. Preventing Dental Caries in Children at High Caries Risk: Targeted prevention of dental caries in the permanent teeth of 6-16 year olds presenting for dental care. <http://www.sign.ac.uk/pdf/Dental-caries-consultation-draft.pdf> Accessed in July 2013.
100. Glennly AM, Gibson F, Auld E, Coulson S, Clarkson JE, Craig JV, Eden OB, Khalid T, Worthington HV, Pizer B; Children's Cancer and Leukaemia Group (CCLG)/Paediatric Oncology Nurses Forum's (CCLG-PONF) Mouth Care Group. The development of evidence-based guidelines on mouth care for children, teenagers and young adults treated for cancer. *Eur J Cancer* 2010;46:1399-412.
101. Alaki SM, Ashiry EA, Bakry NS, Baghlafl KK, Bagher SM. The effects of asthma and asthma medication on dental caries and salivary characteristics in children. *Oral Health Prev Dent* 2013;11:113-20.
102. Kramer MS, Vanilovich I, Matush L, Bogdanovich N, Zhang X, Shishko G, Muller-Bolla M, Platt RW. The effect of prolonged and exclusive breast-feeding on dental caries in early school-age children. *Caries Res.* 2007;41:484-488.
103. Leong PM, Gussy MG, Barrow SL, De Silva-Sanigorski A, Waters E. A systematic review of risk factors during first year of life for early childhood caries. *Int J Paediatr. Dent* 2013;23:235-50.
104. Lim S, Sohn W, Burt BA, Sandretto AM, Kolker JL, Marshall TA, Ismail AI. Cariogenicity of soft drinks, milk and fruit juice in low-income African-American children: A longitudinal study. *J Am Dent Assoc.* 2008;139: 959-967.
105. Griffin SO, Regnier E, Griffin PM, Huntley V. Effectiveness of Fluoride in Preventing Caries in Adults. *J Dent Res* 2007; 86:410-415.
106. Smith RE, Badner VM, Morse DE, Freeman K. Maternal risk indicators for childhood caries in an inner city population. *Community Dent Oral Epidemiol* 2002;30:176-81.
107. Reisine S, Tellez M, Willem J, Sohn W, Ismail A. Relationship between caregiver's and child's caries prevalence among disadvantaged African Americans. *Community Dent Oral Epidemiol* 2008;36:191-200.
108. Ismail AI, Sohn W, Lim S, Willem JM. Prediction of dental caries progression in primary teeth. *J Dent Res* 2009;88:270-275.
109. Weintraub JA, Prakash P, Shain SG, Laccabue M, Gansky SA. Mothers' caries increases odds of children's caries. *J Dent Res* 2010;89:954-958.
110. Dye BA, Vargas CM, Lee JJ, Magder L, Tinanoff N. Assessing the relationship between children's oral health status and that of their mothers. *J Am Dent Assoc* 2011;142:173-183.
111. Alaluusua S, Malmivirta R. Early plaque accumulation--a sign for caries risk in young children. *Community Dent Oral Epidemiol* 1994;22:273-6.
112. Wendt LK, Hallonsten AL, Koch G, Birkhed D. Oral hygiene in relation to caries development and immigrant status in infants and toddlers. *Scand J Dent Res* 1994;102:269-73.
113. Tagliaferro EP, Ambrosano GM, Meneghim Mde C, Pereira AC. Risk indicators and risk predictors of dental caries in schoolchildren. *J Appl Oral Sci* 2008;16:408-13.
114. Mascarenhas AK. Oral hygiene as a risk indicator of enamel and dentin caries. *Community Dent Oral Epidemiol* 1998;26:331-9.
115. Mathiesen AT, Ogaard B, Rølla G Oral hygiene as a variable in dental caries experience in 14-year-olds exposed to fluoride. *Caries Res* 1996;30:29-33.
116. Domejean S, White JM, Featherstone JDB. Validation of the CDA CAMBRA caries risk assessment – a six year retrospective study. *CDA* 2011;39:709-715.
117. Chattopadhyay A. Oral health disparities in the United States. *Dent Clin N Am* 2008;52:297-318.
118. Costa SM, Martins CC, Bonfim MLC, Zina LG, Paiva SM, Pordeus IA, Abreu MHNG. A systematic review of socioeconomic indicators and dental caries in adults. *Int J Environ Res Public Health* 2012;9:3540-3574.
119. Petersen PE, Bourgeois D, Ogawa H, Estupinan-Day S, Ndiaye C. The global burden of oral diseases and risks to oral health. *Bulletin World Health Organization* 2005;83:661-66.
120. Kidd EAM, O'Hara JW. The caries status of occlusal amalgam restorations with marginal defects. *J Dent Res* 1990;69:1275-7.
121. Boyd MA, Richardson AS. Frequency of amalgam replacement in general dental practice. *J Can Dent Asso* 1985;10:763-766.

122. Goldberg J, Tanzer J, Munster E, Amara J, Thal F, Birkhed D. Cross-sectional clinical evaluation of recurrent enamel caries, restoration of marginal integrity, and oral hygiene status. *J Am Dent Assoc* 1981;102:635-641.
123. Hamilton JC, Moffa JP, Ellison JA, Jenkins WA. Marginal fracture not a predictor of longevity for two dental amalgam alloys: a ten year study. *J Prost Dent* 1983;50:200-202.
124. Ando M, Gonzalez-Cabezas C, Isaacs RL, Eckert GJ, Stookey GK. Evaluation of several techniques for the detection of secondary caries adjacent to amalgam restorations. *Caries Res* 2005;38:350-56.
125. Ruby J1, Barbeau J. The buccale puzzle: The symbiotic nature of endogenous infections of the oral cavity. *Can J Infect Dis* 2002;13:34-41.
126. Li Y, Ge Y, Saxena D, Caufield PW. Genetic profiling of the oral microbiota associated with severe early childhood caries. *J Clin Microbiol* 2007;45:81-7.
127. Teanpaisan R, Chaethong W, Pivat S, Thitasomakul S. Vertical transmission of mutans streptococci and lactobacillus in Thai families. *Pediatr Dent* 2012;34:e24-9. 19.
128. Xu P, Gunsolley J. Application of metagenomics in understanding oral health and disease. *Virulence* 2014;5:424-32.
129. Declerck D, Leroy R, Martens L, Lesaffre E, Garcia-Zattera MJ, Vanden Broucke S, Debyser M, Hoppenbrouwers K. Factors associated with prevalence and severity of caries experience in preschool children. *Community Dent Oral Epidemiol* 2008;36:168-78.
130. Ferreira MA1, Mendes NS. Factors associated with active white enamel lesions. *Int J Paediatr Dent*. 2005;15:327-34.
131. Kleemola-Kujala E, Räsänen L. Relationship of oral hygiene and sugar consumption to risk of caries in children. *Community Dent Oral Epidemiol* 1982;10:224-33.
132. Leroy R, Bogaerts K, Martens L, Declerck D. Risk factors for caries incidence in a cohort of Flemish preschool children. *Clin Oral Investig* 2012;16:805-12.
133. Skrīvele S, Care R, Bērziņa S, Kneist S, de Moura-Sieber V, de Moura R, Borutta A, Maslak E, Tserekhava T, Shakovets N, Wagner M. Caries and its risk factors in young children in five different countries. *Stomatologija* 2013;15:39-46.
134. Quaglio JM, Sousa MB, Ardenghi TM, Mendes FM, Imperato JC, Pinheiro SL. Association between clinical parameters and the presence of active caries lesions in first permanent molars. *Braz Oral Res* 2006;4:358-63.
135. Saini T1, Edwards PC, Kimmes NS, Carroll LR, Shaner JW, Dowd FJ. Etiology of xerostomia and dental caries among methamphetamine abusers. *Oral Health Prev Dent* 2005;3:189-95.
136. Murray Thomson W, Chalmers JM, John Spencer A, Slade GD, Carter KD. A longitudinal study of medication exposure and xerostomia among older people. *Gerodontology* 2006;23:205-13.
137. Chi DL, Berg JH, Kim AS, Scott J; Northwest Practice-based Research Collaborative in Evidence-based Dentistry. Correlates of root caries experience in middle-aged and older adults in the Northwest Practice-based Research Collaborative in Evidence-based Dentistry research network. *J Am Dent Assoc* 2013;44:507-16.
138. Ritter AV, Preisser JS, Chung Y, Bader JD, Shugars DA, Amaechi BT, Makhija SK, Funkhouser KA, Vollmer WM; X-ACT Collaborative Research Group. Risk indicators for the presence and extent of root caries among caries-active adults enrolled in the Xylitol for Adult Caries Trial (X-ACT). *Clin Oral Investig* 2012;16:1647-1657.
139. Sánchez-García S, Reyes-Morales H, Juárez-Cedillo T, Espinel-Bermúdez C, Solórzano-Santos F, García-Peña C. A prediction model for root caries in an elderly population. *Community Dent Oral Epidemiol* 2011;39:44-52.
140. Sugihara N, Maki Y, Okawa Y, Hosaka M, Matsukubo T, Takaesu Y. Factors associated with root surface caries in elderly. *Bull Tokyo Dent Coll* 2010;51:23-30.
141. Ritter AV, Shugars DA, Bader JD. Root caries risk indicators: a systematic review of risk models. *Community Dent Oral Epidemiol* 2010;38:383-397.
142. Hadler-Olsen S, Sandvik K, El-Agroudi MA, Øgaard B. The incidence of caries and white spot lesions in orthodontically treated adolescents with a comprehensive caries prophylactic regimen - a prospective study. *Eur J Orthod* 2012;34:633-9.
143. Lovrov S, Hertrich K, Hirschfelder U. Enamel Demineralization during Fixed Orthodontic Treatment - Incidence and Correlation to Various Oral-hygiene Parameters. *J Orofac Orthop* 2007;68:353-63.
144. Martignon S, Ekstrand KR, Lemos MI, Lozano MP, Higuera C. Plaque, caries level and oral hygiene habits in young patients receiving orthodontic treatment. *Community Dent Health* 2010;27:133-8.

145. Ogaard B. Prevalence of white spot lesions in 19-year-olds: a study on untreated and orthodontically treated persons 5 years after treatment. *Am J Orthod Dentofacial Orthop* 1989;96:423-7.
146. Richter AE, Arruda AO, Peters MC, Sohn W. Incidence of caries lesions among patients treated with comprehensive orthodontics. *Am J Orthod Dentofacial Orthop* 2011;139(5):657-64.
147. van der Veen MH, Attin R, Schwestka-Polly R, Wiechmann D. Caries outcomes after orthodontic treatment with fixed appliances: do lingual brackets make a difference?. *Eur J Oral Sci* 2010;118:298-303.
148. Zimmer BW, Rottwinkel Y. Assessing patient-specific decalcification risk in fixed orthodontic treatment and its impact on prophylactic procedures. *Am J Orthod Dentofacial Orthop* 2004;126:318-24.
149. Bagińska J, Rodakowska E, Wilczyńska-Borawska M, Jamiółkowski J. Index of clinical consequences of untreated dental caries (PUFA) in primary dentition of children from north-east Poland. *Adv Med Sci* 2013;21:1-6.
150. Fejerskov O, Luan WM, Nyvad B, Budtz-Jørgensen E, Holm-Pedersen P. Active and inactive root surface caries lesions in a selected group of 60-80-year-old Danes. *Caries Res* 1991;25:385-391.
151. Lynch E, Beighton D. A comparison of primary root caries lesions classified according to colour. *Caries Res* 1994;28:233-239.
152. Nyvad B, Fejerskov O. Active root surface caries converted into inactive caries as a response to oral hygiene. *Scand J Dent Res* 1986;94:281-284.
153. Banting DW. Diagnosis and prediction of root caries. *Adv Dent Res* 1993;7:80-6.
154. Banting DW. The diagnosis of root caries. *J Dent Educ* 2001;65:991-6.
155. DePaola PF, Soparker PM, Kent RL Jr. Methodological issues relative to the quantification of root surface caries. *Gerodontology* 1988;8:3-8.
156. Guivante-Nabet C, Tavernier JC, Trevoux M, Berenholc C, Berdal A. Active and inactive caries lesions in a selected elderly institutionalised French population. *Int Dent J* 1998;48:111-22.
157. Katz RV. The clinical identification of root caries. *Gerodontology* 1986;5:21-4.
158. Nyvad B, Fejerskov O. Root surface caries: clinical, histopathological and microbiological features and clinical implications. *Int Dent J* 1982;32:311-26.
159. Nyvad B, Fejerskov O. Active root surface caries converted into inactive caries as a response to oral hygiene. *Scand J Dent Res* 1986;94:281-4.
160. Nyvad B, ten Cate JM, Fejerskov O. Arrest of root surface caries in situ. *J Dent Res* 1997;76:1845-53.
161. Nyvad B, Fejerskov O. Assessing the stage of caries lesion activity on the basis of clinical and microbiological examination. *Community Dent Oral Epidemiol* 1997;25: 65-75.
162. Ravald N, Birkhed D. Factors associated with active and inactive root caries in patients with periodontal disease. *Caries Res* 1991;25:377-84.
163. Rosén B, Birkhed D, Nilsson K, Olavi G, Egelberg J. Reproducibility of clinical caries diagnoses on coronal and root surfaces. *Caries Res* 1996;30:1-7.
164. Tan HP, Lo EC, Dyson JE, Luo Y, Corbet EF. A randomized trial on root caries prevention in elders. *J Dent Res* 2010;89:1086-1090.
165. Baca P, Clavero J, Baca AP, Gonzalez-Rodriguez MP, Bravo M, Valderrama MJ. Effect of chlorhexidine-thymol varnish on root caries in a geriatric population: a randomized double-blind clinical trial. *J Dent* 2009;37:679-685.
166. Brailsford SR, Fiske J, Gilbert S, Clark D, Beighton D. The effects of the combination of chlorhexidine/thymol- and fluoride-containing varnishes on the severity of root caries lesions in frail institutionalised elderly people. *J Dent* 2002;30:319-324.
167. Rethman M.P., Beltrán-Aguilar E.D., Billings R., Burne R.A., Clark M., Donly K.J., Hujoel P.P., Katz B.P., Milgrom P., Sohn W., Stamm J.W., Watson G., Wolff M.S., Wright J.T., Zero D., Aravamudhan K., Frantsve-Hawley J. and Meyer D.M. Nonfluoride caries preventive agents: A systematic review and evidence-based. *J Am Dent Assoc* 2011;142:1065-1071.
168. Banting DW, Papas A, Clark DC, Proskin HM, Schultz M, Perry R. The effectiveness of 10% chlorhexidine varnish treatment on dental caries incidence in adults with dry mouth. *Gerodontology* 2000;17:67-76.
169. Tobi H, Kreulen CM, Vondeling H, van Amerongen WE. Cost-effectiveness of composite resins and amalgam in the replacement of amalgam Class II restorations. *Community Dent Oral Epidemiol* 1999; 27:137-143.
170. Miller WA, Massler M. Permeability and staining of active and arrested lesions in dentine. *Br Dent J* 1962;112:187-197.

171. Kidd EAM. Caries diagnosis within restored teeth. *Oper Dent* 1989;14:149-158.
172. Kidd EAM. Caries diagnosis within restored teeth, in Anusavice KJ (ed): *Quality evaluation of dental restorations: Criteria for placement and replacement*. Chicago, Quintessence Publishing Co Inc 1989:111-123.
173. Kidd EAM, Joyston BS, Beighton D. Diagnosis of secondary caries: a laboratory study. *Br Dent J* 1994;176:135-139.
174. Elderton RJ. Variability in the decision making process and implications for change towards a preventive philosophy. In Anusavice KJ (ed): *Quality Evaluation of Dental Restorations: Criteria for Placement and Replacement*. Quintessence Publishing Co 1989:211-219.
175. Kidd EAM, O'Hara JW. The caries status of occlusal amalgam restorations with marginal defects. *J Dent Res* 1990;69:1275-7.
176. Goldberg AJ. Deterioration of restorative materials and the risk for secondary caries. *Adv Dent Res* 1990; 4:14-18.
177. Jorgensen KD, Wakumoto S. Occlusal amalgam fillings: marginal defects and secondary caries. *Odontol Tidsk* 1968;76:43-54.
178. Russell AL. The differential diagnosis of fluoride and non-fluoride enamel opacities. *J Public Health Dent* 1961;21:143-6.
179. Featherstone JD, White JM, Hoover CI, Rapozo-Hilo M, Weintraub JA, Wilson RS, Zhan L, Gansky SA. A randomized clinical trial of anticaries therapies targeted according to risk assessment (caries management by risk assessment). *Caries Research* 2012;46:118-29.
180. Tubert-Jeannin S, Auclair C, Amsallem E, Tramini P, Gerbaud L, Ruffieux C, Schulte AG, Koch MJ, Rège-Walther M, Ismail A. Fluoride supplements (tablets, drops, lozenges or chewing gums) for preventing dental caries in children. *Cochrane Database Syst Rev*. 2011;CD007592.
181. Rethman MP, Beltrán-Aguilar ED, Billings RJ, Hujoel PP, Katz BP, Milgrom P, Sohn W, Stamm JW, Watson G, Wolff M, Wright JT, Zero D, Aravamudhan K, Frantsve-Hawley J, Meyer DM; American Dental Association Council on Scientific Affairs Expert Panel on Nonfluoride Caries-Preventive Agents. Nonfluoride caries-preventive agents: executive summary of evidence-based clinical recommendations. *J Am Dent Assoc* 2011;142:1065-1071.
182. Slot DE, Vaandrager NC, Van Loveren C, Van Palenstein Helderman WH, Van der Weijden GA. The effect of chlorhexidine varnish on root caries: a systematic review. *Caries Res*. 2011;45:162-73.

Appendix A: List of Contributing and Participating Authors

List of Contributing Authors (Appendix A1) who participated in the writers' workshop held in Liverpool (July 1-5, 2013) and Participating Authors (Appendix A2) in the Global Collaboratory for Caries Management at King's College London, June 2-5, 2013 (Contributing authors are also Participating authors). The two Co-editors of the ICCMS™ reports are

Dr. Nigel B. Pitts, Kings College London, UK

nigel.pitts@kcl.ac.uk

Dr. Amid I. Ismail, Temple University, Philadelphia USA

ismailai@temple.edu

Appendix A1: "Contributing authors" - Those who contributed substantially in London, Liverpool and subsequent meetings.

Christopher Deery, University of Sheffield, UK	C.Deery@sheffield.ac.uk
Gail Douglas, University of Leeds, UK	G.V.A.Douglas@leeds.ac.uk
Kim Ekstrand, University of Copenhagen, Denmark	kek@sund.ku.dk
Roger Ellwood, University of Manchester, Colgate, UK	roger.p.ellwood@manchester.ac.uk
Juliana Gomez, University of Manchester, UK	Juliana.gomez@postgrad.manchester.ac.uk
Justine Kolker, University of Iowa, USA	Justine-kolker@uiowa.edu
Chris Longbottom, Kings College, London, UK	christopher.longbottom@kcl.ac.uk
David Manton, University of Melbourne, Australia	djmanton@unimelb.edu.au
Stefania Martignon, Kings College, London, UK; University El Bosque, Bogota, Colombia	stefania.martignon@kcl.ac.uk martignonstefania@unbosque.edu.co
Michael McGrady, University of Manchester, UK	michael.mcgrady@manchester.ac.uk
Peter Rechmann, University of California San Francisco, USA	rechmannp@dentistry.ucsf.edu
David Ricketts, University of Dundee, UK	d.n.j.ricketts@dundee.ac.uk
Van Thompson, Kings College, London, UK	Van.thompson@kcl.ac.uk
Svante Twetman, University of Copenhagen, Denmark	stwe@sund.ku.dk
Robert Weyant, University of Pittsburgh, USA	Rjw1@pitt.edu
Andrea Ferreira Zandona, University of North Carolina, USA	azandona@email.unc.edu
Domenick Zero, Indiana University School of Dentistry, USA	dzero@iu.edu

Appendix A2: "Participating authors" - those who attended and contributed in London and at subsequent meetings, and/or assisted with the preparation of the document.

Avijit Banerjee, Kings College, London, UK	avijit.banerjee@kcl.ac.uk
Bennett T. Amaechi, University of San Antonio, Texas, USA	amaechi@uthscsa.edu
Paul Ashley, Eastman Dental Institute, London, UK	p.ashley@ucl.ac.uk
Ximena Baquero, Universidad El Bosque, Bogota, Colombia	ximenabaquero@gmail.com
Mariana Minatel Bragga, University of Sao Paulo, Brazil	fmmendes@usp.br
Adam Christie, Calcivis Limited, Edinburgh, UK	achristie@calcivis.com
Norma Coleman, School of Dentistry, Meharry Medical College, USA	ncoleman@mmc.edu
Fiona M. Collins, Consultant, Colorado, USA	fionacollins@comcast.net
James DiMarino, Premier, USA	jdimarino@premusa.com
Andrea Cortes, University El Bosque, Bogota, Colombia	andrucortes@gmail.com
Bart Dolpheide, GC Inc., Europe	b.dopheide@gceurope.com
Sophie Doméjean, University of Clermont Ferrand, France	sophie.domejean@udamail.fr
Steve Dunne, Kings College, London, UK	Stephen.dunne@kcl.ac.uk
Ken Eaton, Platform for Oral Health in Europe, UK	kenneth.a.eaton@btinternet.com
Jaime Edelson, (FDI) Mexico	jedelson@mac.com
Hafsteinn Eggertsson, Willamette, Eugene, USA	heggerts@gmail.com
Julian Fisher, University of Lille, France	fisher.julian@mac.com
Margherita Fontana, University of Michigan, USA	mfontan@umich.edu
Audrey Galka, Nova Southeastern University, USA	agalka@nova.edu
Tom Gallop, SS White Company, USA	dhardin@sswhiteburs.com
Joan Gluch, University of Pennsylvania, USA	gluchj@pobox.upenn.edu
Guy Goffin, Procter and Gamble, Europe	goffin.g@pg.com
Susie Goolsby, Virginia Commonwealth University, USA	srgoolsby@vcu.edu
Sue Gregory, Public Health England, UK	sue.gregory@phe.gov.uk
Roy Hoxea, Arizona School of Dentistry and Oral Health, USA	rholexa@atsu.edu
Anahita Jablonski-Momeni, Marburg University, Germany	momeni@staff.uni-marburg.de
Leonard V. Jackson, Virginia Commonwealth University, USA	lvjackson@vcu.edu
Edwina Kidd, Kings College, London, UK	professorkidd@aol.co.uk
Carol Landis, Premier, UK	CLandis@PREMUSA.com
Lisa A. Lang, Case Western Reserve University, USA	lal73@case.edu
Brian Laurence, Howard University, Washington DC, USA	blaurence@howard.edu
Kevin Lewis, Dental Protection, London, UK	kevin.lewis@mps.org.uk
Adrian Lussi, University of Berne, Switzerland	adrian.lussi@zmk.unibe.ch

Eddie Lynch, Warwick University, UK	E.Lynch@warwick.ac.uk
Richard Lynch, GSK, Weybridge, UK	richard.j.lynch@gsk.com
Gayatri Malik, Temple University, Philadelphia, USA	gkotru@gmail.com
Kenneth Markowitz, New Jersey Dental School, USA	markowkj@umdnj.edu
Steve Mason, GSK, Weybridge, UK	stephen.x.mason@gsk.com
Roger Matthews, Denplan, UK	RogerM@denplan.co.uk
Michael Metz, University of Louisville, USA	Mjmetz01@louisville.edu
Janelle Montgomery, Smile-On Healthcare Learning, UK and USA	janelle.montgomery@healthcare-learning.com
Ana Neumann, University of Texas, USA	Ana.Neumann@uth.tmc.edu
Hien C Ngo, University of Kuwait, Kuwait	hien.ngo@hsc.edu.kw
Brian B. Novy, Loma Linda University, USA	bnovy@llu.edu
Matthew Palermo, Temple University, Philadelphia, USA	mpalermo@DENTAL.Temple.edu
Klaus Pieper, University of Marburg, Germany	pieper@med.uni-marburg.de
Elmar Reich, (FDI) Biberach, Germany	ereich@t-online.de
Dianne Rekow, Kings College, London	Dianne.rekow@kcl.ac.uk
Eric Rooney, Public Health, UK	Eric.rooney@phe.gov.uk
Margaret Scarlett, Margaret Scarlett Consulting, Atlanta, USA	mscarlett@scarlettconsulting.com
Andreas Schulte, Heidelberg University, Germany	Andreas.Schulte@med.uni-heidelberg.de
Sachin Seth, Dalhousie University, USA	Sachin.Seth@Dal.Ca
Jiangyun Sheng, Boston University, USA	jsheng@bu.edu
Woosung Sohn, Boston University, USA	woosung@bu.edu
Henry St. Germain, University of Nebraska, Lincoln, NE, USA	hstgerma@unmc.edu
Peter Stracey, Software of Excellence, UK	Peter.Stracey@soeuk.com
Noam Tamir, Smile-On Healthcare Learning, UK	noam.tamir@healthcare-learning.com
Graham Thornicroft, Kings Improvement Science, Kings College, London, UK	graham.thornicroft@kcl.ac.uk
Bruce Vernon, Calcivis Limited, Edinburgh, UK	bvernon@calcivis.com
Timothy Watson, Kings College, London, UK	Timothy.f.watson@kcl.ac.uk
Philip Wee, General Practice, London UK	ayhx@aol.com
Mark Wolff, New York University, USA	mark.wolff@nyu.edu
Catherine White, Kings College, London, UK	catherine.white@kcl.ac.uk
Ferranti Wong, Queen Mary Westfield, London, UK	f.s.l.wong@qmul.ac.uk
Douglas Young, University of the Pacific, San Francisco, USA	dyoung@pacific.edu
Olga Lucia Zarta, University El Bosque, Bogota, Colombia	zartao@gmail.com

Appendix B: Scottish Intercollegiate Guidelines Network's (SIGN) Grading of the Evidence

SIGN Levels of Evidence	
1++	High quality meta-analyses, Systematic reviews of RCT's or RCT's with very low risk of bias.
1+	Well conducted meta-analyses, Systematic reviews of RCT's or RCT's with a low risk of bias.
1 ---	Meta-analyses, systematic reviews of RCT's or RCT's with a high risk of bias
2++	High quality systematic reviews of case control and cohort studies. High quality case control or cohort studies with a low risk of confounding and bias and a high probability that the relationship is causal.
2+	Well conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal.
2 --	Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal.
3	Non analytic studies, e.g.: case reports, case series.
4	Expert opinion.

Grades of Recommendation

Note: The grade of recommendation relates to the strength of the supporting evidence on which the evidence is based. It does not reflect the clinical importance of the recommendation.

Grade A	Grade B	Grade C	Grade D	☑
At least one meta-analysis, systematic review, or RCT rated as 1++ and directly applicable to the target population	A body of evidence including studies rated as 2++, directly applicable to the target population, and demonstrating overall consistency of results	A body of evidence including studies rated as 2+, directly applicable to the target population and demonstrating overall consistency of results	Evidence level 3 or 4	Recommended best practice based on the clinical experience of the guideline development group.
OR A body of evidence consisting principally of studies rated as 1+, directly applicable to the target population, and demonstrating overall consistency of results	OR Extrapolated evidence from studies rated as 1++ or 1+	OR Extrapolated evidence from studies rated as 2++	OR Extrapolated evidence from studies rated as 2+	

Preventing Dental Caries in Children at High Caries Risk: Targeted prevention of dental caries in the permanent teeth of 6-16 year olds presenting for dental care. Scottish Intercollegiate Guidelines Network. July 2013. <http://www.sign.ac.uk/pdf/Dental-caries-consultation-draft.pdf> ⁹²

Appendix C: Patients' risk factors. A consideration

The ICCMS™ recommends assessing the following risk factors using both interview data and clinical assessment:

Patient Level	<p>Medical health Current use of medications, recreational drugs, or systemic conditions that may cause hyposalivation⁷¹⁻⁷⁵.</p>
	<p>Head and neck radiation Patients undergoing radiotherapy for head and neck cancer are categorised as high risk for developing caries because of the side effects or sequelae of the treatment regimens^{100,101}. The symptoms include (but are not limited to) xerostomia or hyposalivation, mucositis (affecting eating and oral hygiene practices) and altered taste sensation (which may result in patients utilizing inappropriate or cariogenic means of addressing the issue).</p>
	<p>Sugary drinks and snacks Based on the evidence from systematic reviews and several well-conducted cohort studies¹⁰²⁻¹⁰⁴ it can be concluded that there is a significant association, though weaker than in the past under modern dietary practices and fluoride exposure, between higher risk of dental caries and high exposure to sugared beverages and snacks. Therefore, consumption of sugared beverages and snacks needs to be included as a part of a patient's caries risk assessment.</p>
	<p>Fluoride exposure Patients under certain conditions can be considered to have inadequate fluoride exposure if they have the following profiles^{52,55,66,88,105}:</p> <ul style="list-style-type: none"> • No daily use of fluoridated toothpaste (less than 2x daily) • For children: tooth brushing with non-fluoridated toothpaste <p>Concentration of fluoridated toothpaste less than 1000 ppm of fluoride.</p>
	<p>Mothers or caregivers' caries experience It is well accepted that development of early childhood caries is influenced by environmental factors beyond individual-level factors, including a mother or caregiver's dental health. Several mother-child dyad studies reported that there is a significant correlation between mothers and children's caries status¹⁰⁶⁻¹¹⁰, thus suggesting a mother's (or caregiver's) caries status can be a predictor for child's caries development.</p>

Oral hygiene behaviors

Poor oral hygiene status as evidenced by accumulated plaque on the dentition can be predictive of caries development and, hence, is a useful risk indicator. However, the relationship between presence of plaque and caries risk is complex because it depends on the presence of cariogenic bacterial species, which is the determinant factor, and, hence, its use in clinical risk assessment must be viewed with caution. A longitudinal study¹¹¹ demonstrated that visible plaque on the labial surface of incisors in young children (19 months) was good predictor of caries development at 36 months of follow-up, demonstrating a sensitivity of 83% and specificity of 92%. The research team was able to correctly classify 91% of children with regard to future caries risk using plaque accumulation alone. Wendt et al. (1994) also demonstrated that oral hygiene (i.e., toothbrushing) status in infants and toddlers was associated with lower caries risk¹¹². In a 7-year follow up study, Tagliaferro et al. (2008) found that oral hygiene status was predictive of high caries at baseline but was not predictive of new caries incidence over the 7 year of the study¹¹³. Mascarenhas (1998) reported oral hygiene status to be an important risk indicator for both enamel and dentinal caries in 12-year olds¹¹⁴ and Mathiesen et al. (1996) reported similar results for 14 year olds when brushing with a fluoride dentifrice¹¹⁵. Similarly in adults Domejean et al. (2011) found that visible heavy plaque increased risk for future caries development (OR 2.55; 2.35-2.76)¹¹⁶. In assessing oral hygiene practices, ICCMS™ recommends evaluating the frequency and time spent during tooth brushing and flossing, and timing (after meals, before bedtime).

Socioeconomic status (SES)

Even though definitions of SES may vary, an individual's SES is likely to be an important predictor of caries risk^{117,118}. However, the correlation between SES and dental caries has not always been negative. Data from several emerging economies or rich-developing countries show that caries is more prevalent in higher income groups. The same correlation existed in developed countries in the later part of the 19th and early part of the 20th centuries.

Current evidence from the literature indicating a reverse relationship between one's SES and caries level is mainly based on studies conducted in developed or industrialised countries. Therefore, the relationship might not be applicable to countries at different stages of development. In low-income developing countries, the SES-caries relationship might not be as clear, or can even be reversed (high SES individuals have a higher level of dental caries). Data from the Global Oral Health Data Bank, maintained by the World Health Organization (WHO), suggested that developing countries, where caries prevalence was low initially, experience a high level of caries prevalence as they are industrialised and exposed to refined 'cariogenic' foods¹¹⁹.

The ICCMS™ recommends assessing the following risk factors during the clinical examination of patients:

Intraoral Level	<p>Active caries lesions as defined in a previous section.</p>
	<p>Caries experience</p> <p>Increased caries risk is associated with the presence of restorations (or extractions)¹²⁰⁻¹²². The level of evidence supporting the causal relationship between presence of restorations and increased caries risk is based on a small number of case-control or cohort studies. There is evidence that the presence of marginal ditching places teeth at increased caries risk^{123,124}. The extent of marginal deficiencies will range from those barely perceptible on visual examination alone to those that will readily admit a ball-ended probe. Since an increased width of the marginal deficiency may be a risk factor for the likelihood of developing caries it may be important to have a threshold at which the deficiency is recorded as present or absent. The ICCMS™ recommends that if a ball-ended probe is part of the examination kit, two categories of ditching could be recorded according to whether or not the probe can full enter into the gap between tooth and restoration.</p>
	<p>Thick and undisturbed biofilm</p> <p>Dental caries is now considered an endogenous infection caused by a change in the oral microbial ecology (microbiome) resulting in the selection of bacterial species that have the potential to ferment sugars and starch^{125,126}. The individual differences and complexity of the microbiome are influenced by transmission of bacterial species between infants and their caregivers as well as other environmental sources including foods, drinks, and all human contacts¹²⁷. Recent evidence indicates dental caries and periodontal diseases occur because of a shift in the microbial ecology and the reduction in bacterial diversity of the microbiome in the oral cavity¹²⁸. The level of evidence supporting the causal relationship between accumulation of a thick layer of biofilm or in stagnation areas and increased caries risk is based on several case control and cross-sectional studies^{42,49,129-134}.</p>
	<p>Dry mouth</p> <p>There is an increased caries risk associated with xerostomia/hyposalivation. The level of evidence supporting the causal relationship between xerostomia/hyposalivation and increased caries risk is based a small number of case-control or cohort studies^{135,136}.</p>
	<p>Exposed root surfaces</p> <p>Increased risk of root caries is associated with the number of exposed root surfaces. The level of evidence supporting the causal relationship between root caries and exposed root surfaces is supported by one systematic review, and a small number of case-control or cohort studies¹³⁷⁻¹⁴¹.</p>
	<p>Appliances that may increase development of the biofilm</p> <p>Increased caries risk is associated with the use of an oral appliance including partial dentures. The level of evidence supporting the causal relationship between use of the oral appliances and increased caries risk is based on a small number of case-control or cohort studies, as well as expert opinions¹⁴²⁻¹⁴⁸.</p>
	<p>PUFA</p> <p><i>(Exposed Pulp, Ulceration associated with retained root fragments or sharp edges caused by carious destruction, Fistula, and Abscess)</i></p> <p>Increased caries risk is associated with a higher PUFA score. The level of evidence supporting the causal relationship between an increasing PUFA score and increased caries risk is based on only one study¹⁴⁹.</p>

Appendix D: Full Definition of ICDAS Caries Categories (merged codes)²

Definition of ICCMS™ Caries categories			Specific Tooth surfaces' Findings	
I Caries categories	Sound surfaces (ICDAS code 0)	Sound tooth surfaces show no evidence of visible caries (no or questionable change in enamel translucency) when viewed clean and after prolonged air-drying (5 seconds). Surfaces with developmental defects such as enamel hypomineralisation (including fluorosis); tooth wear (attrition, abrasion and erosion), and extrinsic or intrinsic stains will be recorded as sound.	<i>Pits and Fissures</i>	Multiple stained fissures if seen in other pits/fissures, which are consistent with non-carious habits (e.g. frequent tea drinking or smoking).
	Initial stage caries (ICDAS codes 1 and 2)	Cariou opacity or brown cariou discolouration with no sign of cavitation of the enamel surface. Some lesions on the smooth surfaces may only be revealed after 5 seconds of air-drying.	<i>Pits and Fissures</i>	Cariou discolouration is apparent starting in the base of the fissure or pit and may extend up the wall of the pit/fissure but no distinct loss of enamel is apparent, i.e. the pit/fissure retains its original anatomical appearance. Appearance not consistent with stained pits/fissures (ICDAS™ code 0).
			<i>Mesial / Distal</i>	Usually seen from lingual/ buccal or from occlusal as a shadow confined to enamel.
			<i>Buccal / Lingual</i>	Near the gingival margin or adjacent to areas promoting plaque stagnation such as orthodontic/prosthetic attachments.
	Moderate stage caries (ICDAS codes 3 and 4)	Moderate stage caries has two different appearances: localised enamel breakdown (without dentinal exposure) and dentinal shadowing (sometimes referred to as 'hidden dentinal caries'). Localised enamel breakdown is often seen best after air-drying a surface and confirmation can be assisted with correct use of the WHO/CPI/PSR ball-end probe; use the probe <i>gently across the tooth area</i> (a limited discontinuity is detected if the ball drops into the enamel micro-cavity/discontinuity). Underlying dentine shadow (ICDAS™ code 4) appears as a shadow of grey, blue or brown discoloured dentine visible through either an apparently intact enamel surface or an enamel surface with localised breakdown. It must clearly represent caries that started on the surface being evaluated. If it started on an adjacent surface and there is no evidence of any caries lesion on the one being scored then the surface should be coded "0". Dentinal shadowing is often seen easiest with the tooth surface wet as air-drying the enamel surface makes it more opaque and this may mask the underlying dentinal shadow.	<i>Pits and Fissures</i>	Localised enamel breakdown in the pits and fissures is typified by a widening of the fissure/fossa due to tooth structure cariou loss at its entrance, or within it. Although the pit or fissure may appear substantially and unnaturally wider than normal, the dentine is not visible in the walls or base of the cavity or discontinuity. Underlying dentine shadows in the pits and fissures present as grey, blue or brown discoloured dentine visible beneath the enamel surface or an opaque ring around the pit or fissure from undermined enamel.
			<i>Mesial / Distal</i>	Directly seen from lingual /buccal and when a discoloured dentine is visible through the occlusal marginal ridge.
Extensive stage caries (ICDAS™ codes 5 and 6)	Cavitation due to caries exposing the dentin beneath. Exposure of dentine may not be immediately apparent without air-drying, initially the tooth viewed wet may appear only to have darkening of the dentin visible through the enamel. Once dried there is visual evidence of frank cavitation with dentin clearly visible on walls and base. The WHO/CPI/PSR probe can be used to assess depth of cavity to confirm dentine exposure where the base of the cavity cannot be visualised. Note: The deep pulpal dentine should not be probed.	<i>Pits and Fissures</i>	(In pits or fissures the enamel thickness is 0.5 – 1.0 mm).	

Appendix E: Root caries: Staging of lesions clinically, activity assessment and management options

Staging root caries lesions clinically²

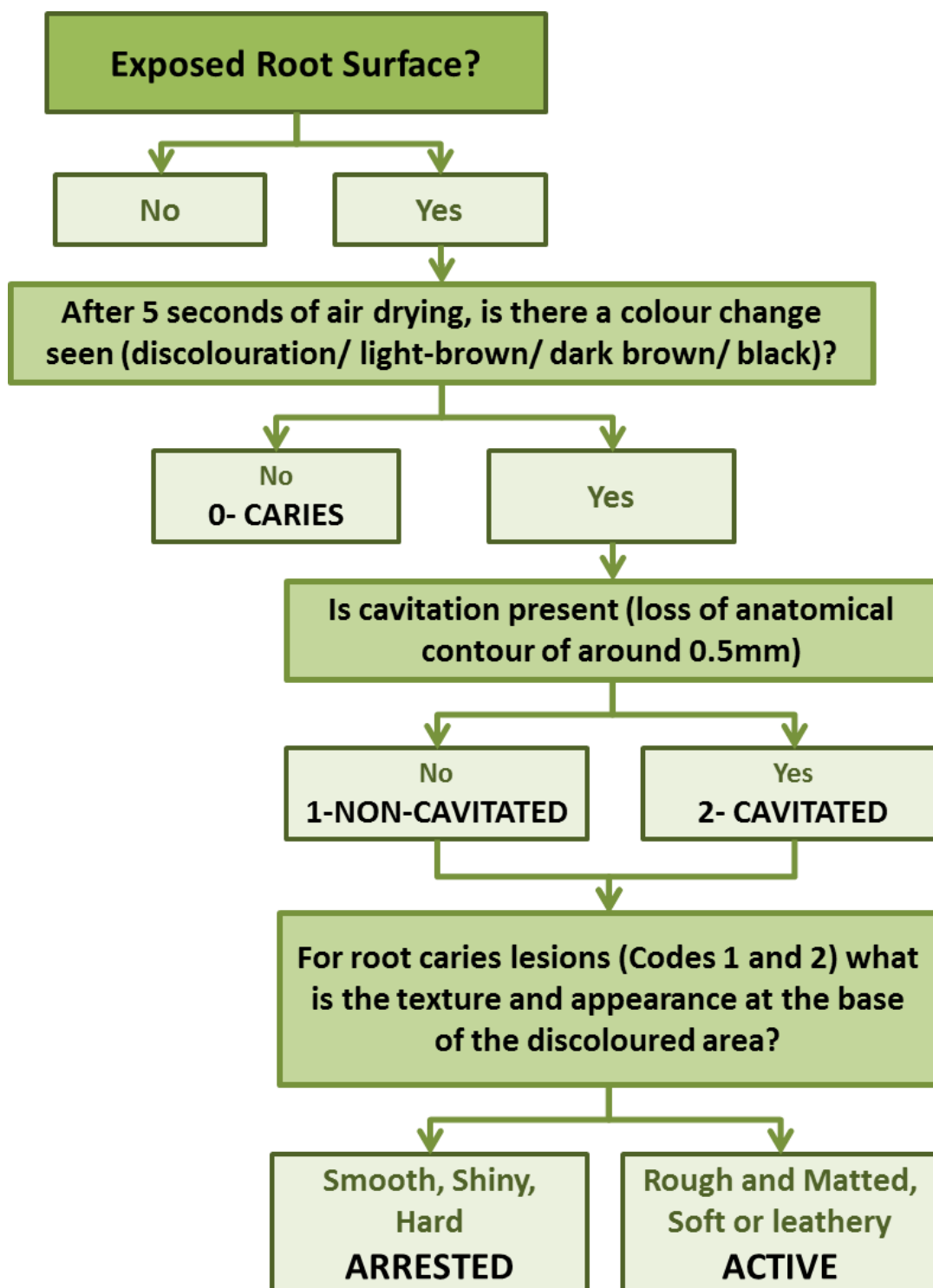
Staging of root caries is based on limited evidence in comparison to coronal caries. The ICCMS™ is looking forward to refining as more evidence comes along.

Root Caries ICDAS Categorisation and description	
Code 0 (Sound)	<p>The root surface does not exhibit any unusual discolouration that distinguishes it from the surrounding or adjacent root areas nor does it exhibit a surface defect either at the cement-enamel junction or wholly on the root surface.</p> <p>The root surface has a natural anatomical contour, or may exhibit a definite loss of surface continuity or anatomical contour that is not consistent with the dental caries process. This loss of surface integrity usually is associated with dietary influences or non-carious lesions such as abrasion or erosion. These conditions usually occur on the facial (labial) surface. These areas are typically smooth, shiny and hard. Abrasion is characterised by a clearly defined outline with a sharp border, whereas erosion has a more diffuse border. Neither condition shows discolouration.</p>
Code 1 (Initial lesion)	<p>There is a clearly demarcated area on the root surface or at the cement-enamel junction (CEJ) that is discoloured (light/dark brown, black) but there is no cavitation present (loss of anatomical contour < 0.5 mm).</p>
Code 2 (Moderate/ Extensive lesion)	<p>There is a clearly demarcated area on the root surface or at the CEJ that is discoloured (light/dark brown, black) and there is cavitation (loss of anatomical contour $\geq 0.5 \text{ mm} \leq 2 \text{ mm}$ (Moderate), $> 2 \text{ mm}$ (Extensive)) present.</p>
Code E	<p>If for any reason a root surface cannot be visualised directly, even with the assistance of gentle air drying, code E (excluded) can be recorded on the dental chart.</p>

Root Caries lesion Activity^{2,49,150-163}

The characteristics of the base of the discoloured area on the root surface can be used to determine whether the root caries lesion is active or not. These characteristics include appearance (shiny/glossy or matte/non-glossy), location in a plaque-stagnation area/not, and perception of texture on gentle probing (soft / leathery, or hard / rough / smooth). Active root caries lesions are usually located within 1 mm of the crest of the gingival margin [Ekstrand et al, 2008, 2013].

The following diagram of characteristics of lesion activity across the ICDAS root caries stages may be useful for reference when examining for root caries:



The management of root caries is most based on expert opinions. The evidence base for supporting any management strategy is either weak or does not exist. ICCMS™ recommends the following management strategies^{49,60,61,164-168}.

ICDAS Root Categories	Activity status	
	Active (leathery and/or soft)	Inactive (hard and shiny)
Root Sound	Risk-based Prevention (Refer to Previous Table)	
Root Initial (Non-cavitated)	Oral hygiene, fluoride varnish, saliva stimulation, high fluoride toothpaste*; chlorhexidine varnish	Refer to Primary Prevention Table and Emerging Evidence section
Root Moderate/Extensive (Cavitated)	TPOC (Glass ionomer cements, composite resin) Oral hygiene, fluoride varnish*, saliva stimulation, high fluoride toothpaste; chlorhexidine varnish	Refer to Primary Prevention Table and Emerging Evidence section TPOC if there is sensitivity or for esthetic reasons

* Best evidence is for the efficacy of 5% fluoride varnish rather than lower fluoride level varnishes.

Appendix F: Some considerations on Caries associated with restorations or sealants (CARS) and Non carious changes^{2,120-122,124,169-177}

Caries-Associated with Restorations and Sealants (CARS) Detection Criteria		
Caries Associated with Restorations and Sealants Codes		
Code 0	Sound tooth surface with restoration or sealant	A sound tooth surface adjacent to a restoration/sealant margin. There should be no evidence of caries (either no or questionable change in enamel translucency after prolonged air drying for 5 seconds). Surfaces with marginal defects less than 0.5mm in width (i.e. will not admit the ball end of the CPI Probe), developmental defects such as enamel hypoplasias; fluorosis; tooth wear (attrition, abrasion and erosion), and extrinsic or intrinsic stains will be recorded as sound. Stained margins consistent with non-cariou habits (e.g. frequent tea drinking) and which do not exhibit signs consistent with demineralization should be scored as sound.
Code 1	First visual change in enamel	When seen wet there is no evidence of any change in colour attributable to carious activity, but after prolonged air drying (for approximately 5 seconds) an opacity or discolouration consistent with demineralisation is visible that is not consistent with the clinical appearance of sound enamel.
Code 2	Distinct visual change in enamel/dentin adjacent to a restoration/sealant margin	<ul style="list-style-type: none"> • If the restoration margin is placed on enamel the tooth must be viewed wet. When wet there is an opacity consistent with demineralisation or discolouration that is not consistent with the clinical appearance of sound enamel (Note: the lesion is still visible when dry). • If the restoration margin is placed on dentin: Code 2 applies to discoloration that is not consistent with the clinical appearance of sound dentin or cementum.
Code 3	Cariou defects of <0.5 mm with the signs of code 2	Cavitation at the margin of the restoration/sealant less than 0.5mm, in addition to either an opacity or discolouration consistent with demineralisation that is not consistent with the clinical appearance of sound enamel or with a shadow of discoloured dentin.
Code 4	Marginal caries in enamel/dentin /cementum adjacent to restoration/sealant with underlying dark shadow from dentin	The tooth surface may have characteristics of code 2 and has a shadow of discoloured dentin which is visible through an apparently intact enamel surface or with localised breakdown in enamel but no visible dentin. This appearance is often seen more easily when the tooth is wet and is a darkening and intrinsic shadow which may be grey, blue, orange, or brown in colour. Note: view tooth wet and then dry. This lesion should be distinguished from amalgam shadows.
Code 5	Distinct cavity adjacent to restoration/sealant	Distinct cavity adjacent to restoration/sealant with visible dentin in the interfacial space with signs of caries as described in code 4, in addition to a gap > 0.5mm in width. OR In those instances where margins are not visible, there is evidence of discontinuity at the margin of the restoration/sealant and tooth substance of the dentin as detected by 0.5mm ball-ended probe run along the restoration/sealant margin.
Code 6	Extensive distinct cavity with visible dentin	Obvious loss of tooth structure, the extensive cavity may be deep or wide and dentin is clearly visible on both the walls and at the base.

Differential Diagnosis between Milder Forms of Dental Fluorosis (Questionable, Very Mild, And Mild) and Nonfluoride Opacities of Enamel^{2,78}

Characteristic	Milder Forms of Fluorosis	Nonfluoride Enamel Opacities
Area affected	Usually seen on or near tips of cusps or incisal edges.	Usually centred in smooth surface; may affect entire crown.
Shape of lesion	Resembles line shading in pencil sketch; lines follow incremental lines in enamel, form irregular caps on cusps.	Often round or oval.
Demarcation	Shades off imperceptibly into surrounding normal enamel.	Clearly differentiated from adjacent normal enamel.
Colour	Slightly more opaque than normal enamel; paper-white. Incisal edges, tips of cusps may have frosted appearance. Does not show stain at time of eruption (in these milder degrees, rarely at any time).	Usually pigmented at time of eruption often creamy-yellow to dark reddish-orange.
Teeth Affected	Most frequent on teeth that calcify slowly (cuspids, bicuspid, second and third molar). Rare on lower incisors. Usually seen on six or eight homologous teeth. Extremely rare in deciduous teeth.	Any tooth may be affected. Frequent on labial surfaces of lower incisors. May occur singly. Usually one to three teeth affected. Common in deciduous teeth.
Gross hypoplasia	None. Pitting of enamel does not occur in the milder forms. Enamel surface has glazed appearance, is smooth to point of explorer.	Absent to severe. Enamel surface may seem etched, be rough to explorer.
Detection	Often invisible under strong light; most easily detected by line of sight tangential to tooth crown.	Seen most easily under strong light on line of sight perpendicular to tooth surface.

Appendix G: Evidence considerations for managing patients' risk factors

Home care	Clinical interventions /approaches	Evidence Level based on Grade Statement	Comments
Tooth brushing twice a day with at least 1,000 ppm F dentifrice		(Level of Evidence 1++; GRADE A)	Reviews confirm the benefits of using fluoride toothpaste in preventing caries in children and adolescents when compared to placebo, but only significantly for higher efficacy toothpastes with fluoride concentrations of 1000 ppm and above. The relative caries preventive effects of fluoride toothpastes of different concentrations increase with higher fluoride concentration. There was strong evidence that daily use of fluoride toothpaste has a significant caries-preventive effect in children compared with placebo (prevented fraction 24%). The effect was boosted by supervised tooth brushing, increased brushing frequency to twice daily, and use of a toothpaste concentration of 1,500 ppm fluoride. Studies are mostly limited to the permanent dentition ^{52,66} . The decision of what fluoride levels to use for children under 6 years should be balanced with the risk of fluorosis and for some with higher levels of risk for fluorosis and low levels of risk for caries, lower levels of fluoride in toothpaste could be considered ^{51,53} .
	Motivational reinforcement	(Level of Evidence 3, Grade D)	Although there is strong evidence that brushing twice per day with a tooth paste containing at least 1000 ppm F has significant benefits in the prevention and control of dental caries, there is limited evidence supporting motivational reinforcement of tooth brushing to change behavior ⁶²⁻⁶⁴ .
Rx F-Mouthrinse		(Level of Evidence 1++, GRADE A)	Both daily (226 ppm F) and weekly (900 ppm F) rinses are efficacious in reducing caries with a prevention fraction of 26% ⁵⁸ .
	Sealants	Level of Evidence 1++, GRADE A)	The application of sealants is a recommended procedure to prevent or control caries. Sealing the occlusal surfaces of permanent molars in children and adolescents reduces caries up to 48 months when compared to no sealant, after longer follow-up the quantity and quality of the evidence is reduced ⁶⁵ .
	F- Varnish 2x /yr.	(Level of Evidence 1-, GRADE B)	This updated review confirms a substantial caries-inhibiting effect of 5% fluoride varnish in both permanent (43%) and primary teeth (37%), however the quality of the evidence was assessed as moderate, as it included studies with a high risk of bias studies, with considerable heterogeneity ⁶⁷ .
	Fluoride gels or solution (2% NaF)	(Level of Evidence 1+, GRADE A)	Reviews confirm the efficacy of fluoride gels and solution with similar levels of efficacy to other fluoride interventions ^{54,55} .
	High Conc. F-Toothpaste	(Level of Evidence 1-, GRADE B)	High fluoride toothpastes (>1450 ppm F) and higher efficacy F toothpastes have been shown to be of added benefit to children and adults at risk of caries. Studies using 5000 ppm F have demonstrated benefits on adolescents ⁵⁹ and also on the treatment of root caries ^{49,60,61} .
General Behaviour Modification in Oral Health	(Motivational Engagement)	(Level of Evidence 1++, GRADE A)	Motivational interviewing has been found to be one of the most effective approaches to altering behaviours in the dental office ⁵⁷ .

Home care	Clinical interventions /approaches	Evidence Level based on Grade Statement	Comments
Risk Modification plan	Dietary intake	(Level of Evidence 1-, GRADE B)	There is some evidence that one-to-one dietary interventions in the dental setting can change behaviour, although the evidence is greater for interventions aiming to change fruit/vegetable and alcohol consumption than for those aiming to change dietary sugar consumption ⁶⁹ .
	Use of recreational drugs	(Level of Evidence 3, Grade D)	There is limited evidence on the role of dental personnel other than referral to specialists. Necessary behavioural change has some unique characteristics, probably requiring specialised training.
	Medication induced hyposalivation	(Level of Evidence 3, Grade D)	Although there is strong evidence on the role of certain drugs in reducing salivary flow, there is limited evidence on the effectiveness and practicality of changing such regimes to benefit oral health. Any such changes must clearly be undertaken in consultation with medical practitioner to ensure effective control of underlying medical conditions.
Increase frequency of fluoride varnish to 4 x /yr.		(Level of Evidence 1-, Grade B)	The benefit of more frequent applications is not clear, but may be beneficial for children at high risk of caries ⁶⁷ .
Combinations of Fluoride therapies		(Level of Evidence 1-, Grade B)	Topical fluorides (mouthrinses, gels, or varnishes) used in addition to fluoride toothpaste achieve a modest reduction in caries compared to toothpaste used alone ⁵⁷ . Combined use of Fluoride therapies for example F varnish and high fluoride toothpaste and mouthrinses may be appropriate for those at high risk (Expert opinion).
Using fluoride dentifrice (1,100 ppm F as NaF), 0.12% chlorhexidine gluconate rinse and 0.05% NaF rinse	Topical NaF gel application (1.1% NaF), counselling on reducing frequency of carbohydrate ingestion	Level of Evidence 1++; GRADE A	There is evidence ¹⁷⁹ that daily use of fluoride toothpaste, 0.12% chlorhexidine rinse 1 minutes 1 week each month, and daily 0.05% F-rinse the other 3 weeks per month results in a statistically significant 24% reduction of mean DMFS between intervention and control (conventional dental care) group in a two year RCT.

Appendix H: Level of evidence for individual lesions' interventions

The level of evidence for each intervention on permanent teeth is as follows:

M_{Initial} Active	<p>No or weak evidence that mechanical removal of biofilm alone, without fluoride prevents lesion progression – however moderate evidence when fluoride dentifrice used. Dental caries is a microbial disease and oral hygiene is an integral part of caries management.</p> <p>Level of evidence for topical clinically applied fluoride - Moderate – 1⁻</p> <p>Level of evidence for oral hygiene with fluoridated dentifrice - Moderate – 1⁻ for concentrations of Fluoride >1000 ppm</p> <p>^b caries preventive effect may be less on occlusal surfaces</p> <p>Level of evidence for resin sealant for initial lesions substantial – 1[*]</p>
M_{Moderate} Active	<p>Level of evidence for Fissure sealing Moderate lesions 2⁺.</p> <p>Level of evidence for proximal infiltration 1⁻, 2⁺</p> <p>Level of evidence TPOC 1⁻</p>
M_{Extensive} Active	<p>Level of evidence TPOC 1⁻</p>

The level of evidence for each intervention level is as follows – some data relating to permanent teeth has been extrapolated to primary teeth:

M_{Initial} Active	<p>No or weak evidence that mechanical removal of biofilm alone, without fluoride prevents lesion progression – however moderate evidence when fluoride dentifrice used. Dental caries is a microbial disease and oral hygiene is an integral part of caries management.</p> <p>Level of evidence for topical clinically applied fluoride - Moderate – 1⁻</p> <p>Level of evidence for oral hygiene with fluoridated dentifrice - Moderate – 1⁻ for concentrations of Fluoride >1000 ppm</p> <p>^b caries preventive effect may be less on occlusal surfaces</p> <p>*Level of evidence for resin-based sealant for initial lesions is substantial for permanent teeth - very limited evidence relates to primary teeth – 1⁺</p> <p>Level of evidence for supervision of oral hygiene with fluoridated toothpaste - 1⁻</p>
M_{Moderate} Active	<p>Level of evidence for fissure sealing Moderate lesions is 2⁺ for permanent teeth – very little evidence relates to primary teeth</p> <p>Level of evidence for separation of teeth to detect cavitation is 2⁺</p> <p>Level of evidence TPOC 1⁻</p>
M_{Extensive} Active	<p>Level of evidence TPOC 1⁻</p>

Appendix I: New Evidence on Current or Emerging Technology

<p>Fluoride supplements¹⁸⁰</p>	<p>Fluoride supplements (tablets, drops, lozenges or chewing gums) for preventing dental caries in children – no benefit over topical fluoride in permanent teeth. Weak evidence found.</p>	<p>This review suggests that the use of fluoride supplements is associated with a reduction in caries increment when compared with no fluoride supplement in permanent teeth. The effect of fluoride supplements was unclear on primary teeth. When compared with the administration of topical fluorides, no differential effect was observed. We rated 10 trials as being at unclear risk of bias and one at high risk of bias, and therefore the trials provide weak evidence about the efficacy of fluoride supplements.</p>
<p>Review xylitol chewing gums (10-20 min. chewing after meals)¹⁸¹</p>	<p>Weak evidence for reducing coronal caries in children 5 and older (Level of Evidence 1---). Extrapolated for adults (no direct evidence) (Level of evidence = 4, Expert opinion).</p>	<p>On the basis of results from three studies, a majority of the panel recommended the use of xylitol lozenges or hard xylitol candy after meals for children older than 5 years. The majority of the panel also suggested a dose of 5 to 8 grams per day divided into two or three doses to maximise clinical benefits. As discussed previously, hard candy also should be used under supervised conditions in neurologically healthy children to reduce the risk of choking. The panel did not find sufficient evidence to support recommendations for use of xylitol by children younger than 5 years. Some members of the panel thought that the existing weak evidence was not sufficient to support a recommendation for the use of xylitol delivered through lozenges.</p>
<p>Antimicrobials Chlorhexidine</p>	<p>(Level of Evidence 1+)¹⁸²</p>	<p>Within the limitations of this review, it may be concluded that in the absence of regular professional tooth cleaning and oral hygiene instructions, CHX-V may provide a beneficial effect in patients in need of special care. The strength of this recommendation is graded as 'weak'.</p>
	<p>Chlorhexidine¹⁸¹</p>	<p>Although chlorhexidine has been shown to reduce <i>Streptococcus mutans</i> in the oral cavity temporarily, most of the clinical studies that evaluated coronal caries as the outcome did not show a statistically significant reduction in caries with the use of chlorhexidine in any vehicle.</p>

Appendix J: Glossary for key words

Note- This glossary will be developed further and made available on the ICDAS website²
(www.icdas.org)

Diagnosis: disease –This should be read in conjunction with the glossary of key terms¹.

Diagnosis: lesion – the human professional summation of all the signs and symptoms of the lesion to arrive at an identification of the status of a lesion in terms of its depth, extent and current activity.

Prognosis – lesion / disease. The likely future outcome for a specific lesion in terms of disease stasis (arrest), regression or progression / The likely future outcome for a patient in terms of the initiation, arrest or progress of the disease in the mouth.

Risk assessment: a process using (non-clinical and clinical) data collection and synthesis aimed at determining the likelihood of disease/lesions being initiated or progressing in a specific time period.

Risk categories: descriptors which specify the level/extent of the likelihood of the initiation or progress of the disease in terms of the number of lesions which will occur within a future specified time period. (Although the level of disease in a population appears to be a continuous scale, in terms of tooth-site numbers affected by caries, there is a general consensus of among dental professionals of using a limited number of discrete categories, such as Low, Medium, High, Extremely High, with or without specifying the number of lesions defining these categories).

Risk indicators: factors which are *associated with* the initiation or progress of the disease.

Risk factors: determinants which contribute to the initiation or progress of the disease.

Caries experience: the sum total of a patient's past caries history, including decayed missing (due to caries) and filled teeth.

Primary prevention (Patient level; site/surface level): the use of techniques (by the patient/carer or Dental professional) aimed at avoiding the onset/initiation of clinical signs of a disease.

Secondary prevention: the use of techniques (by the patient/carer or Dental professional) aimed at: (i) arresting the disease process at any stage of that process and /or (ii) reversing the disease process in its initial stages.

Tertiary prevention: the use of techniques (by the Dental professional) aimed at removing irreversibly diseased tissue and restoring function and/or aesthetics in such a way that further disease progression is avoided.

Healthy tooth tissue: the absence of signs of currently active disease, not absence of signs of past disease.

Disease severity (mouth): the overall level of caries in a mouth in terms of the total number of lesions, combined with the severity of those lesions.

Lesion extent (tooth): the degree to which a lesion has produced demineralization and tissue destruction in a tooth or tooth-site in terms of pulpal direction and/or surface area of a tooth.

Intervention Plan: the sum total of the intended procedures (by patient/carer and/or dental professional aimed at preventing and treating the disease (caries) process and the specific caries lesions present.

Prevention Plan: the sum total of the intended procedures (by patient/carer and/or dental professional aimed at preventing the disease (caries) process and the specific caries lesions present.

Recall: (for this document the convention of including) both *regular* and *intervening* appointments – both for the examination of the overall patient disease (caries) activity and specific lesion behaviour, i.e. both review and monitor

Review (or Re-assessment): (for this document) appointment for patient with a view to the Dental professional reassessing the caries (disease) process, including in relation to patient behaviour.

Monitoring of lesion(s): (for this document) Dental professional assessment of specific lesion behaviour over a time period, which may vary between patients – i.e. lesion re-assessment.

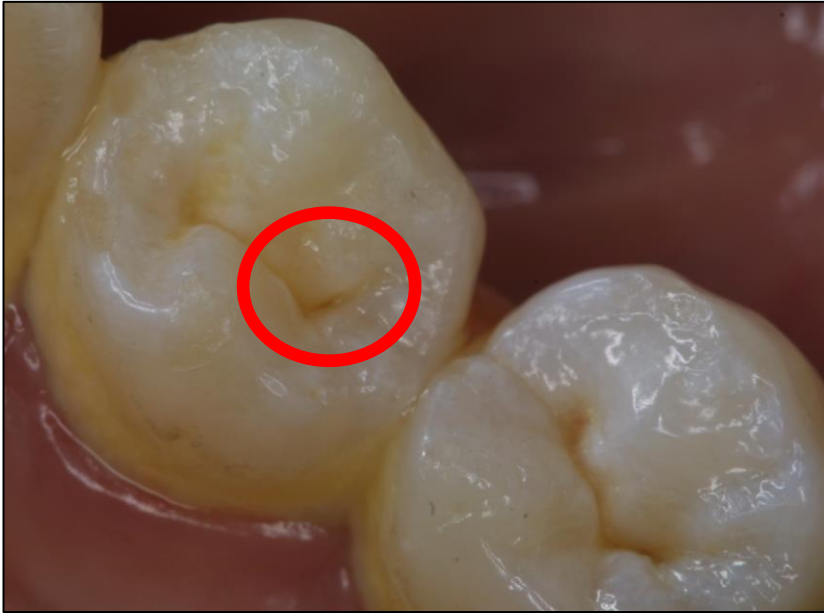
The lesion severity (collapsed) ICDAS codes: Lesion severity code A: The combination of ICDAS codes 1 and 2; Lesion severity code B: The combination of ICDAS codes 3 and 4; Lesion severity code C: The combination of ICDAS codes 5 and 6.

Appendix K: ICCMS™ Caries Staging Photographs and Radiographs

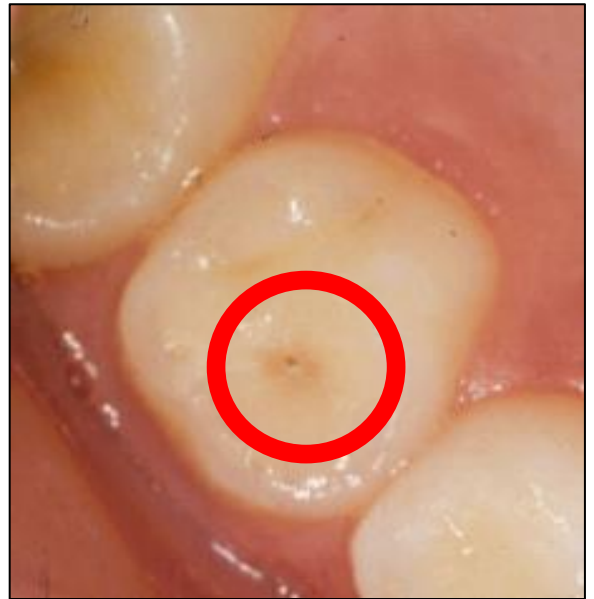
We hope to add future examples over time to the ICDAS webpage (www.icdas.org)

Pits and fissures

Clinically initial caries lesions



Clinically moderate caries lesions (after examining the radiographs some of the lesions may be classified as extensive)



Clinically extensive caries lesions



Smooth tooth surfaces

Clinically initial caries lesions



Clinically moderate caries lesions

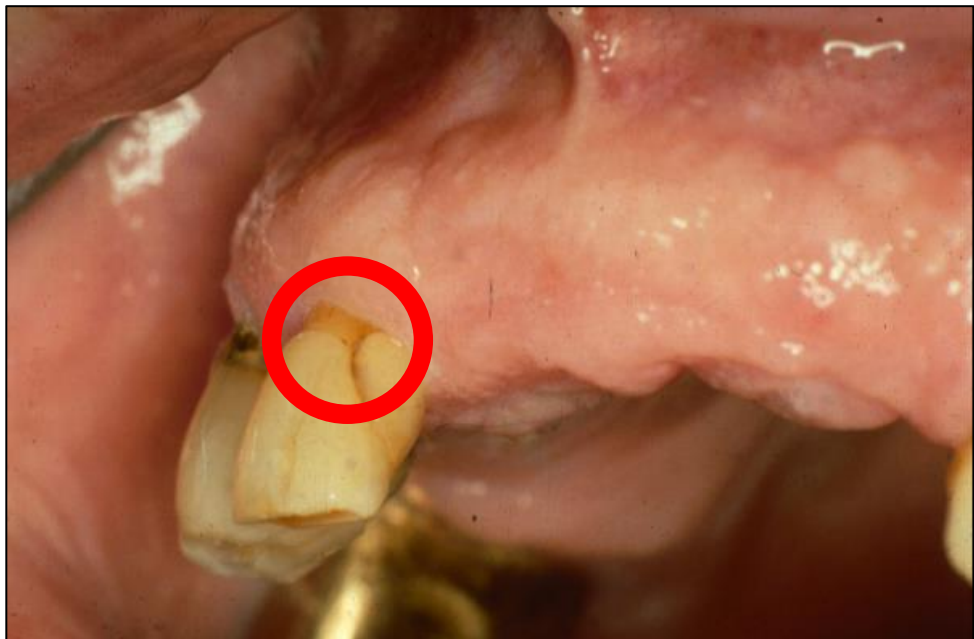
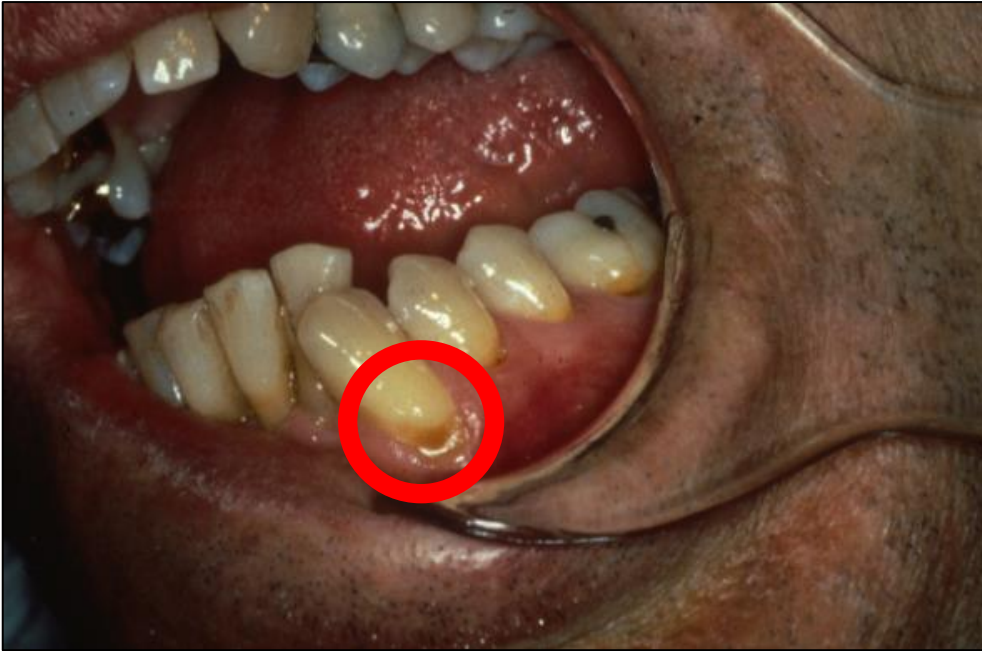


Extensive caries lesions



Root Caries

Clinically non-cavitated lesions



Clinically cavitated lesions



Courtesy of bigdiastema.com

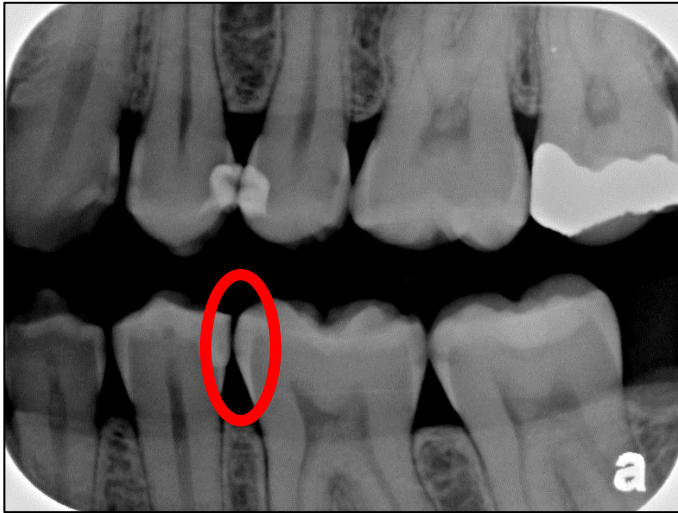


Courtesy of lifecaredental.com.au

Radiographic caries lesions

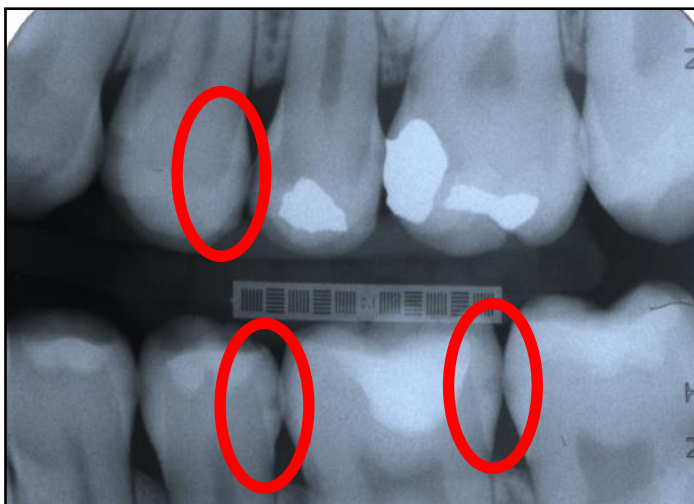
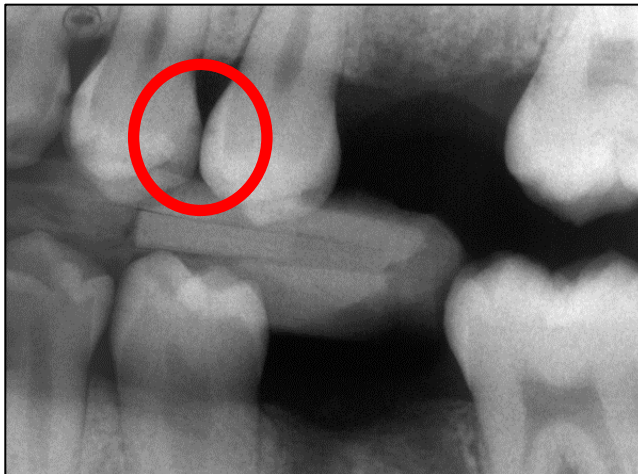
RA: Initial stages

1= radiolucency in the outer ½ of the enamel



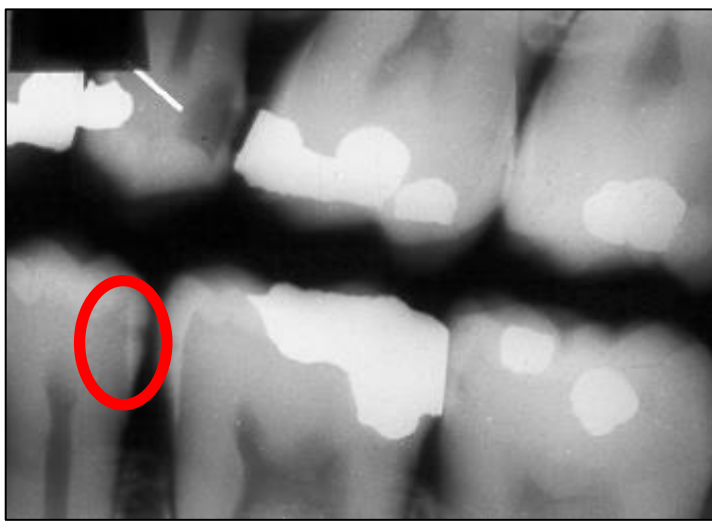
RA: Initial stages

2= radiolucency in the inner ½ of the enamel ± EDJ



RA: Initial stages

3= radiolucency limited to the outer 1/3 of dentin



RB: Moderate stages

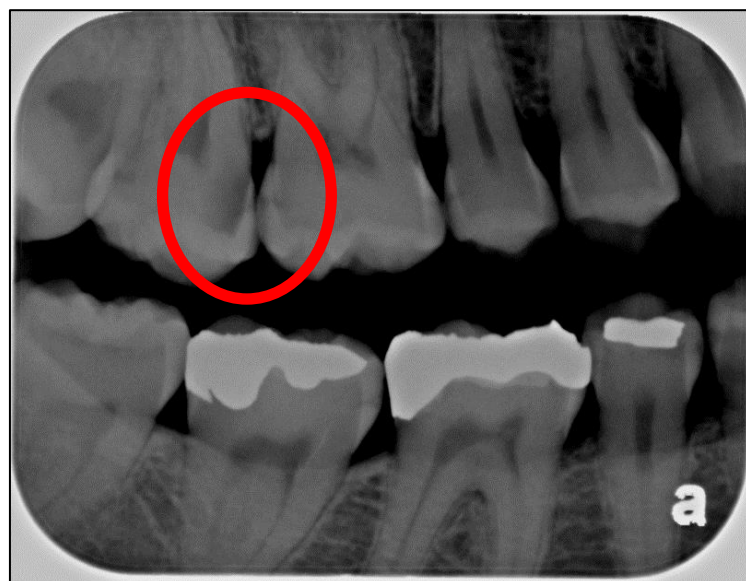
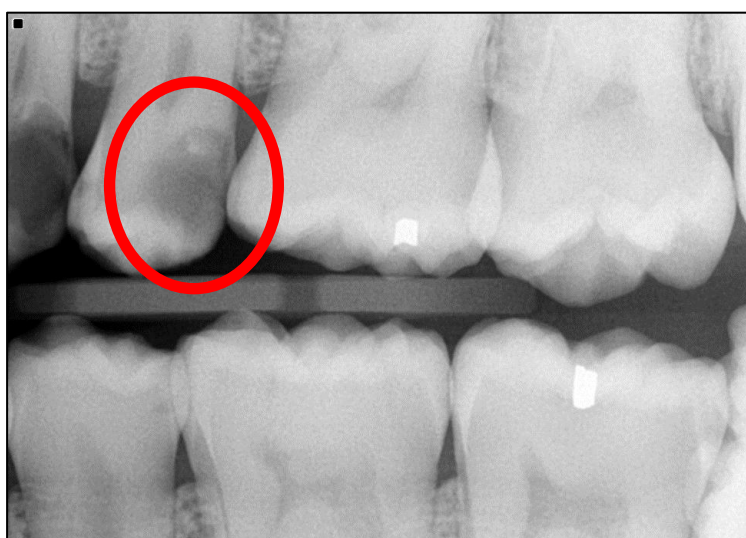
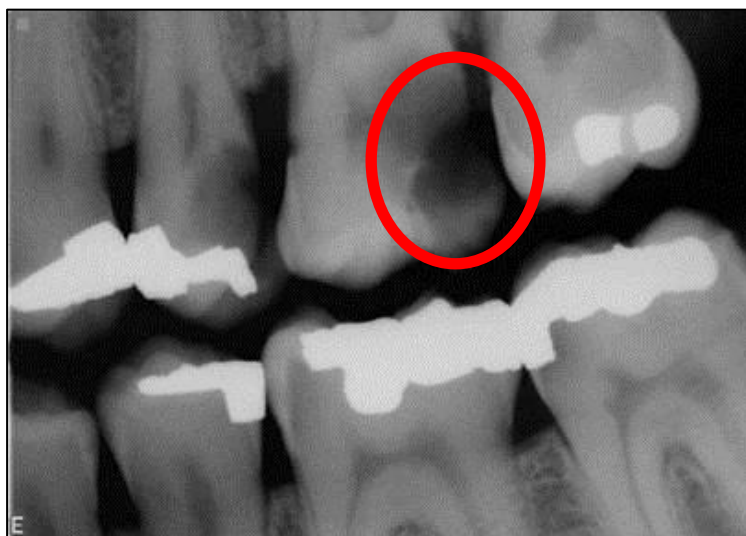
4= radiolucency reaching the middle 1/3 of dentin



Courtesy of <http://dc681.4shared.com/doc/Q-C5tOw2/preview.html>

RC: Extensive stages

5= radiolucency in the inner 1/3 of dentin



Courtesy of www.hillam.net

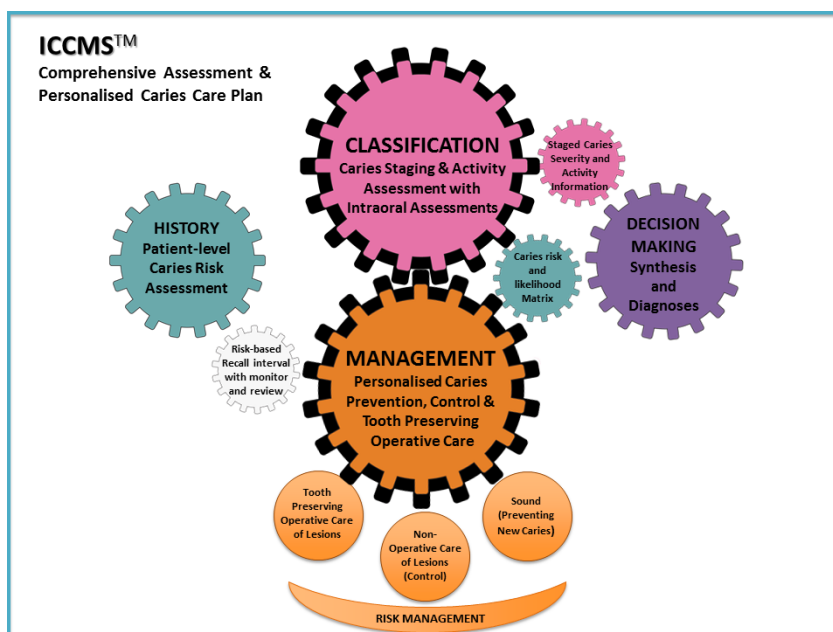
Appendix L: ICCMS™ Clinical Case Example

Note- This case uses the FDI tooth numbering systems.

Patient attending a Dental Clinic in Copenhagen

Patient information:

Male, 25 years old, he lives in Elsinnore, Denmark (ppm F in the water supply = 0.3ppm)



Element 1- Risk Assessment: Assessment of Patient Risk Factors

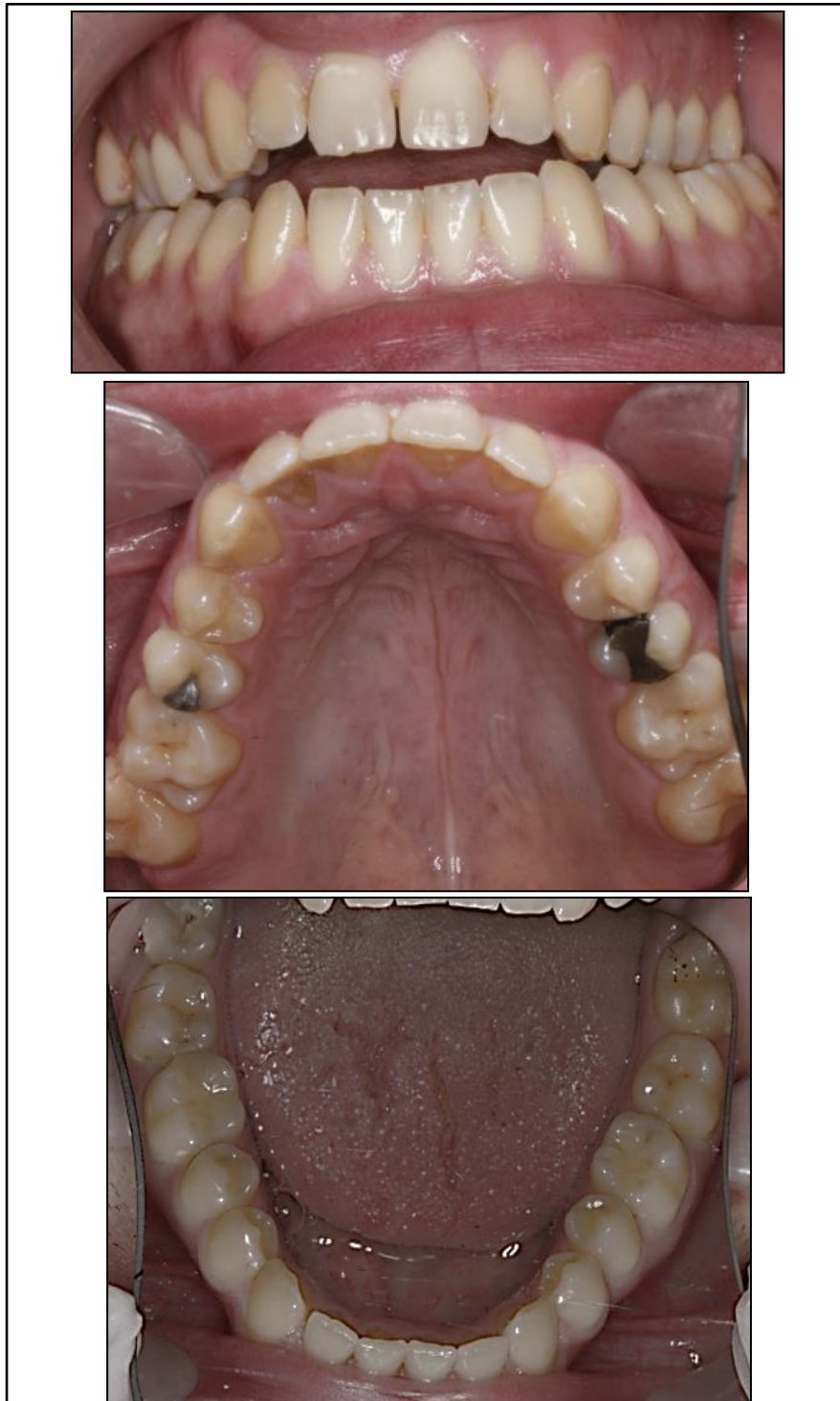
Chief medical and dental complaints: “I have problems with food impaction and have not been to the dentist in the last 3 years”

- Assessment of Patient level caries risk factors

Patient level caries risk factors	At risk	Information
Head and Neck Radiation	<input type="checkbox"/>	No radiotherapy
Dry mouth (conditions, medications/recreational drugs/self-report)	<input type="checkbox"/>	No medicines, no diseases, no self-reported dry mouth
Inadequate oral hygiene practices	<input checked="" type="checkbox"/>	Patient refers that some days he only brushes once a day his teeth (with 1100ppm F toothpaste)
Deficient exposure to topical fluoride	<input checked="" type="checkbox"/>	Some days he only brushes his teeth one time
High frequency/ amount of sugary drinks/ snacks	<input checked="" type="checkbox"/>	Patient refers drinking coffee all day long with sugar (>5 in between meals per day)
Symptomatic-driven dental attendance	<input type="checkbox"/>	No
Social-economic status/Health access barriers	<input type="checkbox"/>	He studies to become a school teacher

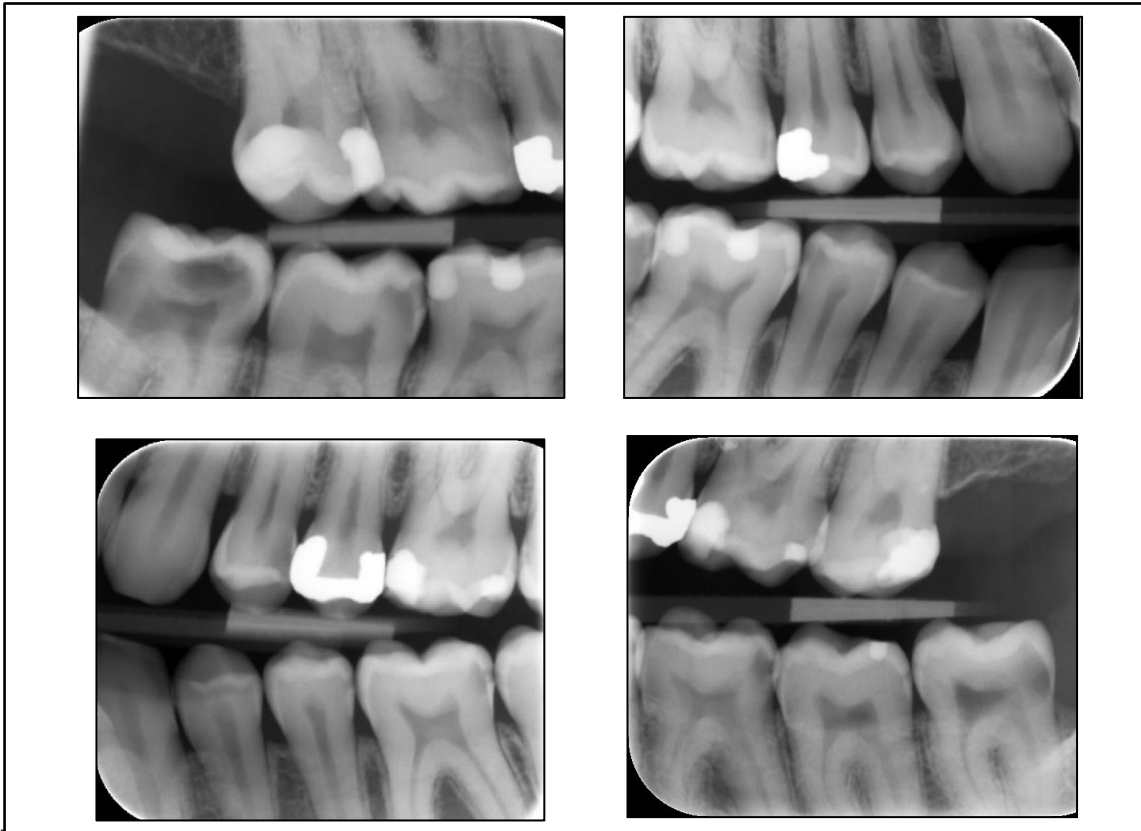
Element 2- Classification: Caries Staging and Lesion Activity Assessment plus Intraoral Caries Risk Factors

- Plaque assessment: presence of thick plaque and gingivitis
- Visual and radiographic assessment
 - o Clinical pictures – overview



- Several coronal caries lesions were detected and staged as Initial, Moderate or Extensive in a number of surfaces by means of the ICCMS™ visual scoring system. Lesions were further assessed as Active or Inactive was further assessed in each lesion.

○ Bite-wing radiographs - overview



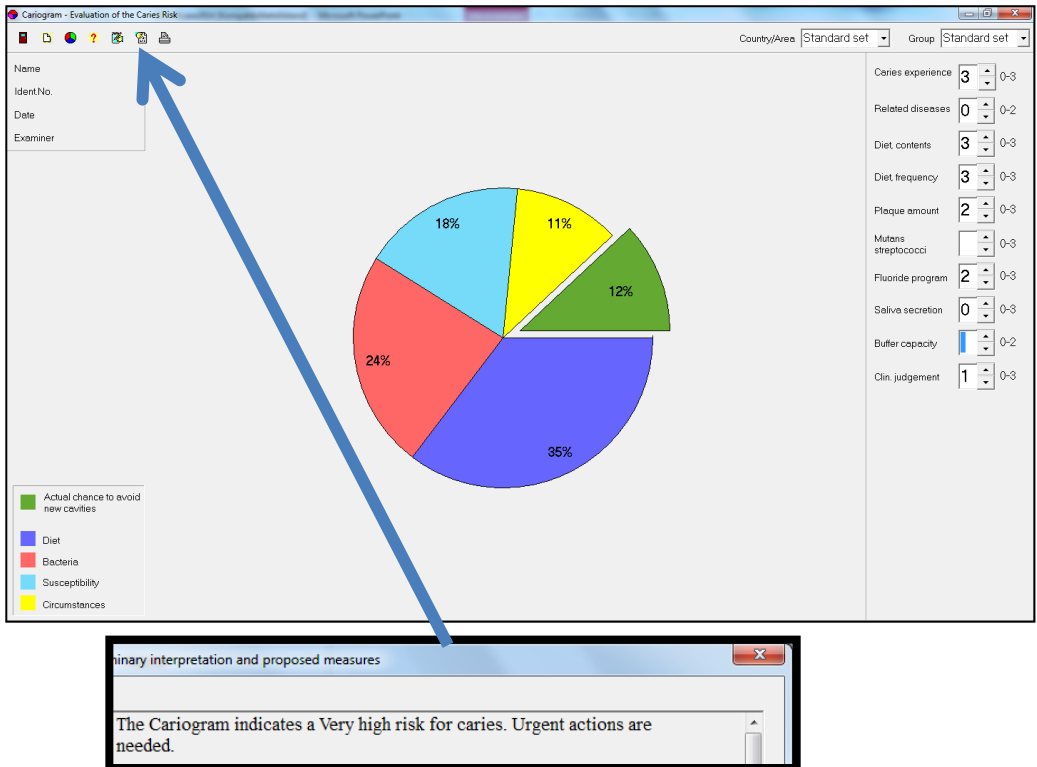
- Several radiolucency zones could be detected and staged in a number of surfaces by means of the ICDAS/ICCMS™ radiographic scoring system as: RA (Initial stages), RB (Moderate stages), RC (Extensive stages).

The combination of clinical (C) and radiographic (R) information (for posterior teeth) of the lesion severity ends up classifying the lesion into the categories of Initial_{CR}, Moderate_{CR} or Extensive_{CR}.

○ Assessment of Intraoral level caries risk factors

Intraoral level caries risk factors	At risk	Information
Hypo-salivation/Gross indicators of dry mouth	<input type="checkbox"/>	Saliva secretion: Normal
PUFA (Exposed pulp, Ulceration, Fistula, Abscess) – Dental sepsis	<input type="checkbox"/>	No PUFA
Caries experience	<input checked="" type="checkbox"/>	High for the country figures at same age group. D ₃ MFT=15 (D ₃ =6; D _{1,2} =3)
Thick plaque: Evidence of sticky biofilm in plaque stagnation areas	<input checked="" type="checkbox"/>	Plaque index; Approximal sites: 45%. Gingivitis index: Approximal sites: 55%. No pathological pockets Calculus lingually on the lower incisors. No changes in colour from normal at the oral mucosa etc.
Appliances, restorations and other causes of increased biofilm retention	<input type="checkbox"/>	No presence of biofilm retention
Exposed root surfaces	<input type="checkbox"/>	No exposed root surfaces

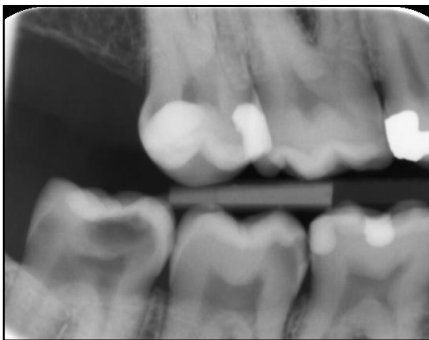
- Caries risk status of the patient
In this case the Cariogram software was used.



The patient's risk status was assessed as High Risk Status.

Element 3- Decision Making: Synthesis and Diagnosis

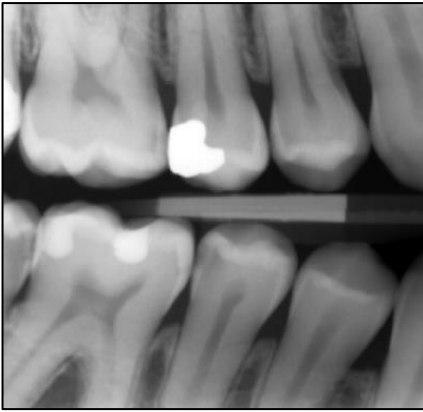
1. ICCMS™ caries diagnosis:



48 occlusal: Extensive active
48 buccally: Extensive active



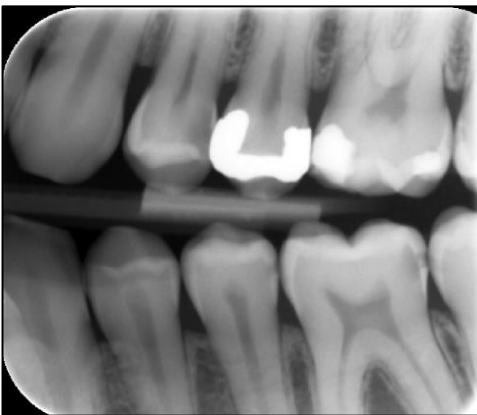
47 occlusally, mesially: Moderate active



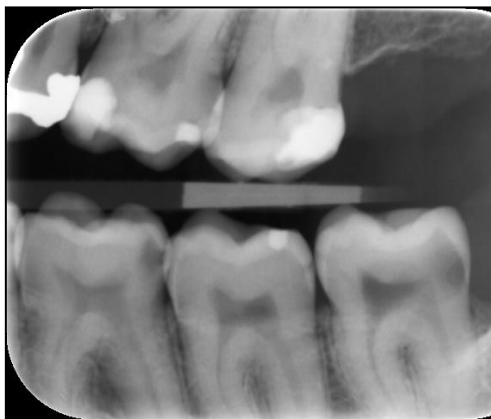
16 mesial: Initial active



46 mesial: Initial active
45 distal: Moderate active



24 distal: Moderate active



35 distal: Initial active
36 distal: Moderate active
37 mesial & buccal: Initial active
38 distal: Extensive active

2. ICCMS™ caries risk analysis to assess likelihood of new lesions or caries progression

In this patient the ICCMS™ caries risk analysis, assessed by means of the likelihood of new lesions or caries progression, depicted:

- 1) The stratification of this individual as a High Risk Status, and
- 2) The current caries activity status at the patient level as Extensive-stage active caries lesions.

		Current Caries Activity Status at the Patient Level		
		No active caries lesions	Initial-stage active caries lesions	Moderate- or extensive-stage active caries lesions
Risk status	Low risk	Low likelihood	Moderate likelihood	Moderate likelihood*
	Moderate risk	Low likelihood	Moderate likelihood	High likelihood
	High risk	Moderate likelihood	High likelihood	High likelihood

So, it is **highly likely** that the patient will develop new lesions within a short period if the caries promoting factors are not changed.

Element 4- Management: Comprehensive Caries Care Plan

4.1 Managing a patient's risk factors (Prevent New Caries)

- Home care

- Instruction in tooth brushing and flossing
- Tooth brushing 2/day \geq 1,450 ppm F- dentifrice
- General Behaviour Modification in Oral Health:
 - Diet counselling: stop /reduce the use of sugar in the coffee
 - Diet counselling: reduce the number of in-between meals

- Clinical Interventions/ approaches

- Motivational reinforcement and One-to-one dietary intake interventions
- F⁻ Varnish four times per year
- Recalls every 3 months where professional cleaning and local treatment with fluoride is done on active lesions

4.2 Managing Individual Lesions

Following the recommended levels of clinical management for active (M_{Initial}: NOC; M_{Moderate}: TPOC in general; M_{Extensive}: TPOC in general), in this patient the management of individual lesions will be:

- 16 Mesial: NOC
 - o Oral hygiene instructions
 - o Fluoride varnish
- 24 Distal: TPOC
 - o Restoration
- 38 Occlusal-Distal: NOC / TPOC
 - o Stepwise excavation / Extraction
- 37 Mesial, Buccal: NOC
 - o Oral hygiene instructions
 - o Fluoride varnish
- 36 Occlusal-Distal: TOPT
 - o Restoration
- 35 Distal: NOC
 - o Oral hygiene instructions
 - o Fluoride varnish
- 45 Distal: TPOC
 - o Restoration
- 46 Mesial: NOC
 - o Oral hygiene instructions
 - o Fluoride varnish
- 47 Mesial-Occlusal: TPOC
 - o Restoration
- 48 Occlusal, Buccal
 - o Extraction

UNIVERSITY OF COPENHAGEN Enhedens navn

16m, I,F

24d Rest.

48o,b ; 47mo ; 46m; 45d
Ex. Rest. I,F Rest.

35d; 36od; 37m,b; 38od
I,F Rest. I,F Stepwise exc.or ex

Slid og dato
Dato 23

Appendix M: Supporters of ICCMS™ and the Global Collaboratory for Caries Management



ICDAS
FOUNDATION
International Caries Detection and Assessment System

ICDAS Foundation



Kings College London

Kings Policy Institute
KCL Dental Institute



Temple University



Dental Protection



GlaxoSmithKline

GSK



CalciVIS



Colgate/ GABA



Henry Schein



Premier



Smile-on



**Alliance for a Cavity-Free
Future**



SS White