

Minimally invasive dentistry part 2: caries risk assessment

Learning outcomes

This article aims to assist the reader to:

- understand the role of caries risk assessment as part of a minimally invasive approach to oral healthcare;
- be aware of some of the available caries risk assessment tools that can be used in practice; and,
- appreciate how caries risk status can be used to tailor oral healthcare for children and adults.

Introduction

Dental caries continues to be a major public health problem in Ireland and worldwide. Untreated dental caries in permanent teeth is the most common health condition in the world according to the Global Burden of Disease 2019 study.¹ Dental team members are acutely aware of the negative impacts of untreated dental caries on the health and well-being of our patients, not to mention the wider societal and economic consequences.² In Ireland each year, approximately 7,000 children are referred for dental extractions under general anaesthesia.³ Although perceived by many as a disease of childhood, the risk and consequences of caries continue into adulthood, and indeed may initiate a lifetime burden of care.

Dental caries is a multifactorial disease, which progresses when pathological factors outweigh preventive factors by tipping the 'caries balance' towards demineralisation and breakdown of the dental hard tissues (**Figure 1**). While restorative dental techniques for caries management and tooth retention have improved significantly over the years, it is clear that preventing dental caries is still preferable to cure.^{4,5} Successful management of dental caries requires both preventive measures and behaviour change, in addition to clinical intervention, preferably using a minimally invasive approach.

Caries risk is the likelihood of a patient developing new caries lesions in the near future. Assessment of a patient's caries risk level can aid clinicians in predicting development of new caries lesions and allow for an individualised approach to caries management. This is in keeping with the concept of minimal intervention dentistry (MID), which deals with the causes of dental disease and not just the outcomes. The aim of MID is to maintain as much healthy tooth structure as possible and keep teeth functional for life.⁶

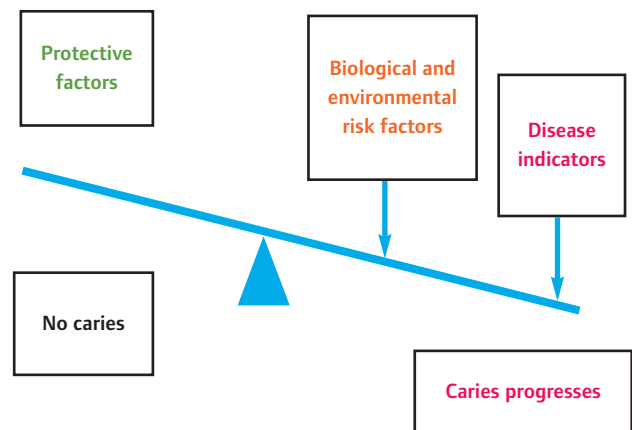


FIGURE 1: The 'caries balance' as depicted in the CAMBRA system.¹²

Caries risk assessment tools

Caries risk can be determined by means of a caries risk assessment (CRA). Several different CRA methods have been developed globally, including the Cariogram, the American Dental Association's (ADA) CRA forms, Caries Management by Risk Assessment (CAMBRA), and the CariesCare Practice Guide systems.⁷⁻¹⁰ The Caries Risk Assessment Checklist (CRAC) has been developed to encourage a formal, risk-based approach to the management of caries in Irish school children.¹¹ Common to all of these systems is the assimilation of information from the medical, behavioural, social and dental histories, and the clinical and radiographic assessment, to inform the CRA.

The dental team may choose any system that best suits local needs and preferences. For the purposes of illustration, we have chosen CAMBRA 123,¹² as it has been relatively well evidenced, and caters for both adults and children. CAMBRA provides a CRA form for two age ranges, namely 0-5 years and six years to adult. The caries risk level is determined by the clinician as low, moderate, high or extreme after evaluating the protective factors, biological and environmental risk factors, and disease indicators. CAMBRA 123 results in a numerical score, which can be used by clinicians to guide decision-making. Both CAMBRA 123 forms and instructions are freely accessible online.¹²



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Table 1: Risk-based caries management options (for children aged under six years).

Risk category	Oral hygiene instruction	Topical fluoride (F ⁻)	Dietary advice	Recall interval	Bitewing interval (from age three)
Low	- Assisted/supervised brushing by adult twice daily - Spit, don't rinse	- For children aged under two years, brush with soft brush and water only as soon as first tooth appears. - For children aged two to five years, use a small pea-sized amount of toothpaste containing at least 1,000ppm F⁻ twice daily.	- Reinforce healthy eating and tooth-friendly drinks advice. - Provide tooth-friendly weaning and snacking advice for infants and toddlers. - Support breastfeeding if applicable. - Drink fluoridated tap water if available.	12 months	Not likely to be indicated.
Moderate	- As above - Consider site-specific interdental cleaning	- As above - Consider professional application of varnish containing 22,600ppm F⁻ at recall visits from age one.	- As above - Consider dietary analysis and individualised advice. - Review diet at recall visits. - Consider requesting sugar-free medications if applicable and/or take with meals if appropriate.	Six months	Depends on detection of proximal caries: enamel caries = two- to three-year interval; dentinal caries = one-year interval.
High	As above	- As above - For children aged under two years, use a small amount of toothpaste (comparable to a grain of rice) containing at least 1,000ppm F⁻ twice daily. - Professional application of varnish containing 22,600ppm F⁻ two to four times a year from age one.	- As above - Dietary analysis and individualised advice.	Three months	As above

Caries risk assessment in practice

The caries risk status informs the development and implementation of a personalised caries management plan for each patient. Preventive measures, bitewing radiograph intervals and recall planning can be tailored for each patient, in accordance with national and international guidelines.^{11,13-15} Furthermore, restorative treatment decisions may also be influenced, e.g., interim high-viscosity glass ionomer restoration for a high-caries-risk patient with multiple lesions, in contrast to a definitive composite restoration in a patient for whom caries risk can be more readily controlled. **Tables 1** and **2** illustrate this tailored approach for different age groups, categorised by caries risk status. These tables represent sample protocols and it is acknowledged that variation will exist depending on local needs, preferred guidance and clinical experience.

The personas in **Figures 2-4** illustrate the practical application of CRA in general dental practice.

Discussion

CRA is integral to MID, which aims to maintain oral health and preserve tooth structure in the long term. Proactive identification of caries risk status, followed by tailored preventive advice, is also well aligned with the common risk factor approach, which is widely advocated within public health strategies to tackle the

rising prevalence of non-communicable diseases. Conditions such as type 2 diabetes, cardiovascular disease and obesity all share common risk factors with caries. Incorporating CRA into clinical practice also helps to 'put the mouth back in the body' by linking oral health to general health.

CRA is a continuous and dynamic process, and a patient's caries risk can change over time. It is important for the dental team to review caries risk at regular intervals. CRA should be performed at least once every second year throughout life. Furthermore, increased attention should be paid to caries risk at certain stages, such as before the eruption of permanent molars, before orthodontic treatment, during pregnancy, and at the onset of chronic diseases such as diabetes.¹⁶

The re-orientation of health services towards prevention is essential for successful implementation of risk-based approaches, as advocated in Smile agus Sláinte, the National Oral Health Policy, and by the World Health Organization (WHO).^{17,18} State-funded dental schemes such as the Dental Treatment Services Scheme (DTSS) do not make provision for preventive measures; rather, they focus on the treatment of disease. Evidence indicates that risk-based programmes result in both reduced costs and improved outcomes for individuals and policymakers.¹⁹ Implementation of CRA can also help to focus resources where they are most needed. In Sweden, geo-mapping of caries risk in children has been used to allocate public resources for preventive care.²⁰

Table 2: Risk-based caries management options (for ages six and over).

Risk category	Oral hygiene instruction	Topical fluoride	Dietary advice	Sealants	Recall interval	Bitewing interval
Low	- Brush twice daily - Two minutes' duration - No rinsing after - Assisted/supervised as appropriate for younger children	Brush with toothpaste containing at least 1,000ppm F ⁻ twice daily.	- Reinforce healthy eating practices and tooth-friendly drinks advice. - Drink fluoridated tap water if available.	Consider fissure sealants on a tooth-by-tooth basis.	12-24 months	Two years ³
Moderate	- As above - Consider site-specific interdental cleaning	- Brush with toothpaste containing 1,450ppm F⁻ twice a day. - Consider professional application of fluoride varnish containing 22,600ppm F⁻ at appropriate recall visits.	- As above - Consider dietary analysis and individualised advice. - Review diet at recall visits. - Consider requesting sugar-free medications if applicable and/or take with meals if appropriate.	Consider sealing pits and fissures of first and second permanent molars.	Six to 12 months	12-18 months
High	- As above - Alcohol-free fluoridated mouthwash	- At a minimum, toothpaste advice as above. - Consider prescribing toothpaste containing 2,800ppm F⁻ for children aged ≥10 years or 5,000ppm F⁻ for people aged ≥16 years. - Professional application of varnish containing 22,600ppm F⁻ two to four times a year. - Consider mouthwash containing 225ppm F⁻ at a different time to brushing for ages seven and over.	- As above - Dietary analysis and individualised advice.	Consider sealing pits and fissures of all permanent teeth	Three to six months	Six to 12 months
Extreme	- As above - Avoid sodium lauryl sulfate (SLS) toothpaste - Saliva substitutes	- Prescribe toothpaste containing 2,800ppm F⁻ for children aged ≥10 years or 5,000ppm F⁻ for people aged ≥16 years. - Otherwise, as above	As above	As above	Three months	Six months

Persona 1 – Martha



Martha is a 26-year-old mature student who has just commenced a nursing degree programme. She has moved into campus accommodation in the city. She is enjoying her course and goes to the library every day to study and work on her assignments. She also works in the evening and at weekends in a cinema.



Martha's general health is important to her. She attends her family dentist once a year for a check-up and has never required a filling. She brushes her teeth twice a day with fluoridated toothpaste.

However, since returning to university her habits have

changed and she sometimes forgets to brush at night. She has also started to treat herself more regularly with a packet of sweets while she is studying and working.



Factor	Score
Fluoridated water	-1
F toothpaste at least once a day	-1
Normal salivary function	-1
Frequent snacking	+2
Total	-1; Moderate caries risk

Actions:



Communicate risk to Martha. Reinforce advice to brush twice daily, including at night, acknowledging the current barriers. Provide advice for healthy, nourishing meals and snacks. Aim to discontinue association of sweets with studying. Obtain bitewing radiographs if not taken within last 12 months. Apply topical fluoride varnish to at-risk sites; consider sealants on a tooth-by-tooth basis. Set recall interval at six months.

FIGURE 2: Persona 1 – Martha.

Persona 2 – Tim

Tim is a 67-year-old farmer who lives two miles from his local village in the countryside. He continues to farm with his adult son and is a keen sports fan. He also enjoys spending time with his family, including three grandchildren living nearby. Tim has enjoyed good health throughout his life. Last year, his GP prescribed an antihypertensive following a routine medical check-up.



Tim's oral health has never been a major concern for him. He gives his teeth a quick brush every morning and most evenings with toothpaste. Since starting his medication, he has noticed his mouth feeling dry. He has started to suck hard sweets as he works on the farm. He has also noticed food tending to get stuck between two of his back

teeth, with occasional sensitivity. He attended his dentist for a check-up. His dentist confirmed that his mouth was dry, and radiographs showed that he had two cavities, which required fillings.



Factor	Score
F toothpaste at least once a day	-1
Frequent snacking	+2
Hyposalivatory medications	+2
Reduced salivary function	+2
New cavities	+3
Total	8; High caries risk

Actions:

Communicate risk to Tim.

Consider liaising with GP with Tim's consent to enquire if an alternative antihypertensive may be prescribed.

Reinforce advice to brush twice daily, including at night. Advise Tim regarding risk of frequent sweet consumption.

Suggest sips of water throughout the day. Consider saliva substitution products.

Apply topical fluoride varnish to at-risk sites; consider prescriptions of toothpaste with increased fluoride concentration, e.g., Duraphat 5000.

Complete restorations and set recall interval at three months.

FIGURE 3: Persona 2 – Tim.

Personae 3 and 4: Daniel and Kayla

Daniel and Kayla are seven-year-old twins. They live with their parents in an estate in a large town. They are both outgoing and busy children. They enjoy school and activities with their friends. Daniel has mild autism. He has a special needs assistant in his classroom who helps him with his reading and language activities.



Daniel and Kayla have had uneventful visits to their family dentist once a year since infancy. Their teeth are brushed twice daily by their father. It is more challenging for Daniel as he does not always cope well with the flavour of the toothpaste. Recently, Daniel has found it more difficult due to sensitivity. Their dentist advised that Daniel has molar incisor hypomineralisation (MIH) and there was enamel breakdown on his newly erupted lower first permanent molars. Kayla's teeth appeared normal. Bitewing radiographs showed that Kayla's teeth were intact, but there were uncavitated lesions evident on Daniel's primary molars.

Persona 3: Daniel

Factor	Score
Fluoridated water	-1
F toothpaste at least once a day	-1
F toothpaste twice daily or more	-1
Normal salivary function	-1
New cavities	+3
New non-cavitated lesions in enamel	+3
Total	6; High*

*Even though the numerical score is 2, Daniel has a high risk of developing caries when considering the overall caries balance. This is due to the presence of MIH and the sensory challenges experienced in this case due to autism.

Actions:

Communicate risk to Daniel's parents.

Provide information regarding MIH.

Advise continuing to brush Daniel's teeth twice daily. Suggest unflavoured F toothpaste, e.g., Oranurse. Consider diet diary to provide tailored dietary advice.

Plan and agree acclimatisation and preparation for Daniel's future visits.

Apply topical fluoride varnish to at-risk sites; fissure seal uncavitated permanent molars. Consider glass ionomer sealant if isolation compromised or hypomineralised enamel present.

Stabilise molars with breakdown, e.g., using high-viscosity glass ionomer cement, and set recall interval at three months. Further planning required regarding definitive management of first permanent molars.

Persona 4: Kayla

Factor	Score
Fluoridated water	-1
F toothpaste at least once a day	-1
F toothpaste twice daily or more	-1
Normal salivary function	-1
Total	-4; Low

Actions:

Communicate risk status to Kayla's parents.

Reinforce advice to brush twice daily, and advice regarding tooth-friendly drinks and snacks.

Consider risk-benefit analysis of topical fluoride varnish and fissure sealants with Kayla's parents.

Agree recall interval. May be up to 12 months given low caries risk.

FIGURE 4: Personae 3 and 4 – Daniel and Kayla.

In summary, implementation of CRA in clinical practice can benefit patients by facilitating a shift towards a health outcomes model of dental care. CRA is aligned with MID and a common risk factor approach, encouraging the integration of oral health with general health.

References

1. Global Burden of Disease (GBD). Disease and Injury Incidence and Prevalence Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017 [published correction appears in *Lancet*. 2019;393(10190):e44]. *Lancet*. 2018;392(10159):1789–1858.
2. Casamassimo PS, Thikkurissy S, Edelstein BL, Maiorini E. Beyond the dmft: the human and economic cost of early childhood caries. *J Am Dent Assoc*. 2009;140(6):650–657.
3. Health Service Executive. Parliamentary Questions Response. 2019(a). PQ 41522/19 link. <https://www.hse.ie/eng/about/personal/pq/pq/2019-pq-responses/october-2019/pq-41522-19-bernard-j-durkan.pdf>.
4. Fraihat N, Madae'en S, Bencze Z, Herczeg A, Varga O. Clinical effectiveness and cost-effectiveness of oral-health promotion in dental caries prevention among children: systematic review and meta-analysis. *Int J Environ Res Public Health*. 2019;16(15):2668.
5. FDI World Dental Federation. FDI policy statement on preventing oral diseases: adopted by the General Assembly: September 2016, Poznan, Poland. *Int Dent J*. 2017;67(1):10–11.
6. FDI World Dental Federation. FDI policy statement on minimal intervention dentistry (MID) for managing dental caries: adopted by the General Assembly: September 2016, Poznan, Poland. *Int Dent J*. 2017;67(1):6–7.
7. Bratthall D, Hänsel Petersson G. Cariogram – a multifactorial risk assessment model for a multifactorial disease. *Community Dent Oral Epidemiol*. 2005;33(4):256–264.
8. American Dental Association (ADA). Caries Risk Assessment Forms. https://www.ada.org/-/media/project/ada-organization/ada/ada-org/files/resources/public-programs/give-kids-a-smile/gkas_caries_risk_assessment_forms.pdf. Accessed October 21, 2023.
9. Young DA, Featherstone JD, Roth JR, et al. Caries management by risk assessment: implementation guidelines. *J Calif Dent Assoc*. 2007;35(11):799–805.
10. Martignon S, Pitts NB, Goffin G, et al. CariesCare practice guide: consensus on evidence into practice [published correction appears in *Br Dent J*. 2019;227(11):988]. *Br Dent J*. 2019;227(5):353–362.
11. Irish Oral Health Services Guideline Initiative. Strategies to prevent dental caries in children and adolescents: guidance on identifying high caries risk children and developing preventive strategies for high caries risk children in Ireland (full guideline). 2009. https://www.dentalhealth.ie/assets/files/pdf/full_strategies_finaleb.pdf.
12. Featherstone JDB, Crystal YO, Alston P, et al. Evidence-based caries management for all ages – practical guidelines. *Front Oral Health*. 2021;2:657518.
13. Kühnisch J, Anttonen V, Duggal MS, et al. Best clinical practice guidance for prescribing dental radiographs in children and adolescents: an EAPD policy document. *Eur Arch Paediatr Dent*. 2020;21(4):375–386.
14. Faculty of General Dental Practice (UK). *Selection Criteria for Dental Radiograph*. 3rd ed. London, UK: 2018.
15. National Collaborating Centre for Acute Care (UK). Dental Recall: Recall Interval Between Routine Dental Examinations. October 2004. NICE Clinical Guidelines, No. 19.
16. Twetman S, Fontana M, Featherstone JD. Risk assessment – can we achieve consensus? *Community Dent Oral Epidemiol*. 2013;41(1):e64–e70.
17. Department of Health Ireland. Smile agus Sláinte: National Oral Health Policy. Department of Health, April 3, 2019.
18. World Health Organization (WHO). Achieving better oral health as part of the universal health coverage and non-communicable disease agendas towards 2030. Report by the Director-General (EB148/8) 148th session of the Executive Board. Provisional Agenda Item 6. December 23, 2020. https://apps.who.int/gb/ebwha/pdf_files/EB148/B148_8-en.pdf. Accessed February 27, 2024.
19. Davidson T, Blomma C, Bågesund M, et al. Cost-effectiveness of caries preventive interventions – a systematic review. *Acta Odontol Scand*. 2021;79(4):309–320.
20. Stromberg U, Magnusson K, Holmen A, Twetman S. Geo-mapping of caries risk in children and adolescents – a novel approach for allocation of preventive care. *BMC Oral Health*. 2011;11:26.