REVIEW ARTICLE

International Caries Detection and Assessment System (ICDAS): An Integrated Approach

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ABSTRACT

Detecting dental caries at the earliest stage is definitely important in planning appropriate treatment for the same. However there is a lack of consistency among various criteria systems which is used to assess stages of dental caries. This inturn will limit the comparability of outcomes in different epidemiological and clinical studies. The ICDAS criteria is a new detection and assessment system classifying different stages of dental caries on the basis of histological extent and activity. The ICDAS criteria were developed by a team of caries researchers and employ an evidence based and prevention oriented approach. It can be used in the four domains of clinical practice, education, research and public health and provides all stake holders a common language for classifying dental caries. Recently ICDAS has evolved to include a number of approved 'formats' which supports decision making at both individual and public health levels and thus generated the ICCMS for improved long term outcomes.

KEYWORDS: Assessment, Dental caries, ICDAS, ICCMS

INTRODUCTION

Detecting dental caries at the earliest stage is of paramount importance. Dental caries is a reversible, biological process in the early stages.[1] If dental caries is detected at the non cavitated stage, it may be possible to enhance re-mineralization or inhibit demineralization by appropriate preventive measures.[2] However, the majority of caries detection methods were ambiguous and took into account only cavitated lesions.[3] The International Caries Detection and Assessment System which is a newly developed visual method for detecting dental caries, is therefore recommended to classify various stages of carious process extending from early clinically visible changes in enamel to wide cavitations.[4] The essential feature of ICDAS is the subdivision of stages of the continuum of dental caries into a variable number of discrete and predictable categories based upon the histological extent of the lesion within the tooth.[5]

DEVELOPMENT OF ICDAS

In 2002 an International Consensus Workshop on Caries Clinical Trials was held involving 95 participants from 23 countries.[6] This workshop sought to review the whole area of cariology and caries clinical trials and seek consensus as to 'agreeing where the evidence leads'. As part of this process, a systematic review of previous caries classification was planned and undertaken.[7]

A key area of consensus to emerge from the meeting was to separate out specific definitions for three specific terms around caries diagnosis which were confused in the literature. The consensus was to refer to[6]:

- Lesion detection- which implies an objective method of determining whether or not the disease is present.
- Lesion assessment- which aims to characterize or monitor a lesion, once it has been detected.
- Caries diagnosis- which should imply a human professional summation of all available data.

The need for further International consensus in the areas of caries detection and assessment realized at the workshop led to the convening of the first meeting of the International Caries Detection and Assessment System Group in the spring 2002. This group sought to overcome as much of the confusion around the evidence and the terminology in this area as possible.[8] One of the main goal of this committee has been to develop an integrated clinical detection and assessment system of dental caries which can be used for research as well as clinical practice. However there is an incompatibility among the terminology, criteria and grading systems which is used across the partially overlapping fields of caries epidemiology, caries research and clinical caries management. This challenge along with the recommendations of the NH Consensus Development Conference (2001) and the ICW Meeting on Clinical Caries Trials, led an adhoc group to start the development of the International Caries Detection and Assessment System-ICDAS.[4]

The 'D' in ICDAS stands for dental caries detection by (i) degree of dental caries; (ii) contour (pit-and-fissure or smooth surfaces); (iii) anatomy (crowns versus roots); and (iv) restoration or pit and fissure sealant status. The

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'A' in ICDAS stands for evaluation of stages of dental caries (non cavitated or cavitated) and activity (active or arrested).[3] The ICDAS measures surface changes and possible histological depth of the carious lesions depending on surface characteristics. Examination of clean and dry teeth is the primary requirement for applying the ICDAS system. The instrument used is a ball ended explorer to remove any plaque or food debris. It is highly recommended that the teeth should be cleaned with a toothbrush or a prophylaxis head/cup before the clinical examination. The use of a sharp explorer is contraindicated as it can damage the enamel surface covering the early carious lesions.[9]

The ICDAS codes for coronal caries varies from 0-6 depending on the degree of the lesion.[10] After the ICDAS convention held in Baltimore, USA in 2005 in association with International Association for Dental Research, the sequence of codes 3 and 4 was swapped with what became known as the ICDAS-II Criteria. Since then, there have been no added changes in the system, so the 'II' suffix has been dropped from the name.[5]

Codes	Pit and Fissures	Smooth Surface
Code 0 Sound	There should be no evidence of caries Surfaces with developmental defects such as enamel hypoplasia; fluorosis; tooth wear and extrinsic or intrinsic stains will be recorded as **sound**.	There should be no evidence of caries. Surfaces with developmental defects such as enamel hypoplasias; fluorosis; tooth wear and extrinsic or intrinsic stains will be recorded as **sound**.
Code 1 First Visual Change in Enamel	When seen wet there is no evidence of any change in color attributable to carious activity, but after prolonged air drying, a carious opacity or discoloration (white or brown lesion) is visible, which is not consistent with the clinical appearance of sound enamel, or when there is a change of color due to caries it is not consistent with the clinical appearance of sound enamel and is limited to the confines of the pit and fissure area (whether seen wet or dry).	When seen wet there is no evidence of any change in color attributable to carious activity, but after prolonged air drying a carious opacity (white or brown lesion) is visible that is not consistent with the clinical appearance of sound enamel. This will be seen from the buccal or lingual surface.
Code 2 Distinct Visual Change in Enamel	The tooth must be viewed wet. When wet there is a carious opacity (white spot lesion)and/or brown carious discoloration which is wider than the natural fissure/fossa that is not consistent with the clinical appearance of sound enamel	There is a carious opacity or discoloration (white or brown lesion) that is not consistent with the clinical appearance of sound enamel. This lesion may be seen directly when viewed from the buccal or lingual direction. In addition, when viewed from the occlusal direction, this opacity or discoloration may be seen as a shadow confined to enamel, seen through the marginal ridge.
Code 3 Localized Enamel Breakdown	The tooth viewed wet may have a clear carious opacity (white spot lesion) and/or brown carious discoloration which is wider than the natural fissure/fossa that is not consistent with the clinical appearance of sound enamel. Once dried for approximately 5 seconds there is carious loss of tooth structure at the entrance to, or within, the pit or fissure/fossa.	Once dried for approximately 5 seconds there is distinct loss of enamel integrity, viewed from the buccal or lingual direction. The base and walls of the cavity are within enamel and dentin is NOT visible.
Code 4 Underlying Dark Shadow from Dentin	This lesion appears as a shadow of discolored dentin visible through an apparently intact enamel surface which may or may not show signs of localized breakdown (loss of continuity of the surface that is not showing the dentin). The shadow appearance is often seen more easily when the tooth is wet.	This lesion appears as a shadow of discolored dentin visible through an apparently intact marginal ridge, buccal or lingual walls of enamel. This appearance is often seen more easily when the tooth is wet. The darkened area is an intrinsic shadow which may appear as grey, blue or brown in color
Code 5 Distinct Cavity with Visible Dentin	Cavitation in opaque or discolored enamel exposing the dentin beneath involving less than half of the tooth surface.	Cavitation in opaque or discolored enamel exposing the dentin beneath involving less than half of the tooth surface
Code 6 Extensive Distinct Cavity with Visible Dentin	Cavitation in opaque or discolored enamel exposing the dentin beneath involving at least half of the tooth surface	Cavitation in opaque or discolored enamel exposing the dentin beneath involving at least half of the tooth surface

Table 1: Coronal Primary Caries Codes

There are slight changes between the visual signs associated with each code depending on a number of factors such as (i)the surface characteristics (ii)adjacent teeth present or not (iii)caries present with a restoration or sealant. Therefore, a detailed description of each of the codes is given under the following headings, so as to help the examiners while using ICDAS: Pits and fissures, smooth surface (both mesial and distal) (Table 1); caries associated with restorations and sealants (CARS) (Table 2); coding for restoration and sealants (Table 3) and root surfaces (Table 4).[10] However the basis of the codes is same through ou t (Table 5).

Code	Caries associated with restoration and sealant 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. Surfaces with marginal defects less than 0.5mm in width, developmental defects such as enamel hypoplasias; fluorosis; tooth wear and extrinsic or intrinsic stains will be recorded as sound.
Code 1 First visual change in enamel	When seen wet there is no evidence of any change in color attributable to carious activity, but after prolonged air drying (for approximately 5 seconds) an opacity or discoloration 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:	The tooth must be viewed wet. When wet there is an opacity consistent with demineralisation or discoloration that is not consistent with the clinical appearance of sound enamel/dentin or cementum
Code 3 Carious 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 discoloration consistent with demineralisation that is not consistent with the clinical appearance of sound enamel or with a shadow of discolored 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 discolored dentin which is visible through an apparently intact enamel surface or with localized 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 color.
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.
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.

Table 2: Caries Associated with Restorations and Sealants Codes

0	Sound: i.e. surface not restored or sealed
1	Sealant, partial
2	Sealant, full
3	Tooth colored restoration
4	Amalgam restoration
5	Stainless steel crown
6	Porcelain or gold or PFM (porcelain fused to metal crown) crown or veneer or inlay or onlay or other restorative material
7	Lost or broken restoration
8	Temporary restoration
9	Used for the following conditions
90	Implant for other non-carious related reasons
91	Implant placed due to caries
92	Pontic placed for reasons other than caries
93	Pontic placed for carious reasons
96	Tooth surface cannot be examined: surface excluded
97	Tooth missing because of caries
98	Tooth missing for reasons other than caries
99	Unerupted

Table 3: ICDAS Two Digit Coding Method for Restorations/Sealants

Code E	If the root surface cannot be visualized directly as a result of gingival recession or by gentle air-drying, then it is excluded. Surfaces covered entirely by calculus can be excluded or, preferably, the calculus can be removed prior
Code 0	The root surface does not exhibit any unusual discoloration that distinguishes it from the surrounding or adjacent root areas nor does it exhibit a surface defect either at the cemento-enamel junction or wholly on the root surface.
Code 1	There is a clearly demarcated area on the root surface or at the cemento-enamel junction (cej) that is discoloured (light/dark brown, black) but there is no cavitation (loss of anatomical contour < 0.5 mm) present.
Code 2	There is a clearly demarcated area on the root surface or at the cemento-enamel junction (cej) that is discoloured (light/dark brown, black) and there is cavitation (loss of anatomical contour ≥ 0.5 mm) present.

Table 4: Codes for Detection of Carious Lesions on the Root Surfaces

Code	Description
0	Healthy
1	First visual change in enamel seen only after prolonged air drying
2	Definite visual change in enamel
3	Localized enamel breakdown without clinical visual signs of dentine involvement
4	Underlying dark shadow from dentin
5	Definite cavity with visible dentin
6	Large distinct cavity with visible dentin

Table 5

INTERNATIONAL CARIES CLASSIFICATION AND MANAGEMENT SYSTEM – THE ICCMS

Over the last decade, the ICDAS system has been built upon incrementally by the ICDAS Coordinating Committee via a further series of international workshops, often held in partnership with a series of International dental organizations. These include the International Association for Dental Research, the European Organization for Caries Research, the Association for Dental Education in Europe and the FDI World Dental Federation. Over the 2008-12 period, these development meetings have included:

- ICDAS Workshop at Bogota, Colombia-October 2008
- ICDAS Workshop at Temple University, USA-April 2010
- ICDAS Workshop at Mountpellier, France- July 2010
- ICDAS pre ORCAWorkshop Kaunas, Lithuania-July2011

This work has developed the ICDAS preventively oriented framework for patient-centered caries management[11] into a more comprehensive International Caries Classification and Management System- the ICCMS.[12-17] The International Caries Classification & Management System-ICCMS deliberately incorporate a range of options designed to accommodate the needs of different users across the ICDAS domains of clinical practice, dental education, research and public health. This Caries Management System seeks to improve decision making and enable improved long-term caries outcomes; it was trade marked by the ICDAS Foundation (a charity) on advice in order to be able to ensure that this open system remains free for use by all and allows the linkage to evidence to be maintained by the ICDAS Coordinating Committee.[5]

THE FUTURE OF ICDAS

Researchers and clinicians have chosen the stage of disease and characteristics for assessment of carious lesions. Figure 1 shows the adaptation of WHO "stepwise" approach to the surveillance of non-communicable diseases for use with oral health indicators. This approach allows a logical association of the different indicators used into a series of core indicators which can be used at STEP 1, 2 or 3 depending on the conditions, local needs, priorities and resources.[4,8] Importantly, this approach also documents how each step can be supplemented into an expanded form, when needed, and also identifies a series of standardized alternative indicators that could be added as and when they are needed. While the detailed content may be in need of refinements, the overall framework seems to have much to commend it and the adoption of this model was well received at a BASCD meeting at the end of 2003 and at the 4th ICDAS meeting in Bornholm in April 2004.[8]

While concluding, the ICDAS collaborative team has developed useful, easy to use system which clearly defined criteria for clinical visual caries detection. Even when used by inexperienced dental examiners, the system has been shown to be reliable in detecting dental caries on coronal tooth surfaces. Due to the changing trend in recording non-cavitated lesion in daily practice, ICDAS

can promote preventive therapies that results in remineralization of non-cavitated lesions and preservation of tooth structure and a much decreased DMF all-over.

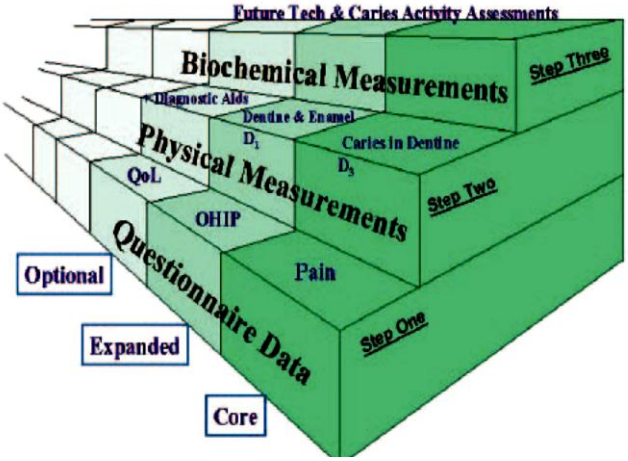

Figure 1: Adaptation of the WHO's "stepwise" approach to the surveillance of non-communicable diseases for use with oral health indicators. [Courtesy from: Pitts NB ICDAS - an international system for caries detection and assessment being developed to facilitate caries epidemiology, research and appropriate clinical management. Community Dental Health 2004; 21:193-198.]

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