| Review Article |
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# Newer Concept of Measuring Dental Caries - A Review

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**Abstract:** Dental caries is a complex disease affecting the teeth, which is mainly caused by imbalance between demineralization and remineralization process around the tooth surface. It is a major cause of tooth loss and pain around the world. Today it is one of the most common diseases of world which if left untreated lead to infection, pain and tooth loss. Therefore there is need for early assessment of dental caries to lower its prevalence and to assess efficiency in the provision of preventive and therapeutic dental services, to know the selective use of dental caries preventives and targeting of services toward persons at greatest risk. For early assessment of dental caries, indices can be used to know its prevalence and the population which is at higher risk. There are some limitations in the previously developed dental caries index regarding the quantification and severity of diseases. To solve these problems later new indices are developed like ICDAS, PUFA, CAST index. Dental caries index helpful in detection of oral diseases on large scale in field survey. Provide data regarding prevalence of a particular condition occurring within a given population and use of this data for the implementation of the dental caries prevention program.
**Keywords:** CAST, Dental caries, ICDAS, PUFA

## INTRODUCTION

Dental caries is the most prevalent chronic disease affecting the human race. Once it occurs, its manifestations persist throughout life even though the lesion is treated [1]. Dental caries is a complex disease affecting the teeth, which is mainly caused by imbalance between demineralization and remineralization process around the tooth surface. It is a major cause of tooth loss and pain around the world [2].

Caries incidence is witnessing a decline in developed countries due to proper availability of fluoride products, better oral health services and awareness regarding etiology of caries. At the same time incidence of caries is increasing in developing countries [3].

Today it is one of the most common diseases of world which if left untreated lead to infection, pain and tooth loss. Therefore there is need for early assessment of dental caries to lower its prevalence and to assess efficiency in the provision of preventive and therapeutic

dental services, to know the selective use of dental caries preventives and targeting of services toward persons at greatest risk [4].

To apply measures which can prevent or control caries, a reliable picture of it in a population is prerequisite; this can only be obtained if we have a reliable caries assessment system (index) [5]. In view of the global epidemic of untreated caries in children there is an urgent need to establish a scoring system that both assesses and quantifies various advanced stages of caries. Quantitative measurement of disease most commonly relies on ''index ''. So, Dental index is the main tool of epidemiological studies in dental diseases to measure prevalence, incidence, and severity.

For early assessment of dental caries, indices can be used to know its prevalence and the population which is at higher risk [6]. At the community level, assessment of dental caries is useful in understanding the effect of preventive and therapeutic agents and the knowledge, attitude and behavior regarding the use of

these agents i.e. suitable indices can be utilized to assess the therapeutic efficiency of the these aids used [7].

Epidemiological indices are attempted to quantify clinical conditions on a graduated scale, thereby facilitating comparison among population examined by the same criteria and methods. There are some limitations in the previously developed dental caries index regarding the quantification and severity of diseases. To solve these problems later new indices are developed and these are:

1. International Caries Detection And Assessment System (ICDAS)
2. PUFA (Pulp-Ulcer-Fistula-Abscess) Index
3. Caries Assessment Spectrum And Treatment (CAST) Index

## 1. The International Caries Detection And Assessment System (ICDAS) Index [8]

- This index was given by Ismail AI, Sohn W, Tellez M, Amaya A, Sen A, Hasson H, Pitts NB in 2007.
- The ICDAS criteria were developed by an international team of caries researchers to integrate several new criteria systems into one standard system for caries detection and assessment.
- First step is to determine whether a clean and dry tooth surface is sound, sealed, restored, crowned, or missing. Afterwards, the examiners classifies the

carious status of each tooth surface using a seven-point ordinal scale ranging from sound to extensive cavitations.

- It was designed to detect six stages of the carious process, ranging from the early clinically visible changes in enamel caused by carious demineralization to extensive cavitations.
- ICDAS was divided into sections covering coronal caries (pits and fissures, mesial-distal, and buccal-lingual), root caries, and caries-associated-with-restorations and sealants.

## ICDAS criteria for detection of caries on coronal tooth surfaces

- The detection of dental caries on coronal tooth surfaces is a two-stage process. The first decision is to classify each tooth surface whether it is sound, sealed, restored, crowned, or missing.
- Before describing the codes, it is important to define the term 'tooth surface'. In ICDAS, each tooth is divided into mesial, distal, facial, lingual and occlusal surfaces. Some tooth surfaces are further divided into sections.

**Decision number 1: classification of the restoration, sealant, or missing status in the international caries detection and assessment system (ICDAS)**

### Table 1: Codes and Criteria of ICDAS index

| CODE | DESCRIPTION |
|---|---|
| 0 | Unrestored or unsealed |
| 1 | Sealant, partial. A sealant that does not cover all pits and fissures on a tooth surface |
| 2 | Sealant, full. A sealant that covers all pits and fissure on a tooth surface |
| 3 | Tooth colored restoration. In the opinion of the dentist, the tooth has a tooth colored (resin or glass–ionomer cement) restoration |
| 4 | Amalgam restoration |
| 5 | Stainless steel crown |
| 6 | Porcelain or gold or PFM crown or veneer |
| 7 | Lost or broken restoration |
| 8 | Temporary restoration |
| 9 | Tooth does not exist or other special cases. |
| Used in as the following: | |
| 9-6 | Tooth surface cannot be examined because of access problem to visualize the tooth surface |
| 9-7 | Tooth missing because of caries (all tooth surfaces are coded 97) |
| 9-8 | Tooth missing for reasons other than caries (all tooth surfaces are coded 98) |
| 9-9 | Un-erupted (all tooth surfaces care coded 99) |

The second decision that should be made for each tooth surface is the classification of the carious status on an ordinal scale. Tooth surfaces may be sound, or have a 'first visual change in enamel' (ICDAS code 1) which is defined differently for pits and fissures from the same condition on smooth tooth surfaces

**Decision number 2: classification of the carious status based upon the international caries detection and assessment system (ICDAS):**
**Sound tooth surface: Code 0**

There should be no evidence of caries (either no or questionable change in enamel translucency after prolonged air drying (suggested drying time 5 s). Surfaces with developmental defects such as enamel

Hypoplasia; Fluorosis; tooth wear (attrition, abrasion and erosion), and extrinsic or intrinsic stains will be recorded as sound. The examiner should also score as sound a surface with multiple stained fissures if such a condition is seen in other pits and fissures, a condition which is consistent with noncarious habits (e.g. frequent tea drinking).

**First visual change in enamel: Code 1**

When seen wet there is no evidence of any change in color attributable to carious activity, but after prolonged air drying (approximately 5 s is suggested to adequately dehydrate a carious lesion in enamel) a carious opacity or discoloration (white or brown lesion) is visible that is not consistent with the clinical appearance of sound enamel or when there is a change of color because of caries which 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). The appearance of these carious areas is not consistent with that of stained pits and fissures as defined in code 0.

**Code 1: Smooth tooth surfaces**

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.

**Distinct visual change in enamel: Code 2**

The tooth must be viewed wet. When wet there is a (i) carious opacity (white spot lesion) and/or (ii) brown carious discoloration which is wider than the natural fissure/fossa that is not consistent with the clinical appearance of sound enamel (Note: the lesion must still be visible when dry).

**Localized enamel breakdown because of caries with no visible dentin or underlying shadow: Code 3**

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 s there is carious loss of tooth structure at the entrance to, or within, the pit or fissure/fossa. This will be seen visually as evidence of demineralization [opaque (white), brown or dark brown walls at the entrance to or within the fissure or pit, and although the pit or fissure may appear substantially and unnaturally wider than normal, the dentin is not visible in the walls or base of the cavity/discontinuity.

If in doubt, or to confirm the visual assessment, the WHO/CPI/PSR probe can be used gently across a tooth surface to confirm the presence of a cavity apparently confined to the enamel. This is achieved by sliding the ball end along the suspect pit or fissure and a limited discontinuity is detected if the ball drops into the surface of the enamel cavity/discontinuity

**Underlying dark shadow from dentin with or without localized enamel breakdown: Code 4**

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. The darkened area is an intrinsic shadow which may appear as grey, blue or brown in color. The shadow must clearly represent caries that started on the tooth surface being evaluated. If in the opinion of the examiner, the carious lesion started on an adjacent surface and there no evidence of any caries on the surface being scored then the surface should be coded '0'.

**Distinct cavity with visible dentin: Code 5**

Cavitation in opaque or discolored enamel exposing the dentin beneath. The tooth viewed wet may have darkening of the dentin visible through the enamel. Once dried for 5 s there is visual evidence of loss of tooth structure at the entrance to or within the pit or fissure – frank cavitation. There is visual evidence of demineralization opaque (white), brown or dark brown walls at the entrance to or within the pit or fissure and in the examiner judgment dentin is exposed.

WHO/CPI/PSR probe can be used to confirm the presence of a cavity apparently in dentin. This is achieved by sliding the ball end along the suspect pit or fissure and a dentin cavity is detected if the ball enters the opening of the cavity and in the opinion of the examiner the base is in dentin. (In pits or fissures the thickness of the enamel is between 0.5 and 1.0 mm. Note the deep pulpal dentin should not be probed).

**Extensive distinct cavity with visible dentin: Code 6**

Obvious loss of tooth structure, the cavity is both deep and wide and dentin is clearly visible on the walls and at the base. An extensive cavity involves at least half of a tooth surface or possibly reaching the pulp.

**Advantages of ICDAS index**

- In conclusion the ICDAS collaborative team has developed useful, easy to use and clearly defined criteria for the clinical visual caries detection.
- This system has been shown to be reliable in detecting dental caries on coronal tooth surfaces, even when used by inexperienced dental examiners.

**Limitations of ICDAS index**
- However ICDAS still lacks validated definitions of caries activity which currently limits its ultimate utility for dental practice.

**2. PUFA (Pulp-Ulcer-Fistula-Abscess) Index [9]**
The failure of DMF index to provide information on the clinical consequences of untreated dental caries, such as pulpal abscess, which may be more serious than the carious lesions themselves, is the basis for the development of PUFA index. This index records the advanced stages of untreated caries lesions so that caries data collected should have impact on health decision makers, which is not possible with DMF index. Scoring method of PUFA index is described in table 2.

**Table 2: PUFA index codes and criteria:**

| Codes | Criteria |
|---|---|
| P/p: | Pulpal involvement is recorded when the opening of the pulp chamber is visible or when the coronal tooth structure have been destroyed, the carious process and only roots or root fragments are left. No probing is performed to diagnose pulpal involvement. |
| U/u: | Ulceration due to trauma from sharp pieces of tooth is recorded when sharp edges of a dislocated tooth with pulpal involvement or root fragments have caused traumatic ulceration of the surrounding soft tissues. |
| F/f: | Fistula is scored when pus releasing sinus tract related to a tooth with pulpal involvement is present. |
| A/a: | Abscess is scored when a pus containing swelling related to a tooth with pulpal involvement is present. |

In many developing countries, access to oral health services is limited and teeth are often left untreated or are extracted because of pain or discomfort, such an index can provide useful information for researches and authorities.

**Advantages of PUFA index**
- Simple to record
- Can be used for primary and permanent dentition
- Result can be presented alongside with DMF index.

**Limitations of PUFA index**
- There are few subjects with score "u"(ulcer)
- Assessment of abscess and fistula can be combined into one code.
- Hence reliability and validity of this index requires further discussion.

**3. Caries Assessment Spectrum And Treatment (CAST) Index [10]**
This index was developed because of the need to find a reliable, pragmatic cohesive and easy to read reporting system which is based on the strengths of PUFA and ICDAS-II indices and provide a link to the widely used DMF index (M and F component). It covers the total dental caries spectrum – from no carious lesion, through caries protection (sealant) and caries cure (restoration) to carious lesions in enamel and dentine, and the advanced stages of caries lesion progression in pulpal and tooth surrounding tissue. It does not record active and inactive carious lesions. The CAST index has not been validated, nor has its reliability been tested. It is also not suggested for use in clinical trials. Other limitation can be that it does not provide data on treatment or preventive measures required for each code.

**Table 3: CAST index codes and criteria:**

| Codes | Characteristic | Description |
|---|---|---|
| 0 | Sound tooth | No visible evidence of a carious lesion is present. |
| 1 | Sealed | Pits and/ or fissures are at least partially sealed with a sealant material. |
| 2 | Restored | A cavity has been restored with an (in) direct restorative material. |
| 3 | Enamel | Distinct visual change in enamel only. A clear caries discoloration is visible with or without localised enamel breakdown. |
| 4 | Dentine | Internal caries related discolouration in dentine. The discoloured dentine is visible through enamel which may or may not exhibit a visible localized breakdown of enamel. |
| 5 | Dentine | Distinct cavitation into dentin. The pulp chamber is intact. |
| 6 | Pulp | Involvement of pulp chamber. Distinct cavitation reaching the pulp chamber or only root fragments is present. |
| 7 | Abscess/Fistula | A pus containing swelling or pus releasing sinus tract related to a tooth with pulpal involvement. |
| 8 | Lost | The tooth has been removed because of dental caries. |
| 9 | Others | Does not correspond to any of the other categories. |

The emphasis of CAST index is prevention and risk assessment. It will facilitate health professionals to present the real picture of preventable carious lesions to policy makers. CAST index generates scores which are detailed in nature influencing its amenability for analysis.

### Advantages of CAST index
- It is helpful in the analysis of dental caries situation in public oral health setting.
- CAST index not only provide information regarding the no of cavitated and non-cavitated lesions, it can also report the consequences of the untreated ones, by recording pulpal involvement and presence of fistula.
- In this way, cast index can become important diagnostic tool.

### Limitations of CAST index
The detailed scoring of CAST is advantageous but difficult to analyze and compare with existing indices. Incipient carious lesions are characteristically diagnosed in dry environment but using CAST Index as specified by its developers leads to potentially missing these lesions.

### Public Health Significance of indices
- Index plays a key role in Public Health Programs.
- Dental caries index helpful in detection of oral diseases on large scale in field survey.
- Provide data regarding prevalence of a particular condition occurring within a given population and use of this data for the implementation of the dental caries prevention program.
- Additionally, by use of these index we can interpretate the consequences of dental caries and there progression.
- It is also used to provide baseline data on indicators that show existing dental health status in populations.
- It provides data to support recommendations for public health interventions to improve the health status of population.

### CONCLUSION
Index is considered to be an ideal method to quantify the disease. There is an increasing need to quantify various oral diseases in order to prevent the disease and reduce the prevalence. This will also help in decreasing the severity of already existing disease. So it can be concluded that indices proposed for various disease will be helpful for quantifying the disease. Every indices will have their own advantages, uses, disadvantages and limitations, so further research in developing relent indices is recommended.

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