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EDITORIAL**A new model for caries classification and management****The FDI World Dental Federation Caries Matrix**

The dental profession recognizes the need for a framework for comprehensive caries classification and management. The FDI Caries Matrix is a key step in integrating current science and establishing political consensus for such a framework.

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The majority of the 1 million dentists around the world, represented by the 130 national dental association (NDA) members of the FDI World Dental Federation (FDI), use G.V. Black's¹ caries lesion classification and disease management system that is more than 100 years old. Although many of its principles still hold true, the system increasingly is unable to meet the needs and demands of our patients.

In 2008, FDI President Dr. Burton Conrod recognized that despite the best efforts of the dental profession in the past century, the burden and impact of dental caries, the effect of caries on people's quality of life and its indirect impact on the economy remained high throughout the world. He called for a profession-led initiative to develop a new paradigm for caries management that would contribute to a common vision of health.

Dr. Conrod's call to action, supported by FDI members, resulted in the establishment of the FDI Global Caries Initiative (GCI),² which was launched at the Rio Caries Conference in 2009 and set out a 10-year agenda for implementing a new paradigm for caries management, disease prevention and health promotion. Its vision was to "improve oral health through the implementation of a new paradigm for managing dental caries and its consequences, one that is based on our current knowledge of the disease process and its prevention, so as to deliver optimal oral and thus general health and well-being to all peoples."³

During the last 50 years, the evidence that we should move to a new disease prevention and health promotion model of care has grown stronger, but such a move has been only partially successful.⁴ The need to create a better model of oral health care now is being supported at a global level by many international dental organizations. The importance of oral health has been acknowledged and highlighted in the 2011 United Nations declaration on the control and prevention of noncommunicable diseases.⁵ In addition, the World Health Organization's Global Oral Health Programme has recognized the importance of promoting "a new paradigm among dental practitioners, shifting from a restorative to preventive/health promotion model."⁶

FDI's role is to support and complement the continuing development of caries lesion classification and disease management systems through the development of a common framework. This framework should be integrated into global health improvement

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TABLE 1

Principal carious lesion classification criteria.*	
CLASSIFICATION BASIS	CLASSIFICATION
Treatment of Caries	D = decayed or caries lesions, M = missing owing to extraction, F = filled or restored caries lesions
Morphology (Location of the Lesion)	Occlusal caries, smooth-surface caries and root caries
Prior Condition of the Tooth	Primary caries, secondary (recurrent) caries
Severity and Rate of Caries Progression	Acute caries, chronic caries, active caries and arrested caries
Extent of the Lesion	Incipient caries, advanced caries
Chronology or Age	Early childhood caries, adolescent caries, adult caries
Etiology (Causes or Origins of Caries)	Baby bottle tooth decay
Affected Tissues	Enamel, dentin, cementum

* Source: Fejerskov and Kidd.⁷

TABLE 2

Caries classification systems selected for review.	
SYSTEM	DESCRIPTION
Black's Classification System*	Developed by G.V. Black in the early 1900s, this system divides dental caries into several classes on the basis of the site of the tooth
World Health Organization (WHO) Basic Methods Application of the Decayed, Missing, Filled Teeth (D,MFT) and Decayed, Missing, Filled Index Calculated per Surface (D,MFS)†	An index that represents caries prevalence of a person as recommended by the WHO
International Caries Detection and Assessment System (ICDAS)‡	A peer-reviewed and internationally recognized clinical scoring system designed to lead to better-quality information and to provide a framework to support and enable personalized total caries management for improved long-term health outcomes
American Dental Association Caries Classification System (CCS)§	An enhanced system for classifying the entire range of caries as a disease process and its effect on patient care; it seeks to balance the data collection needs and time limitations of practicing dentists with the need for scientifically accurate data differentiation for use in clinical caries management systems
Mount-Hume Classification System¶	A system that defines the extent and complexity of a caries lesion and at the same time encourages a conservative approach to the preservation of natural tooth tissue; it can provide some guidance regarding the choice of restorative material
Site-Stage (SI/STA) Classification System#	Similar to the Mount-Hume system; it designates the site ("SI") component and stage ("STA") component of the caries lesion and provides some guidance regarding the choice of restorative material
The Caries Assessment Spectrum and Treatment (CAST) Index**	A comprehensive and pragmatic hierarchical caries assessment index describing the complete range of stages of caries progression

* Source: Black.¹
 † Source: World Health Organization.⁸
 ‡ Source: Ismail and colleagues.⁹
 § Source: D.M. Meyer, DDS, e-mail communication, April 2012.
 ¶ Source: Mount and colleagues.¹⁰
 # Source: Lasfargues and colleagues.¹¹
 ** Source: Frencken and colleagues.¹²

initiatives to enable dentists to play a central role in interdisciplinary and multiprofessional collaborative medical and health practice. The FDI Council posed the challenge to

develop such an inclusive framework, and the FDI Science Committee responded. Dental caries is classified according to different criteria (Table 1⁷). To assess those cri-

teria's strengths and potential gaps and deficiencies in terms of accommodating the needs of future patient care, the science committee reviewed seven caries lesion classification systems^{1,8-12}

TABLE 3

Strengths, potential gaps in and deficiencies of seven select systems as part of practice-based caries management for patients.

SYSTEM	STRENGTHS	GAPS	DEFICIENCIES
Black's Classification System*	System accepted by health systems worldwide as basis for dental care; simple and practical with long history of use in general dental practice	Does not record noncavitated lesions; focuses care on restoration of cavities	Leads to underestimation of caries experience
World Health Organization (WHO) Basic Methods Application of the Decayed, Missing, Filled Teeth (D,MFT) and Decayed, Missing Filled Index Calculated per Surface (D,MFS)†	Simple to use; accepted at global level; long track record of use supported by literature; allows for meaningful comparison of caries situation in various populations; recognized by majority of countries and ministries of health	Does not record noncavitated lesions	By ensuring acceptable level of precision, there is underestimation of total magnitude of caries; not often used in general practice
International Caries Detection and Assessment System (ICDAS)‡	Includes stages of carious lesion progression in enamel; carious lesion assessment can be carried out through visual inspection; ICDAS note system validated; clinically reliable in permanent and primary teeth; includes practice friendly formats	In very young children, some claim it is not practical to dry surfaces to assess for early enamel caries (others, however have used it successfully for this age group)	Prevention education needed in some countries (to ensure that small lesions are not restored)
American Dental Association Caries Classification System (CCS)§	For use in daily practice while mapping both to more complex education- or research-oriented systems and to less differentiated classification systems	Capable of integrating lesion activity, but method has not been validated or integrated into the system to date	Limited data available
Mount-Hume Classification System¶	Simple to use; aligned to general practice; gives some guidance regarding choice of restorative material; similar to Site-Stage system (see below)	Does not assess lesion activity	Limited data available
Site-Stage (SI/STA) Classification System#	Simple to use; aligned to general practice; gives some guidance regarding choice of restorative material; used in France; similar to Mount-Hume system (see above)	Does not assess lesion activity	Limited data available
The Caries Assessment Spectrum and Treatment (CAST) Index**	Visual/tactile hierarchical one-digit coding system; includes the total spectrum of stages of caries lesion progression and abscess and fistulae, as well as sealants and restorations; allows for easy communication among health professionals and policy-makers; is built on the strength of the ICDAS, DMF and Pulpal involvement, Ulceration caused by dislocated tooth fragments, Fistula and Abscess (PUFA) indexes	Used only for epidemiological surveys	Limited data available

* Source: Black.¹
 † Source: World Health Organization.⁸
 ‡ Source: Ismail and colleagues.⁹
 § Source: D.M. Meyer, DDS, e-mail communication, April 2012.
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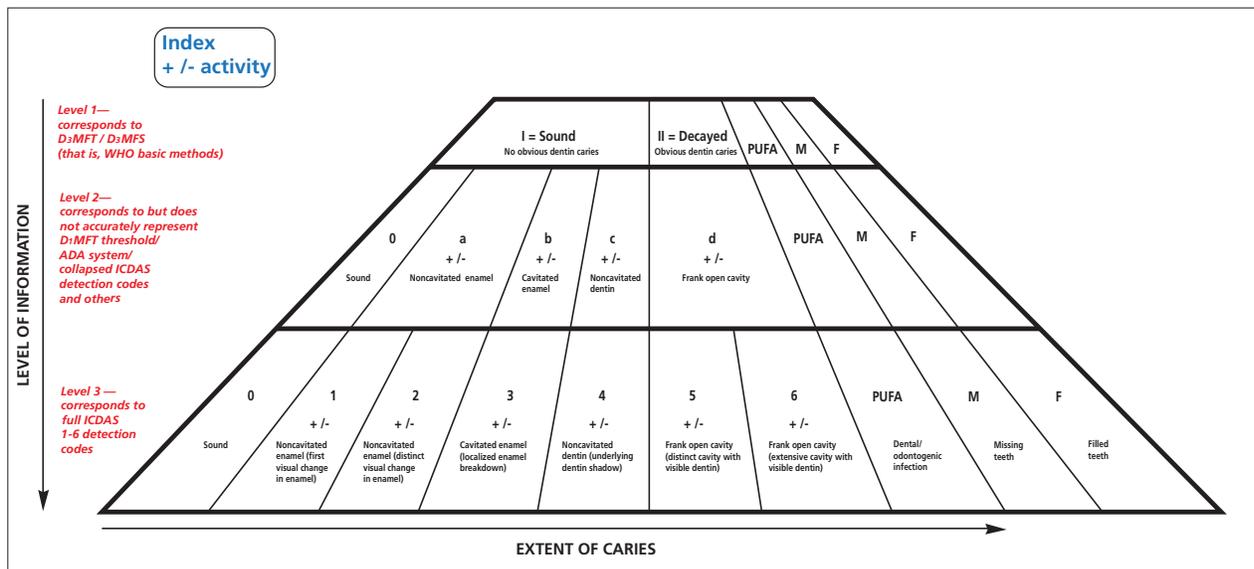


Figure The proposed FDI World Dental Federation Caries Matrix consists of three tiers, one above the other. The extent of the caries lesion and pathology is depicted on the horizontal axis. The top tier (level 1) represents the World Health Organization⁸ Basic Methods (Decayed, Missing, Filled Teeth [D₃MFT]/Decayed, Missing Filled Surfaces [D₃MFS]) system. The bottom tier (level 3) is the full International Caries Detection and Assessment System (ICDAS),⁹ which provides the most detailed level of information and allows for an expanding degree of detail. The middle tier (level 2) seeks to describe the D₁MFT threshold, the American Dental Association (ADA) Caries Classification System (written communication, D.M. Meyer, DDS, April 2012) and the collapsed ICDAS detection, as well as other systems. The middle tier (level 2) of the FDI Caries Matrix makes differentiations between cavitated and noncavitated enamel that correspond to ICDAS but do not correspond to all the named systems. Note that even for the sound/decayed interface at level 1 (WHO Basic Methods), there are a range of regional variations in the conventions used for exact positioning of the vertical lines that subdivide the extent of caries. Future harmonization of these conventions is highly desirable. The + and - symbols indicate the activity of caries lesions as defined in the glossary of terms for caries by Longbottom and colleagues.¹³ The FDI World Dental Federation Caries Matrix as illustrated does not address surface origin of the caries. F: Filled. M: Missing. PUFA: Pulpal involvement (P/p), ulceration caused by dislocated tooth fragments (U/u), fistula (F/f) and abscess (A/a).²⁴ Figure reproduced with permission of FDI World Dental Federation, Geneva.

(written communication, D.M. Meyer, DDS, April 2012) (Table 2) that fulfilled one or all of the following criteria:

- use in clinical practice;
- use in large-scale epidemiologic surveys in more than one geographical region;
- promotion for use in clinical practice by one or more NDAs;
- inclusion of elements likely to enable a shift toward prevention.

The committee did not carry out a comprehensive and systematic search for all the caries lesion classification systems; rather, its aim was to identify systems that are in common use in the different domains of dentistry, as well as those developed to accommodate features that could respond to the needs of future patient care.

Some general themes emerged from this review

(Table 3^{1,8-12} [written communication, D.M. Meyer, DDS, April 2012]). Only a few systems are validated by published research findings and there is no consensus across the profession on validation mechanisms. It is difficult to compare systems and outcome data. Data from most systems are difficult to communicate to policymakers and other health professions in terms of their effect on health and well-being. Each system has strengths, but no one system is appropriate and relevant in all settings. And the same gaps and deficiencies can be listed for several systems.

On the basis of its assessment of existing caries lesion classification systems, the FDI Science Committee developed the FDI Caries Matrix. The intent of this matrix was not to establish a new caries lesion

classification system, but to integrate existing systems into a framework that could be used by clinicians, researchers, educators, public health workers and decision makers (Figure). The framework uses terms defined in an international glossary¹³ adopted by the FDI in 2010. The International Caries Detection and Assessment System (ICDAS) Foundation,^{9,14} building on earlier work,¹⁵ uses a similar layered approach across key domains for its International Caries Classification and Management System (ICCMS).¹⁶ The three levels of the matrix allow users to continue to employ their preferred systems and, for those working within a system that involves a limited description of the stages of the caries process, it provides an opportunity to record greater detail if required

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as preventive caries management evolves. The inclusion of descriptive terms aims to provide an initial reference to assist communication and guide the development process, taking advantage of the strengths of existing caries lesion classification systems, as well as to help to define their limitations.

Proponents of existing caries lesion classification systems are encouraged to provide the FDI Global Caries Initiative Task Team (info@fdiworldental.org) with details on how to enable their systems to be integrated into and brought into harmony with the matrix. Also, when more research evidence and subclinical detail emerges about caries etiology, progression and even histology by means of lesion detection aids, such information can be added below the current clinical visual base level. The proposed matrix does not offer a definitive solution to caries lesion classification and disease management, but it provides a springboard for a dynamic and integrated process in which experts can assess consistency and parallels between different systems. Caries lesion classification should shift from a system that predominantly describes the current state of a lesion that needs to be restored to a system that assesses and quantifies the risk of progression of the disease; this will provide a more sensitive guide to care management than does a system based solely on visual inspection of the lesion's site and size.¹⁷ This approach is being developed by the American Dental Association (ADA), which has initiated a dialogue on caries systems, beginning with its hosting of the ADA Caries Classification Conference in 2008.¹⁸ The meeting drew a broad group of stakeholders to discuss the development of "a new, enhanced system for classi-

fying the entire range of caries as a disease process and the impact of such a system on patient care."¹⁸

Whereas caries as a disease is largely preventable, from a management perspective it involves many factors that influence health outcomes at both an individual and a population level.^{19,20} In calling for a new paradigm for managing dental caries and critically assessing its consequences, we need to acknowledge the importance of the social determinants of health with respect to caries disease control and prevention.²¹ This aspect is reflected in the International Association for Dental Research (IADR) Global Oral Health Inequalities Research Agenda (GOHIRA) initiative. That initiative seeks to contribute to the goal of the WHO Commission on the Social Determinants of Health, which stressed the need for the closing of both the health equity gap (within a generation) and the implementation gap (as soon as possible).²² In education, the European Organisation for Caries Research (ORCA) and the Association for Dental Education in Europe (ADEE) have examined the cariology curriculum in terms of educating from a prevention-based model of care.¹⁶ Both these initiatives were aided by recent developments in the ICDAS-ICCMS. Within modern caries management models, health risk assessment, specific oral health risk assessment and the assessment of caries progression can provide the foundation for a new inclusive caries management system.²³ Including the Pulpal involvement, Ulceration caused by dislocated tooth fragments, Fistula and Abscess (PUFA) index²⁴ to measure and record the consequences of caries dis-

ease process at its most severe and advanced stage provides the opportunity to supplement direct caries measures with quantification of the consequences of caries and to communicate the effect of oral disease at both an individual and a population level.²⁴ It also clearly shows the extent of urgent treatment need and the effect of treatment strategies that can be assessed easily. Consequences of the caries process mark the endpoint of a spectrum, complete the matrix concept and make it relevant for settings in which access to care is low or unavailable. Hence, there are multiple objectives for the use of the matrix:

- to provide a framework that enables an assessment of caries as a health outcome;
- to provide a framework that will guide further development of a caries lesion classification and disease management system or systems that is or are relevant, feasible and appropriate in a prevention-based system of medicine and health care;
- to provide a framework that facilitates communication between practitioners, researchers, policy makers and patients.

The dental profession recognizes the need for a comprehensive framework,²⁵ one that includes caries lesion classification and disease management systems and that offers a foundation for risk assessment and surveillance, disease prevention and health promotion. This framework will enable the quantification of health outcomes, which is important for the future progress of our profession. The FDI Caries Matrix is a key step in integrating current science and establishing political consensus for such a framework. ■

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PROSTHETIC JOINT INFECTIONS

In Dr. Daniel Skaar and colleagues' December JADA article, "Dental Procedures and Subsequent Prosthetic Joint Infections: Findings from the Medicare Current Beneficiary Survey 2011" (Skaar DD, O'Connor H, Hodges JS, Michalowicz BS. *JADA* 142(12):1343-1351), they per-