Diagnosing and Reporting Early Childhood Caries for Research Purposes

A Report of a Workshop Sponsored by the National Institute of Dental and Craniofacial Research, the Health Resources and Services Administration, and the Health Care Financing Administration

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Dental caries in primary teeth of children 5 years of age or younger is still one of the major health problems in the United States (1). The 1988–94 National Health and Nutrition Examination Survey (NHANES III) found that 8.4 percent of 2-year-old children had at least one decayed or filled tooth and that by age 5, 40.4 percent of the children were affected. Dental caries in primary teeth is one of the major reasons for hospitalization of children (2) and is costly to treat (3,4).

It is evident from the number of conferences and published papers on early childhood caries that interest in this subject has grown in recent years. Further, it has become increasingly clear that research efforts to investigate epidemiologic, etiologic, and clinical aspects of dental caries in primary teeth of preschool-aged children would be advanced greatly by the development and adoption of standardized case definitions and diagnostic criteria. During the Early Childhood Caries Conference held at the National Institutes of Health in October 1997, the need for clarification of these issues became patently clear (5,6). As a follow-up to this conference, a paper was commissioned by the National Institute of Dental and Craniofacial Research (NIDCR) to review case definitions and clinical diagnostic criteria used in studies of early childhood caries (ECC) involving children 1 to 5 years of age and published in peer-reviewed journals between 1966 and 1998 (7).

The results of this review confirmed that the lack of a working consensus among researchers regarding case definitions and diagnostic criteria made it nearly impossible to evaluate evidence from different studies bearing on the relative frequency, etiology, clinical course, and impact of early childhood caries. The commissioned review served as the rationale and basis for convening a group of invited experts at the National Institutes of Health to review current evidence on dental caries in preschool-aged children. This group of experts met on April 28-29, 1999, to review the current evidence on case definitions and diagnostic criteria for dental caries in primary teeth. This report describes the workshop's deliberations and resulting recommendations.

Goals and Structure of Workshop

The workshop included invited participants and observers (Figure 1). Among the participants were experts in caries diagnosis and cariology, pediatric dentists, general dentists, and public health professionals representing the following organizations: the American Dental Association, the American Academy of Pediatric Dentistry, the Centers for Disease Control and Prevention, the National Institute of Dental and Craniofacial Research, the Health Resources and Services Administration, the Health Care Financing Administration, the Indian Health Service, the American Association of Public Health Dentistry, and the Association of State and Territorial Dental Directors. Dr. Preston A. Littleton facilitated the workshop.

The workshop's goal was to review current methods of diagnosis of dental caries in primary teeth and to propose case definitions and diagnostic criteria for future research projects regarding dental caries in preschool-aged children. These steps are a prerequisite for the success of research programs to study the epidemiology, etiology, prevention, and treatment of dental caries in preschool-aged children. The review paper (7) and other documents were distributed to the participants prior to the meeting.

During the first half-day of the twoday workshop, presentations were made to set the stage for the workshop. Dr. Slavkin presented NIDCR's vision for caries research in the 21st century; Dr. Ismail presented findings from his systematic review of case definitions and diagnostic criteria; and Dr. Pitts, Dr. Longbottom, and Ms. MacRitchie presented data from the Dundee (Scotland) Health Visitor/Mutans Study. For a day and a half the participants addressed the following questions regarding dental caries in preschoolaged children: (1) What are the patterns of dental caries in primary teeth in these children? (2) What case definitions should be used to define the presence, patterns, and severity of dental caries in primary teeth? (3) What are the diagnostic criteria for dental caries in primary teeth? (4) What terms best describe the patterns of dental caries in primary teeth?

As the discussion of these questions proceeded, it was suggested that certain issues be clarified further, even if not resolved, through exploratory analyses of NHANES III data on coronal caries in the primary dentition of children 2–5 years of age. Accordingly, such exploratory analyses were initiated during the workshop and were continued for several weeks thereafter. The results of the final recommendations of the participants are presented in this report.

The authors of this report are listed in alphabetical order. They prepared and edited this report based on the deliberations of invited participants (listed in Figure 1) at a workshop held on April 28-29, 1999, in Bethesda, MD. The report was reviewed by all workshop participants, but did not undergo external peer review. Accepted for publication: 9/14/99. Authors' affiliations are listed in Figure 1. [J Public Health Dent 1999;59:192-97]

Recommendations

Recommendation #1: The participants concluded that there is a lack of critical information on early childhood caries and recommended that additional research be conducted on the epidemiology, etiology, and effective prevention of dental caries in preschool-aged children.

Pediatric dentists, general dentists, and public health experts attending the workshop agreed that more reliable, valid, and up-to-date information is needed to combat this major health problem in preschool-aged children. The lack of agreement on case definitions and diagnostic criteria for dental caries in preschool-aged children hinders research efforts to measure, accurately and consistently, the burden of dental caries in this population (5-8).

Another concern expressed at the workshop was that the current epidemiologic and clinical diagnostic criteria for dental caries in preschoolaged children do not provide information on the progression of dental caries from the stage of noncavitated carious demineralization of enamel to cavitation. Recent studies have found that noncavitated carious lesions in smooth tooth surfaces are more prevalent than cavitated carious lesions in primary teeth of children aged 6 to 18 months (9,10). In children 18 months of age or older, cavitated lesions frequently become more prevalent than noncavitated lesions (9,10). Early iden-

FIGURE 1 List of Workshop Participants and Observers

Facilitator Dr. Preston A. Littleton Participants Dr. George Acs Dr. Eugenio Beltrán Dr. Eric Broderick Dr. Thomas F. Drury Dr. Robert J. Feigal Dr. Harry Goodman Dr. Alice M. Horowitz Dr. Herschel S. Horowitz Dr. Amid I. Ismail Ms. Candace M. Jones Dr. Michael J. Kanellis Dr. Linda M. Kaste Dr. Dushanka V. Kleinman Dr. YiHong Li Mrs. Heather MacRitchie Mr. Marco P. Maertens Dr. Nigel B. Pitts Dr. John Rossetti Dr. R. Gary Rozier Dr. Don Schneider Dr. Robert H. Selwitz Dr. Harold C. Slavkin Dr. George K. Stookey Dr. Norman Tinanoff Dr. R. Angela Wandera Dr. Domenick T. Zero Observers Dr. Robert J. Allnutt Dr. Norman S. Braveman Dr. Milton I. Houpt Ms. Candace M. Jones Dr. Christopher Longbottom Dr. Brent Davidson McDaniel Dr. David M. Perry Dr. Dennis Mangan

American Academy of Pediatric Dentistry Centers for Disease Control and Prevention Indian Health Service, Office of Public Health National Institute of Dental and Craniofacial Research American Dental Association Association of State and Territorial Dental Directors National Institute of Dental and Craniofacial Research Bethesda, MD University of Michigan American Public Health Association University of Iowa Medical University of South Carolina National Institute of Dental and Craniofacial Research University of Alabama Dental Health Services Research Unit, Dundee, Scotland National Institute of Dental and Craniofacial Research Dental Health Services Research Unit, Dundee, Scotland Health Resources and Services Administration University of North Carolina Healh Care Financing Administration National Institute of Dental and Craniofacial Research National Institute of Dental and Craniofacial Research Indiana University University of Maryland Dental School University of Michigan Eastman Dental Center

Montgomery County Dept. of Health and Human Services National Institute of Dental and Craniofacial Research UMDNJ–New Jersey Dental School Indian Health Service Dental Health Services Research Unit, Dundee, Scotland University of Michigan American Dental Association National Institute of Dental and Craniofacial Research tification of dental caries, especially in infants and toddlers, is a prerequisite for the secondary prevention of dental caries and for preventing the destruction of primary teeth. In addition, early identification of dental caries in preschool-aged children provides an opportunity to identify youngsters at high risk for the disease so that appropriate primary disease preventive interventions can be initiated to protect unaffected teeth. The workshop participants recognized that the lack of population-based data on dental caries during the first five years of life is an urgent problem that requires attention. The goal of reducing disparities in dental caries in children in the United States cannot be achieved without understanding the burden of disease and its determinants.

The workshop participants also concluded that data based on the current etiologic models of dental caries in primary teeth are not consistent on why some preschool-aged children are more susceptible to dental caries early in life, while others living within similar social and behavioral environments are at much lower risk for early tooth decay. New research on dental caries in primary teeth requires the consistent use of up-to-date methods to diagnose dental caries.

Recommendation #2: The participants recommended that research projects involving preschool-aged children should collect data on the presence of noncavitated and cavitated decayed teeth or tooth surfaces, teeth missing due to caries, and filled teeth or tooth surfaces.

The participants concluded that dental caries can be defined as a demineralization of tooth tissue consequent to a dental infection that is dependent on frequent exposure to fermentable carbohydrates and is influenced by saliva, fluoride, and other trace elements. They also agreed that dental caries in primary and permanent teeth develops in stages. In the initial stage, there is some loss of minerals from the hydroxyapatites of calcium and phosphate, the building blocks of enamel and dentin. As the loss of tooth structure continues, large microporous areas develop and, consequently, the refraction of light through the enamel or dentin changes, leading to the appearance of chalky white or opaque patches in the tooth surfaces. These changes in the color of enamel are more apparent after thorough drying of tooth surfaces. The white opacities, so-called "white spot lesions," tend to be located in areas where dental plaque accumulates. If the loss of tooth structure continues, as a result of the repeated infusion of acids into enamel and the removal of apatite, the outer tooth surface covering the inner carious demineralization collapses, leading to the formation of a "cavity."

Given the possible rapid progression of dental caries in primary teeth of susceptible children (11), as well as the need to reduce the probability of a false negative diagnosis, the workshop participants unanimously concluded that both noncavitated and cavitated carious lesions should be included in the research diagnostic criteria for dental caries in primary teeth. Diagnosis of noncavitated carious lesions will provide more useful data on the caries process in primary teeth and may aid in understanding the progression of dental caries during early childhood. It also will provide a more comprehensive outcome to evaluate the success of interventions to prevent dental caries early in life. The workshop participants recognized that diagnosis of noncavitated carious lesions will require devoting more time for training and calibration of examiners in research studies involving preschool-aged children and may significantly add to the time required for data collection. The experience of the research teams leading the Dundee (Scotland) Health Visitor/Mutans Study (Pitts N, personal communication, July 12, 1999), the Iowa Fluoride Study (Levy SM, personal communication, July 12, 1999), and others (12-15), all confirmed the feasibility and importance of diagnosing noncavitated carious lesions in primary teeth.

The participants adopted new diagnostic criteria for noncavitated carious tooth surfaces. The criteria were developed using information published in the dental literature (14), the Iowa Fluoride Study (Levy SM, personal communication, July 12, 1999) and the Dundee (Scotland) Health Visitor/Mutans Study (Pitts N, personal communication, July 12, 1999). The senior authors of the Iowa and Dundee reports reviewed and agreed to the following definitions:

In pits and fissures, noncavitated lesions may present as distinct chalky white enamel directly adjacent to or into a pit or fissure or may appear as a light to dark brown discolored area no larger than the size of the pit or fissure. The lesions must have no clinically visible loss of enamel structure (cavitation) and there must be no evidence of undermining (evidenced by darkening of subsurface seen through adjacent enamel). These lesions should be detected after the teeth are cleaned and dried. There is no need to examine the lesions using an explorer. However, an explorer may be used without significant axial force to clean debris from a pit or fissure or to confirm the absence of a cavity. Staining of pits or fissures in preschool-aged children is uncommon. Extrinsic stains, if found, are usually dark black in color and can be scraped off with an explorer.

In smooth surfaces, noncavitated carious lesions usually present as distinct chalky white enamel, usually adjacent or close to the gingival margin. The lesions occur in areas where plaque accumulates and are parallel to the gingival margin. There is no clinically visible or irreversible loss of enamel structure or macroscopic break in the enamel surface. Normally, no tactile examination is necessary for these lesions. In approximal smooth surfaces, diagnosis can be based on direct vision from the facial or lingual sides of a tooth. If there is undermining of a marginal ridge or in the enamel surrounding a noncavitated area, then that should be considered as evidence of dentinal caries and the lesion classified as "cavitated."

Criteria for diagnosing dental caries used in previous national surveys in the United States can be modified to incorporate the aforementioned new criteria for diagnosing noncavitated carious lesions (13). The workshop participants also recommended that research projects be supported to test the feasibility and reliability of diagnosing noncavitated lesions using visual and gentle tactile (without exerting excessive pressure on a tooth) examination with transillumination of primary teeth.

Recommendation #3: The participants recommended that future studies of dental caries in the primary dentition should present, when feasible, the prevalence and extent of the disease for the following age groups: <12 months, 12–23 months, 24–35 months, 36–47 months, 48–59 months, and 60–71 months. The participants also agreed that "early childhood" should include all preschool-aged children between birth and 71 months of age.

Previous studies of dental caries in primary teeth included children between the ages of birth and 89 months (7). Case definitions of dental caries in primary teeth were not age-specific and usually have included data from

Age(Months)*	Early Childhood Caries	Severe Early Childhood Caries
<12	1 or more dmf surfacest	1 or more smooth dmf surfacest
12-23	1 or more dmf surfacest	1 or more smooth dmf surfacest
24-35	1 or more dmf surfacest	1 or more smooth dmf surfacest
36–47	1 or more dmf surfaces†	1 or more cavitated, filled, or missing (due to caries) smooth surfaces in primary maxillary anterior teeth OR dmfs score ≥ 4
48–59	1 or more dmf surfacest	1 or more cavitated, filled, or missing (due to caries) smooth surfaces in primary maxillary anterior teeth OR dmfs score ≥ 5
6071	1 or more dmf surfaces†	1 or more cavitated, filled, or missing (due to caries) smooth surfaces in primary maxillary anterior teeth OR dmfs score ≥ 6

FIGURE 2 Proposed Case Definitions of Early Childhood Caries and Severe Early Childhood Caries

*Elsewhere in this report, the phrase "preschool-aged children" is used to refer to children 71 months of age or younger. *Any carious lesion, noncavitated (d₁) or cavitated (d₂), missing tooth due to caries (m), or filled surface (f). Includes primary teeth only.

	Descriptive Issues
Descriptive epidemiology	• What is the epidemiology of dental caries in primary teeth (with respect to prevalence, extent, severity, burden, and scope of ECC)?
Intraoral patterns	What teeth or tooth surfaces are most susceptible to dental caries and at what age?
	Analytical Issues
Risks for onset and progression	 What are the major negative and positive risk factors associated with ECC's initial onset and progression?
Markers of susceptibility and preclinical cariogenesis	 Are there any biological markers that can be used to identify preschool-aged children who may have a susceptibility to ECC?
	 Are there any biological markers that can be used to identify the cariogenesis of ECC in a preclinical state?
Mechanisms articulating risk factors and disease onset and	• What are the major biological, psychological, social, and cultural mechanisms by which negative and positive risk factors impact ECC onset and progression?
progression	To what extent are any of the intervening mechanisms interrelated?
	• To what extent do any of them interact?
	 Are there any special conditions under which underlying mechanisms and their interrelations and interactions operate to a greater or lesser degree?
	Experimental Issues
Type of intervention	 What kinds of interventions are effective in preventing the onset of ECC and its progression?
Patterns and timing	• Do these interventions have some optimal combination, an optimal timing, or an optimal sequencing?
	Health Services Issues
Access to care	• What is the overall accessibility to preventive, restorative, and other treatment for ECC among all preschool- aged children and among preschool-aged children with any ECC experience?
Beyond the clinical profile	• To what extent does the ECC profile of preschool-aged children who visit a dentist regularly (e.g., every year) differ from that of children who do not visit a dentist regularly or at least annually?
Clinical protocols	 What kinds of clinical decision-making protocols are currently being used by dental practitioners in the prevention and diagnosis of ECC and in the treatment, referral, and follow-up of children with ECC?
Treatment practices	 What treatments are provided for children with ECC at various stages of the disease process?
Health care settings	In what kinds of health care settings are these treatments provided?
	 To what extent are children hospitalized for treatment of ECC?
Treatment effectiveness	 How effective are these various forms of treatment?
Economic impact	 What is the economic cost of ECC and S-ECC in terms of both direct and indirect costs, as well as the psychological costs inherent in pain and suffering associated with certain types of ECC?
Source of payment	 What sources of payment are used to cover the costs associated with ECC? Specifically, to what extent are state-administered Medicaid programs used to cover or limit any of the treatment costs?
Community-based programs	• What kinds of community-based programs currently exist for the prevention of ECC and in what types of community settings are they typically found?
	 To what extent are ECC prevention programs integrated with other types of community-based programs concerned with the health of preschool-aged children or their caretakers?
Parental awareness of ECC	 What role does parental awareness of ECC play in the prevention and early treatment of ECC?
	Concept-measurement Issues
Case definition	• Is ECC more adequately conceptualized as one disease with several subclasses? Or is it more fruitful to think of it as one disease that may manifest itself as a major clinical syndrome as well as express itself in other minor ways that are not sufficiently distinctive to be the basis for specific subclasses?
	• Should the case definition, or any part of it, be based only on certain teeth (e.g., anterior) and/or only on certain surfaces (e.g., smooth), or on some specific combination of tooth and surface types?
	• Is it more beneficial to approach case definition issues on the basis of the assumption that ECC is a discrete diagnostic entity or on the basis of the assumption that ECC represents the intersection of several continuous aspects of the disease process?
	• Is the current fucus on preschool-aged children (5 years or younger) the appropriate population context in which to address the ECC problem or might children 3 years or younger be a more appropriate population on which to focus? In this context, how may the needs for prevention and the needs for treatment both be addressed in a balanced and responsive way?
Research diagnostic criteria	• Should the diagnostic criteria be based entirely on the presence of one or more cavitated or noncavitated lesions on any tooth surface, or should the diagnostic criteria be based on both inclusion and exclusion criteria? For example, should smooth surfaces only be considered, or should both smooth surfaces and pit-and-fissure surfaces be considered?
	• Should the lingual surfaces of maxillary second primary molars or the buccal surfaces of mandibular second primary molars be considered smooth surfaces or pit-and-fissure surfaces? If only smooth surfaces are to be considered, are there any conditions under which pit-and-fissure surfaces would or would not be considered?
	 Given that the diagnostic criteria used in past and future proposed studies have been, or will be, based on manifestational criteria, what kinds of studies need to be considered to explore the feasibility of going beyond manifestational criteria to a consideration of etiological criteria as a basis for diagnosis?

FIGURE 3 Scientific Opportunities in the Study of ECC [continued next page]

FIGURE 3

Scientific Opportunities in the Study of ECC [continued from previous page]

	Concept-measurement issues [continued]
Grading the severity of the disease	• Should there be one or several thresholds of severity based on the age of the child? For example, should any ECC experience in a child aged 3 or younger always be considered <i>severe</i> , with efforts to <i>grade</i> severity accordingly limited to 4- and 5-year-olds?
	• If the grading of severity is limited to 4- and 5-year-olds, how many grades of severity will be recognized and on what basis or bases will they be defined? Will severity in these two age groups be based simply on the sheer extent of the disease, and if so, how far will the disease have had to progress to be classified as severe?
	• If mere statistical criteria are used to develop a cut-off value at or above which a 4–5-year-old is considered to have severe ECC, what percentile value, or how many standard deviations above the mean extent, or other statistics-based norm, would be used to set this cut-off value?
	• If criteria of severity other than, or in addition to, extent criteria are to be utilized, how might the types of teeth and tooth surfaces affected be used for this purpose?
	• In this same context, to what extent might the psychological and social impact of the disease on the child and his or her family be used to assess severity? Such an approach would lead to a consideration of pain, inability to play, attend preschool, interact with siblings, peers, teachers, and parents, as well as limitation of functioning with regard to eating, chewing, and talking, in assessing severity.
	• If different criteria of severity are used for preschool-aged children at different years of life, how will certain anomalies associated with discontinuities in the age grading of the severity of disease be handled? For example, if a zero-tolerance approach is taken to grading severity in a child 3 or younger, and a certain number of surfaces (e.g., 6 or more) is used to identify severe ECC in a 4–5-year-old, 3-year-olds with one decayed surface would represent severe caries, but would become nonsevere cases the day they turned 4. This kind of anomaly would be particularly irksome in longitudinal studies.
	Methodological Studies
Measurement reliability	 To what extent are the newly proposed measurements of ECC <i>objective</i>, as evidenced by interexaminer reliability?
	 To what extent are the new measurements precise, as evidenced by intraexaminer reliability?
Measurement validity	To what extent do the new measurements have content or face validity?
	 To what extent do they have concurrent validity, as evidenced by their association with known time-bound correlates of coronal caries in preschool-aged children?
	• To what extent do they have <i>predictive</i> validity, as evidenced by their associations with known <i>time-ordered</i> correlates of coronal caries in preschool-aged children?
	• To what extent do they have <i>construct</i> validity, as evidenced by results from studies of biological markers, risk factors, comorbid conditions, natural history and clinical course, and responses to preventive and treatment regimens for coronal caries?
Information bias	• To what extent are mean dfs or dft scores biased estimates of dmfs and dmft scores, respectively? This question may be addressed by currently available as well as newly proposed data sets.
	• To what extent does ignoring noncavitated lesions bias estimates of the prevalence, extent, and other aspects of ECC? This question is only addressable with newly proposed data sets.
Alternatives to the visual- tactile oral examination	• In view of ongoing developments in molecular biology, and their and other new technologies, what opportunities currently exist to develop methods of case ascertainment of ECC that may provide usable alternatives to the current visual-tactile oral examination by a trained and calibrated dental professional?
	What criteria might be used to evaluate such approaches for their feasibility, quality, and effectiveness?
	• What might be the implications of such studies for the case definition, research diagnostic criteria, and severity grading of ECC?
Evaluating age variations in ECC	• Should age, in this context, be conceptualized in chronological terms as the age of the child from birth or the age of the tooth from its eruption? And should it be measured in whole years, whole months, or perhaps some finer temporal metric?
Research design issues	 How might cross-sectional surveys, case-control studies, observational prospective studies, and clinical trials be used most effectively to obtain pertinent high-quality information to address the broad spectrum of issues identified in this overview?
	 How might the relevant strengths and weaknesses of quantitative and qualitative methodologies best be used in addressing the issues raised?
	• Are there special qualities that a dental examiner has to possess to obtain high-quality assessments of ECC in field studies? If so, what kinds of training and quality control are needed to develop these qualities and ensure their presence throughout the course of a research study?
	 To what extent might parents or surrogate parents (and their children when they are old enough) be enlisted in longitudinal studies to chart the history of the health of a child's primary dentition so that the child would have a story of their primary teeth to keep for a lifetime?
Separating measurement unreliability from true temporal change	• In longitudinal studies, how many occasions of measurement will be required to separate measurement unreliability from true change in key parameters of ECC without having to assume that the measurement errors at each occasion are correlated?

children in different stages of physical and cognitive development. Consequently, studies of the risk factors for dental caries in preschool-aged children may have been confounded by age. Moreover, the findings do not reflect the severity (extent) of the carious attack relative to the age of the child. The participants noted that an early carious lesion in a 1-year-old child represents a different level of severity than a single lesion found in a 5-yearold child.

Recommendation #4: The participants defined the term "early childhood caries" to indicate the presence of one or more decayed (noncavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth. The participants recommended that the term "severe early childhood caries" refer to children with "atypical," "progressive," "acute" or "rampant" patterns of dental caries.

Some children develop "atypical" or more severe forms of dental caries. They can experience dental caries in any smooth surface before age 36 months, or after that age can have dental caries in maxillary anterior teeth or develop multiple carious lesions involving anterior and/or posterior primary teeth. Dental caries in these children usually progresses rapidly.

After reviewing the current distribution of dental caries in the US population (based on NHANES III data), the workshop participants decided to diagnose the presence of severe early childhood caries according to the age of a child and extent of caries experience in the primary dentition (number of dmf surfaces). In children younger than 36 months of age, the identification of any sign of dental caries in smooth tooth surfaces indicates the presence of, or susceptibility to, S-ECC (Figure 2).

In children between the ages of 36 and 71 months, workshop participants developed criteria that identify children with one or more cavitated, missing (due to caries), or filled smooth surfaces in maxillary anterior teeth or an age-specific dmfs score at or higher than approximately the 50th percentile. These criteria for S-ECC in children aged 36–71 months would identify youngsters with caries experience in maxillary anterior teeth and/or in other teeth, either in different smooth surfaces or in the pit and fissure surfaces of the primary molars (Figure 2).

The participants also recommended that the reporting of data on ECC and S-ECC, as defined in this document, does not preclude the reporting of data using other groupings of teeth or patterns of dental caries. Researchers may report on the presence of dental caries in pits and fissures, in posterior or anterior teeth, or just in maxillary anterior teeth. If other statistics are reported, the participants strongly recommended that the case definition (number and type of tooth surfaces) be defined clearly in any report.

The participants strongly stressed that these case definitions were designed to standardize the collection and reporting of data in research projects. These case definitions were not developed for resource allocation or targeting of dental services at this time. Validation of these case definitions is required before such uses are advised.

Recommendation #5: The participants recommended that the prevalence of children with ECC and S-ECC be reported for each of the following age groups: birth–11 months, 12–23 months, 24–35 months, 36–47 months, 48–59 months, and 60–71 months.

Specifically, they recommended that at a minimum, the mean number of noncavitated decayed (d_1) , cavitated decayed (d_2) , missing due to caries (m), filled (f) surfaces or teeth, and total dmfs (t) be reported. In addition to providing statistical information for all children 5 years of age or younger, the participants recommended that most if not all of this information also be reported for children with ECC and separately for those classified with S-ECC.

Research Opportunities

The participants recommended that case definitions and criteria should be assessed in clinical and nonclinical settings to evaluate their ease of use, requirements for training and calibration, examiner reliability, and concurrent, predictive, and construct validity. The participants also recommended that the NIDCR sponsor a research program to develop new diagnostic tools for dental caries that are more sensitive and specific and yield better outcomes for evaluation of preventive and treatment interventions than current visual-tactile and radiographic methods.

After the workshop, it became clear from the reactions and comments of participants on earlier drafts of this report that it would be useful to provide a tentative overview of the kinds of research questions that would need to be pursued. Figure 3 provides a detailed list of research projects that should be of interest to basic, public health, and social science researchers.

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