Early childhood caries screening tools

A comparison of four approaches

Richard K. Yoon, DDS; Arlene M. Smaldone, DNSc, CPNP, CDE; Burton L. Edelstein, DDS, MPH

Prioritizing young children who have the greatest need of early dental intervention requires the use of a reliable and clinically useful risk assessment method. Since 1978, the American Academy of Pediatric Dentistry (AAPD) has proposed and refined its policy on classifications of, consequences of and preventive strategies for early childhood caries (ECC).[1] In 2006, AAPD introduced the Caries-risk Assessment Tool (CAT).[2] Cariologists,[3] other dental associations (for example, the American Dental Association[4]) and dental manufacturers (for example, CariFree[5]) have developed similar multifactorial clinical tools, demonstrating how actively the field of caries risk assessment is being adopted and used. The developers of these efforts seek to refine a trouble-free screening test to enable health care providers, Early Head Start staff members, Special Supplemental Nutrition Program for Women Infants and Children (WIC) staff members and others involved with young children to identify young children at risk of developing caries.

Any sign of dental caries in children younger than 3 years is defined as severe early childhood caries (S-ECC).[6] S-ECC is prevalent among U.S. children. An esti-

ABSTRACT

Background. Early childhood caries (ECC) is prevalent and consequential. Risk assessment tools have been proposed that can be used to identify children who require intensive interventions. In this study, the authors compare four approaches for identifying children needing early and intensive intervention to prevent or minimize caries experience for their accuracy and clinical usefulness.

Methods. The authors screened 229 predominantly low-income Hispanic children younger than 3 years with ECC and 242 without ECC by using the American Academy of Pediatric Dentistry's Caries-risk Assessment Tool (CAT) and the optional screening measure of culturing *Streptococcus mutans*. The authors compared four approaches (CAT, CAT minus socioeconomic status, CAT minus socioeconomic status plus mutans streptococci [MS] and MS alone) for accuracy and clinical usefulness.

Results. The results of the CAT demonstrated high sensitivity (100.0 percent) and negative predictive value (NPV) (100.0 percent) but low specificity (2.9 percent) and positive predictive value (PPV) (49.4 percent). The MS culture alone had the highest combination of accuracy and clinical usefulness (sensitivity, 86.5 percent; specificity, 93.4 percent; PPV, 92.5 percent; NPV, 87.9 percent). When we removed the socioeconomic status element, the CAT's performance improved.

Conclusions. Salivary culture of MS alone in a population of young, low-income Hispanic children outperformed the CAT and variations on the CAT for test accuracy (sensitivity and specificity) and clinical usefulness (predictive values).

Clinical Implications. Screening for ECC by using salivary MS cultures and variations on the CAT are promising approaches for identifying children who need early and intensive intervention to prevent or minimize caries experience.

Key Words. Early childhood caries; risk assessment; pediatric dentistry; public health; community dentistry; Hispanic Americans.
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Dr. Yoon is an associate professor, Division of Pediatric Dentistry, Columbia University College of Dental Medicine, New York City.
Dr. Smaldone, is an associate professor of clinical nursing, Columbia University School of Nursing, Center for Health Policy, New York City.
Dr. Edelstein is a professor and the chair, Section of Social and Behavioral Sciences, Columbia University College of Dental Medicine, 630 W. 168th St., PH17-306, New York, N.Y. 10032, e-mail ble22@columbia.edu. Address reprint requests to Dr. Edelstein.

mated one in 10 two-year-olds (10.9 percent) have frank caries[7] and a higher percentage of children have earlier signs of disease, such as visually evident enamel decalcifications or voluminous soft plaque accumulation. Caries experience increases with age; an aggregate of 28 percent of 2- to 5-year-olds have visually evident caries.[8] ECC can affect children's health and function and negatively affects families' welfare and communities' resources.[9] Intervention early in the disease process is desirable because timely and effective management can arrest the caries process and obviate, minimize or delay the need for restorative care. Restoring the teeth of young children who "lack cooperative ability"[10] owing to their developmental stage is challenging for clinicians, the children and their caregivers and often requires use of general anesthetic,[1,11] which can involve the "potential seriousness of anesthesia-induced developmental neurotoxicity."[12] Despite a high level of need, only a small percentage of children younger than 4 years (11.6 percent of U.S. children in 2007[13]) receive dental care. As a result of the difficulties of providing restorative care and limited access to care for young children, 73 percent of preschool-aged children in the United States who have had caries have untreated disease.[8]

A clinically useful screening test used to identify children at high risk of experiencing caries should be simple, rapid, inexpensive relative to the direct cost of the disease, usable by a variety of providers, valid and reliable, as well as sensitive and specific.[14] Although some conditions, such as streptococcal pharyngitis, may be identified quickly with a rapid antigen detection test, the multifactorial nature of caries as a biopsychosocial condition[15] and its multiple bacterial components limit the use of any single test for determining caries risk. Nonetheless, *Streptococcus mutans* is correlated highly with the caries process[16,17] and culturing mutans streptococci (MS) is included in the CAT as an optional screening measure. Biological evidence for MS specificity in caries initiation is evident in ecological modeling,[18] in the positive relationship between MS acquisition by infants and maternal salivary levels,[19,20] and in the finding that preventive measures in mothers that interrupt MS transmission decrease caries occurrence in children at 3 years of age[21] and across subsequent years of growth and development.[22,23] Nevertheless, microbiological screening for MS in saliva has been used to only a small degree in infants and toddlers compared with its use in older children, owing to the difficulties of collecting stimulated saliva.[24-28] In young children, however, collecting unstimulated saliva from the dorsum of the tongue using a sterile tongue depressor for transfer of samples onto selective agar media is sufficient.[24,27]

The results of investigations of sensitivities, specificities and predictive values of such MS testing have established age as a clinically significant factor in the link between caries prevalence and MS levels, with younger children showing a stronger correlation between MS levels and caries.[29] Consistent with the findings of Baehni and Guggenheim,[30] specificity was higher than sensitivity, depending on MS cutoff levels, suggesting that cariogenic bacteria are a necessary but not sufficient condition for caries in young children.[29] Furthermore, the accuracy of MS testing (measured as sensitivity and specificity) decreases as age and MS cutoffs increase,[29] supporting the idea that the clinical usefulness of MS testing (measured as positive predictive values [PPVs] and negative predictive values [NPVs]) may be greatest in young children. In addition to MS, models of caries association and prediction typically are used to collect data regarding a variety of dietary, fluoride and social variables.[16] These more expansive models can demonstrate higher correlations with caries status and reduce the amount of variance explained by MS.

We conducted this study to examine the accuracy and clinical usefulness of four caries-risk assessment approaches: the CAT alone (without its optional MS screening measure), MS alone, the CAT excluding the socioeconomic status (SES) risk factor and the CAT excluding the SES risk factor supplemented with MS in screening children younger than 3 years for S-ECC.

METHODS

Setting, participant recruitment and eligibility. After obtaining study approval by the Columbia University Medical Center's Institutional Review Board, we prospectively recruited patients who were new to the pediatric dental clinic at the time of their initial nonurgent dental visit. The clinic serves residents of three communities with fluoridated water in the

ABBREVIATION KEY. AAPD: American Academy of Pediatric Dentistry. **CAT:** Caries-risk Assessment Tool. **CFU:** Colony-forming unit. **ECC:** Early childhood caries. **MS:** Mutans streptococci. **NPV:** Negative predictive value. **PPV:** Positive predictive value. **S-ECC:** Severe early childhood caries. **SES:** Socioeconomic status. **WIC:** Special Supplemental Nutrition Program for Women Infants and Children.