



## Development and Integration of Oral Health Services for Preschool-age Children

James J. Crall, DDS, ScD<sup>1</sup>

### Abstract

The purpose of this paper was to highlight 6 important considerations for developing a comprehensive strategy for optimizing the oral health of preschoolers. These considerations are based on the nature of Early Childhood Caries and the strengths and limitations of various components of the pediatric health care delivery system. Emphasized are 3 strategies for optimizing oral health care delivery for young children within the context of primary care: (1) early establishment of dental homes; (2) risk-based approaches; and (3) integration of dental and medical components of the primary care delivery system. Additional considerations are noted concerning: (1) scope of services provided by medical care personnel; (2) care coordination and referrals; (3) terminology; and (4) unresolved issues likely to have significant implications for future oral health care delivery for infants and young children. (*Pediatr Dent* 2005;27:323-330)

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Children from low-income families, in general, and racial and ethnic minorities, in particular, have higher levels of untreated Early Childhood Caries (ECC) and limited access to oral health care. The problem of untreated dental disease is especially acute for infants and young children. Efforts organized by dental professionals to address these problems have focused on several strategies:

1. educating parents and caregivers about behaviors that promote oral health;
2. encouraging early establishment of "dental homes";
3. training dentists and allied dental personnel on how to provide recommended services to infants and young children;
4. improving Medicaid and State Children's Health Improvement programs.

Despite these efforts, substantial disparities in pediatric oral health and access to oral health services persist in US preschool-age children.<sup>1</sup>

Growing concern over these disparities has prompted additional efforts to have other primary care providers (pediatricians, family physicians, physician assistants, nurse practitioners, etc) address this problem. A variety of initiatives, varying in scope and approach, have been

developed and implemented to expand the involvement of primary medical care providers. Relatively little consideration, however, has been directed to developing a comprehensive strategy for optimizing the oral health of preschoolers based on the nature of ECC and the strengths and limitations of various components of the pediatric health care delivery system.

Within that context, the purposes of this paper were to:

1. frame key issues that merit consideration in providing oral health services for preschool-age children;
2. underscore the importance of strategic approaches and systems development and integration to enhance oral health care delivery and oral health for young children;
3. comment on state programs that seek to involve pediatricians, family physicians, and their staffs in oral health care for high-risk infants and young children;
4. highlight key unresolved questions regarding future efforts to improve the oral health of vulnerable preschoolers.

### Framing oral health services for preschool children within the context of primary care

#### Epidemiology and unmet treatment needs: Magnitude of the problem

Data from a recent national survey of US children's oral health, the National Health and Nutrition Examination Survey (NHANES) III, show that roughly 60% of children

<sup>1</sup>Dr. Crall is professor and chair of pediatric dentistry, UCLA School of Dentistry, and is director, MCHB National Oral Health Policy Center, UCLA Center for Healthier Children, Families and Communities, Los Angeles, Calif.  
Correspond with Dr. Crall at jcrall@dent.ucla.edu



exhibited evidence of dental caries (tooth decay) in their primary teeth by age 5.<sup>2</sup> Further analyses of NHANES III data show that children from low-income households are more likely to have untreated caries, with African American and Latino children having higher rates than their Caucasian counterparts.<sup>1</sup> Some 30% of 2- to 5-year-old NHANES III preschoolers from families living below 100% of the federal poverty level (FPL) had untreated decayed teeth. 2004 US Department of Health and Human Services poverty guidelines were \$12,490 for a 2-person family and \$18,850 for a 4-person family. The prevalence of untreated decay in children in low-income families between 101% and 200% of the FPL, meanwhile, was roughly 25%. By comparison, about 12% of children from families with incomes between 201% and 300% of the FPL had untreated decayed teeth, and only 6% of children from families above 300% of the FPL had untreated caries.

Studies have shown that the prevalence of caries increases with age, particularly in high-risk children with limited access to oral health services. For example, Vargas et al<sup>3</sup> reported that 43% of 3-year-olds in Maryland Head Start programs had untreated caries in 2000, but the prevalence among 4-year-olds increased to 62%.

Approximately 40% of US preschoolers—approximately 10 million children—live in “low-income families” (ie, families whose household incomes are less than 200% of the FPL).<sup>4</sup> Some 4.6 million of these preschoolers live in “poverty” (ie, in families with incomes below 100% of the FPL). The principal relevance of these combined data to considerations of oral health care delivery for preschoolers is to underscore the sheer magnitude of the problem in terms of the number of children involved and the importance of organized systematic approaches for addressing children’s oral health.

#### **Appreciating caries as a chronic, complex disease**

Much has been made recently of the infectious, transmissible nature of dental caries. While this attention to infectivity and transmissibility has captured the attention and imagination of the public and scientists alike, other experienced researchers have pointed out the importance of considering caries as a chronic, complex disease. The following excerpts were obtained from a recent article by Fejerskov<sup>5</sup> published in *Caries Research*:

*By appreciating that dental caries belongs to the group of common diseases considered as “complex” or “multifactorial” such as cancer, heart diseases, diabetes, and certain psychiatric illnesses, we have to realize that there is no simple causation pathway. It is not a simplistic problem such as “elimination of one type of microorganism,” or a matter of improving “tooth resistance.” Complex diseases cannot be ascribed to mutations in a single gene or to a single environmental factor. Rather, they arise from the concerted action of many genes, environmental factors, and risk-con-*

*ferring behaviors. As stressed recently by Kiberstis and Roberts (2002), one of the greatest challenges facing biomedical researchers today is to sort out how these contributing factors interact in a way that translates into effective strategies for disease diagnosis, prevention and therapy... Let us keep in mind that dental caries is ubiquitous in all populations (Fejerskov and Baelum, 1998), but the incidence rate varies greatly within and between populations. It is important to appreciate that the caries incidence rate in a group of individuals appears fairly constant throughout life if no special efforts to control lesion progression are made (Hand et al, 1988; Luan et al, 2000). These new paradigms help to explain the nature of lesion initiation and progression and, accordingly, why dental caries cannot truly be “prevented,” but rather “controlled” by a multitude of interventions... At the individual patient level, we have successfully “controlled” the physiologic balance of the intraoral environment with topical fluorides, dietary monitoring, “plaque control,” etc, but the well-trained clinician knows that some patients require much more and “closer” monitoring than others to avoid new lesions. The consequence of the paradigms is to appreciate that the risk of developing new lesions is never zero. Therefore, dental caries can never be 100% preventable at the individual and much less at the societal level because of its complex nature. Dental caries is as old as mankind.*

The implications of this concept are extremely important to the design and implementation of optimal pediatric oral health care delivery.

#### **Suitability of a primary care model for pediatric oral health**

The chronic, complex nature of dental caries, as previously outlined by Fejerskov, speaks to the need for an ongoing system of care that can provide a relatively comprehensive set of services in a timely and coordinated manner. The fundamental attributes of primary care, outlined by Starfield<sup>6</sup> and summarized as follows, largely embody these precepts:

1. **first-contact care:** implies accessibility to and use of services for problems or episodes for which people usually seek care;
2. **longitudinality:** presupposes a regular source of primary care and its use over time;
3. **comprehensiveness:** implies that primary care facilities must be able to arrange for all types of health care services (diagnostic, preventive, and treatment), including those not provided efficiently within the facility, such as referrals for consultations or definitive management of conditions;
4. **coordination (integration) of care:** requires some form of continuity, either by practitioners or medical records or both, as well as recognition and management of potentially diverse problems. Coordination



is particularly important for patients with multiple problems (such as children with special health care needs) or advanced levels of disease.

Accordingly, primary care principles provide a solid foundation for the design of systems to deal with dental caries as a chronic, complex disease. Additional details and rationale for adopting primary care principles can be found in a related publication on organization and financing oral health services for children.<sup>7</sup>

Dentists generally are not recognized as primary care providers in a health policy context. Primary dental care providers (general dentists and pediatric dentists), however, are considered to be important members of "the primary care team" for 2 principal reasons:

1. The general model for the care they provide embodies the fundamental components of primary care:
  - a. first point of contact (for dental services);
  - b. continuity of care;
  - c. emphasis on prevention;
  - d. coordinated, comprehensive services.
2. The majority of the services they provide generally are not available from other types of primary health care practitioners.<sup>7</sup>

The terms "medical home" and "dental home" are commonly used to delineate the attributes that comprise optimal primary care for children. Issues related to "interfaces" between primary medical care providers and primary dental care providers, with respect to providing oral health services, have been explored in previous work conducted on behalf of the American Academy of Pediatric Dentistry (AAPD).<sup>8</sup> Consideration of a comprehensive model for integrating primary care services, however, received little attention. A recent policy statement issued by the American Academy of Pediatrics (AAP) has provided guidelines for risk assessment and the establishment of dental homes for infants and young children.<sup>9</sup> Again, however, issues left largely unanswered concern mechanisms for integrating oral health services provided in medical homes and dental homes.

#### Current systems gaps

Figure 1 provides a general overview of current gaps between what currently exists and what is needed in terms of systems to improve oral health and oral health care for preschoolers.

This overview highlights relatively high levels of dental caries in vulnerable children as a result of fragmented, uncoordinated activities by various parties, many of whom continue to rely on outdated

service delivery concepts that fail to address oral health for preschoolers in a comprehensive, contemporary, risk-based fashion. Key consequences of these gaps are:

1. Failures to convey critical health promoting information about oral health to caregivers and children in a timely, reinforcing manner.
2. Missed opportunities to deal with dental problems in their early stages. Attributes of a more effective system are shown on the right of Figure 1.

#### Challenges facing the dental care delivery system

Several deterrents to providing optimal oral health care for vulnerable children currently exist within the dental care delivery system. Foremost among them are:

1. a relatively small numbers of pediatric dentists;
2. reluctance of many general dentists to treat young children;
3. declining dentist-to-population ratios;
4. relatively low levels of participation by dentists in Medicaid.

These issues are addressed further in the section on unresolved questions. Suffice it to say at this juncture, however, that much remains to be done to optimize the contributions of the dental care delivery system concerning oral health for young children.

#### Challenges facing well-child care

Faced with the system gaps noted previously, some have advocated approaches that rely on greater involvement of medical primary care personnel to provide oral health services for young children within the context of well-child care programs. Examples of these personnel include the more than 100,000 primary care physicians and over 40,000 practicing physicians assistants and nurse practitioners.

What exists:	What is needed:
<ul style="list-style-type: none"> <li>■ Relatively high levels of oral diseases (primarily dental caries) among large numbers of children and significant disparities               <ul style="list-style-type: none"> <li>• Those with the greatest needs and highest risk have least access to services</li> </ul> </li> <li>■ Disjointed/fragmented delivery system components working in relative isolation               <ul style="list-style-type: none"> <li>• Public sector/private sector</li> <li>• Dental care/primary care</li> <li>• 'Preventers'/'treaters'</li> <li>• Clinicians/communities</li> </ul> </li> <li>■ 'Blind' (untargeted)/one-size-fits-all/dated approaches to service delivery</li> </ul>	<ul style="list-style-type: none"> <li>■ Continuous, coordinated, risk-based use of effective measures that promote oral health, control oral diseases, restore damaged oral structures, and reduce future risk of disease</li> <li>■ Strategic, data-driven approaches that recognize and respect diversity among people and communities, and engage a broad group of stakeholders to address local needs</li> <li>■ Emphasis on cost-effective approaches</li> </ul>

Figure 1. Gaps in oral health and oral health care for preschoolers.



Professional guidelines for the periodicity of primary medical care services recommend that children see a physician:

1. 8 times during their first year of life for periodic well-child services (assessments, immunizations, etc);
2. 3 times during their second year;
3. once a year thereafter until age 6.

For the most part, compliance with these recommendations is relatively high. As with dental services, however, utilization of recommended services by vulnerable children trails that of more affluent children.

Although such approaches may have potential benefits, Schor<sup>10</sup> has indicated that the current approach to well-child care is facing its own set of considerable challenges. Excerpts from Schor's recent publication in *Pediatrics* note that:

*Well-child care is a core service of pediatrics, but it receives little emphasis in pediatric training, reluctant consideration by insurers, and rare attention from researchers. Although it encompasses a variety of health-promoting and disease-preventing services, the desired outcomes of well-child care and quality standards for its provision have not been specified. It is not surprising, then, that preventive care services, as they are being provided currently, are not meeting the needs of many families, especially families with the most vulnerable children. The quality of child health supervision varies greatly among physician practices, and parents are signaling their dissatisfaction by failing to obtain approximately one half of recommended preventive care services. In addition, evidence of effectiveness is lacking for much of the content of well-child care, which may jeopardize both its place as a covered insurance benefit and its reimbursement. It is time for major revision of well-child care, taking into account the varying needs of individual children and families, the operation of child health care practices, and the broad issues of access to primary care and payment for services within the US health care system.*

Again, these observations underscore the importance of strategic considerations when developing programs to engage (nondental) primary care providers in oral health care for young children.

#### Framework summary

Six key issues that merit consideration when contemplating approaches for providing oral health services for preschool-age children have been identified:

1. Dental caries is a highly prevalent, progressive disease that affects millions of preschool-age children in the United States. Children from low-income families, particularly members of racial and ethnic minorities, are disproportionately affected by caries and have limited access to basic oral health services.
2. Dental caries is a chronic, complex (multifactorial) disease for which individuals are at varying levels of

risk throughout their lifetimes. Accordingly, the risk of developing new carious lesions is never 0, and service delivery systems should be designed to help individuals control the disease process through a multitude of risk-based periodic interventions.

3. The principles of primary care are well-suited to dealing with dental caries as a chronic, complex disease.
4. Significant gaps exist between current approaches for addressing ECC and providing oral health services for infants and young children and the kinds of strategies that are needed to optimize oral health for preschoolers.
5. Several factors limit the capacity of the current dental care delivery system to provide optimal oral health services for vulnerable preschool children.
6. The well-child component of the pediatric primary care system faces significant challenges of its own, which could limit primary care providers' contributions to improving oral health in preschoolers.

### Strategies for optimizing oral health care delivery for young children within the context of primary care

#### Early establishment of dental homes

The rationale for providing early and periodic dental care for children includes, but is not limited to, the following:

1. Starting care early provides the best opportunity to:
  - a. promote health;
  - b. reduce risk of future disease;
  - c. allow children to experience dental care in a positive, comfortable context.
2. Young children often present significant behavior management challenges when restorative services are needed.
3. Despite their contributions to function, mitigation of pain and infection, esthetics, and development of the dentition, restorative services have relatively little impact on underlying disease processes absent additional steps to reduce risk.
4. Recent studies suggest that early initiation of dental care can produce improved health outcomes and cost savings—the ultimate in cost-effectiveness.<sup>11,12</sup>

The concept of a "dental home" is derived and closely parallels the concept of a "medical home" that has been promoted for pediatric care.<sup>13</sup> AAPD policy<sup>14</sup> notes that a dental home should be expected to provide:

1. an accurate risk assessment for dental diseases and conditions;
2. an individualized preventive dental health program based on the risk assessment;
3. anticipatory guidance about growth and development issues (ie, teething, digit or pacifier habits, and feeding practices);
4. a plan for emergency dental trauma;
5. information about proper care of the child's teeth and gingival tissues;



6. information regarding proper nutrition and dietary practices;
7. comprehensive dental care in accordance with accepted guidelines and periodicity schedules for pediatric dental health;
8. referrals to other dental specialists, such as endodontists, oral surgeons, orthodontists, and periodontists, when care cannot be provided directly within the dental home. (The referral component also includes referrals to pediatric dentists from general dentists who cannot or choose not to provide comprehensive dental care for pediatric patients.)

Use of the term "dental home" is relatively new and occasionally misunderstood. The underlying concept essentially calls for ongoing, comprehensive care to be provided by adequately trained professionals under arrangements that include the expectations previously noted. This concept, however, is consistent with the general model that has evolved for providing primary dental care services.

Considerable attention has been directed lately to the development and promotion of policies emphasizing early establishment of dental homes. Prime examples include the adoption of policies by numerous professional dental and public health organizations (such as the AAPD, American Dental Association, American Public Health Association, American Association of Public Health Dentistry, and the Maternal and Child Health Bureau's Bright Futures). These policies recommend that dental care for children begin within 6 months after the eruption of a child's first tooth or by the child's first birthday.

Until recently, a considerable discordance existed between the policies adopted by dental and public health organizations concerning early establishment of a dental home and the recommendations of the AAP. A policy statement on Oral Health Risk Assessment Timing and Establishment of the Dental Home was published by the AAP in 2003.<sup>9</sup> This policy statement essentially eliminated the discrepancy for a broad range of children deemed to be at high risk for dental caries by virtue of individually assessed clinical risk factors or by being in one of the following risk categories:

1. children with special health care needs;
2. children of mothers with high caries rates;
3. children with demonstrable caries, plaque, demineralization, and/or staining;

4. children who sleep with a bottle or breast-feed throughout the night;
5. later-order offspring (of siblings with caries experience);
6. children in families of low socioeconomic status.

The AAP policy acknowledges that "To prevent caries in children, high-risk individuals must be identified at an early age (preferably high-risk mothers during prenatal care), and aggressive strategies should be adopted, including anticipatory guidance, behavior modifications (oral hygiene and feeding practices), and establishment of a dental home by 1 year of age for children deemed at risk."

#### Risk-based approaches

Early establishment of dental homes for all children remains a goal for optimizing pediatric oral health. Current circumstances and systems capacity limitations need to be overcome, however, to make that goal a reality. Risk-based approaches provide an opportunity to focus existing resources on children who are most vulnerable to the development of dental disease while efforts to overcome current systems capacity limitations are mounted. Recognition of the importance of risk-based approaches has spawned the development of a number of caries risk-assessment instruments, including AAPD's Caries-risk Assessment Tool.<sup>15</sup> Although scientists continue to search for optimal practical approaches to caries risk assessment, recent studies suggest that application of approaches em-

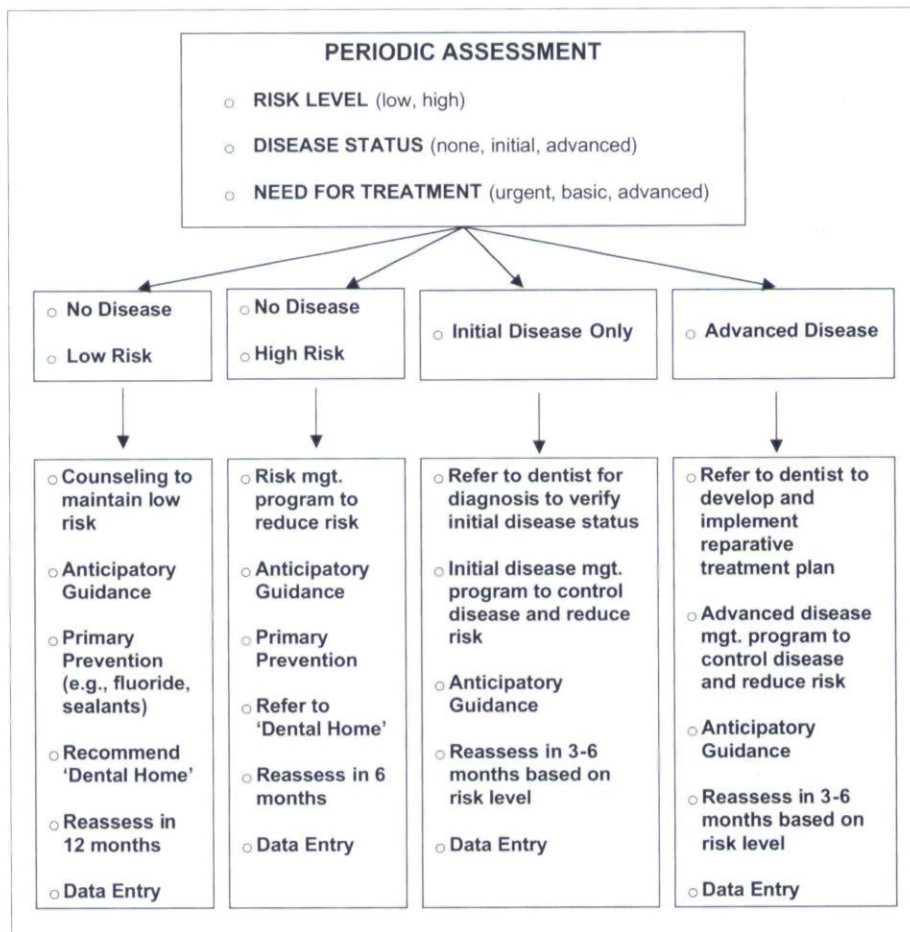


Figure 2. Diagrammatic representation of a model system. Adapted from Crall and Edelstein.<sup>17</sup>



phasizing early and periodic assessment of plaque and incipient (white spot) carious lesion formation can achieve relatively high levels of accuracy in predicting future caries in preschoolers.<sup>16</sup> Furthermore, economic evaluations of strategies employing this risk-based approach combined with risk-based prevention strategies making efficient use of personnel and resources, demonstrated reductions in both costs and dental caries in preschool children.<sup>11</sup>

#### **Systems integration: Concepts and implementation challenges**

From a systems perspective, optimizing children's oral health depends on the attainment of 2 overarching goals:

1. promoting health and controlling risk in those who are relatively healthy;
2. returning individuals who are experiencing initial or advanced levels of disease to a relative state of health by repairing the consequences of disease and implementing effective steps to reduce risk and/or manage the disease process.<sup>17</sup>

Figure 2 provides a conceptual model that separates children into 4 categories based upon caries risk and level of disease and includes examples of sets of activities that could be incorporated into risk-management (2 left columns) or disease management (2 right columns) approaches.

The aforementioned activities necessary to accomplish the 2 broad goals may well differ in their approaches and involve different types of personnel with different sets of competencies working in a variety of facilities (see Hegner<sup>8</sup>). Ultimately, however, attainment of these goals is most likely to be achieved conjointly through the development and implementation of unified systems relying on a series of subsystems (eg, dental and medical components of the pediatric primary care delivery system) each with the capacity and responsibility to provide or manage all of the previously listed fundamental components to carry out various functions.

### **Considerations for programs that seek to engage primary medical care personnel in pediatric oral health services**

#### **Scope of services**

There continues to be debate and policy development regarding the types and levels of services that should be provided by pediatric primary care clinicians. This topic was discussed by a panel convened for the AAPD's Interfaces Conference. The panel generally agreed that the key areas for involvement of nondental health professionals in preschoolers' oral health care included: (1) risk assessment; (2) counseling and anticipatory guidance; (3) referrals to dental homes; and (4) preventive services (eg, fluoride varnish applications), depending upon local circumstances and ease of establishing dental homes, preventive services.<sup>8</sup>

Some states have initiated programs seeking to engage and reimburse primary medical care clinicians for a narrow scope of services (eg, fluoride varnish applications

only), while others have taken a broader approach. For example, North Carolina has created a state-wide program that trains and reimburses pediatricians and family practice physicians for a bundle of services consistent with the Interfaces panel's recommendations.

#### **Care coordination and referrals**

Care coordination (sometimes referred to as "case management") increasingly is becoming recognized as an important aspect of securing optimal oral health care for vulnerable children. The percentage of US births to mothers on Medicaid is approaching 40% overall and exceeding 40% in 20 states,<sup>18</sup> with nearly 25% of all US births to foreign-born mothers in 2002.<sup>19</sup> These statistics have created a growing awareness of the need for early interventions to educate parents about what health services are available and recommended for their infants and how to access those services. Community-based social programs (eg, WIC and Early Head Start), State Medicaid programs, and pediatric primary medical care providers often share responsibilities for care coordination. Guidelines for the timing of pediatric referrals for dental services (establishment of dental homes) have been established by the AAP. Responsibilities and mechanisms for securing referrals to dentists, however, have not been well-specified to date.

#### **Terminology**

The terms used to characterize pediatric oral health programs have important connotations. For example, the word "dental" is defined as meaning "of or relating to the teeth or dentistry" and "dentistry" is defined as "the art or profession of a dentist."<sup>20</sup> The use of the term "dental services" to refer to services performed in the mouth by medical personnel may be lexicographically correct (to the extent that the term refers to services related to the teeth). Such usage, however, may well confuse parents, policy makers, and readers of scientific literature. Moreover, calling services provided by medical personnel "dental services" has the potential to elevate interprofessional political sensitivities. Hence, the term "oral health services" seems more appropriate. Likewise, there are promotional materials for state programs involving medical personnel that state that application of fluoride varnish "prevents caries in 3-year-olds." These materials seemingly undermine efforts to educate parents about the chronic nature of dental caries and guidelines that call for early establishment of dental homes for high-risk children.

### **Unresolved questions regarding efforts to improve the oral health of vulnerable preschoolers**

The success of future efforts to improve oral health care delivery and the oral health of preschoolers, particularly those who are at highest risk for the development of dental caries, depends in large part on several key issues. Because full elaboration on these issues is beyond the scope of this paper and the ultimate course of events largely un-



knowable at this juncture, the issues are merely introduced as follows for consideration.

### **Future participation by various primary care groups in pediatric oral health care**

The case has been made, here and elsewhere, for a more highly integrated collaboration among various groups of primary care providers. This strategy has considerable conceptual advantages. The question, however, remains an empirical one of extreme importance—specifically, to what extent general dentists, pediatricians, family physicians, other medical primary care providers, and even pediatric dentists will choose to become involved in efforts to extend oral health services to infants and young children. The future design and implementation of public programs (eg, Medicaid and SCHIP) are likely to be significant codeterminants of providers' involvement.

### **Systems integration or fragmentation?**

Likewise, it is unclear at this juncture whether there will be increasing integration of efforts by primary care providers (including allied health care providers) or greater fragmentation of the primary care delivery system. Unfortunately, these questions often are decided based on politics rather than scientific studies of the effectiveness and cost-effectiveness of various arrangements.

### **Age-1 dental visit**

As aforementioned, prominent dental organizations have established policies that call for children to have their first visit to a dentist by age 1. Getting these policies to have their desired effect, however, will require substantial educational efforts and, perhaps more importantly, strong leadership on the part of professional dental organizations. Ultimately, the extent of those educational efforts and leadership will largely determine whether age-1 dental visits become a reality for all children or merely for those who have little difficulty accessing services (who ironically are those children at the least risk for the development of dental problems).

### **Expectations about costs**

The topics of lowered costs and cost savings are ever-present in current health policy discussions. Recent evidence suggests that early initiation of oral health services and use of targeted, risk-based approaches can actually lower overall costs and produce better health outcomes for children who use services according to recommended schedules. Care must be taken, however, to manage expectations of policy makers and program officials about the likely effect on overall program costs of implementing programs that effectively engage providers and families in early and ongoing care. There likely will be better health outcomes and lower costs per child who uses services over time. Overall program costs are not likely to decline, however, until the backlog of treatment needs—from programs not provid-

ing universal access—has been dealt with and early and periodic use of services based on risk-based approaches becomes commonplace.

## **Summary**

This paper has highlighted 6 important considerations for developing a comprehensive strategy for optimizing the oral health of preschoolers. These considerations are based on the nature of Early Childhood Caries and the strengths and limitations of various components of the pediatric health care delivery system. Emphasized were 3 strategies for optimizing oral health care delivery for young children within the context of primary care:

1. early establishment of dental homes;
2. risk-based approaches;
3. integration of dental and medical components of the primary care delivery system.

Additional considerations were noted concerning:

1. scope of services provided by medical care personnel;
2. care coordination and referrals;
3. terminology;
4. unresolved issues likely to have significant implications for future oral health care delivery for infants and young children.

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#### ABSTRACT OF THE SCIENTIFIC LITERATURE



#### THE EFFECT OF 2 BONDING AGENTS AND PLACEMENT TECHNIQUES ON MARGINAL LEAKAGE IN A CLASS II COMPOSITE

The failure of composite restorations is thought to be caused by marginal leakage. The purpose of this study was to analyze 2 different placement techniques (incremental and bulk) and 2 different adhesive systems on the marginal microleakage of Class II restorations using five different resin materials.

Two hundred standardized Class II cavity preparations were cut in extracted human premolar teeth and evenly divided into 5 groups, according to restorative material used. Each group was subdivided into 4 subgroups based on adhesive system and placement technique. Samples were then thermocycled, stained, and sectioned longitudinally to evaluate degree of microleakage. The results overall showed both adhesive systems to be similar, with neither achieving complete marginal seal, and the incremental technique of placement having less leakage. Degrees of microleakage were evident among the various materials tested and, thus, influenced the extent of leakage.

**Comments:** Once again, this study reinforces the fact that leakage is inevitable at the tooth-resin margin of any restoration notably along the cervical margin of a Class II preparation. The study was limited by comparing just 2 adhesive systems and not taking into account other variables such as drying time or moisture levels. Nevertheless, the reaffirmation of using an incremental placement technique to lessen any chance of failure is notable. Differences in degree of leakage were found between the various materials tested, in this case limited to 5—a number that could certainly be expanded upon in future studies. **GM**

*Address correspondence to Dr. Paulo E. Capel Cardoso, Faculdade de Odontologia, Depto. de Materiais Dentários, Av. Prof. Lineu Prestes 2227- CEP 05508-900, Sao Paulo, SP, Brazil.*

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