

The importance of preventive dental visits from a young age: systematic review and current perspectives

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Background: Dental caries, the most common childhood chronic disease, disproportionately affects vulnerable parts of the population and confers substantial impacts to children, families, and health systems. Because efforts directed toward oral health promotion and disease prevention are fundamentally superior to dental rehabilitation secondary to disease development, early preventive dental visits (EPDVs) are widely advocated by professional and academic stakeholders. The aim of this comprehensive review was to critically review and summarize available evidence regarding the effectiveness of EPDVs in improving children's oral health outcomes.

Materials and methods: A systematic literature search of the PubMed and Embase electronic databases was undertaken to identify peer-reviewed publications investigating the effectiveness of EPDVs on oral health outcomes, including clinical, behavioral, and cost end points up to October 30, 2013. Outcomes of the identified studies were abstracted and summarized independently by two investigators.

Results: Four manuscripts met the inclusion criteria and were included in the review. All studies were conducted in the US and employed a retrospective cohort study design using public insurance-claims data, whereas one study matched claims files with kindergarten state dental surveillance data. That study found no benefit of EPDVs in future clinically determined dental caries levels in kindergarten. The other three studies found mixed support for an association of EPDVs with subsequent more preventive and fewer nonpreventive visits and lower nonpreventive service-related expenditures. Selection bias and a problem-driven dental care-seeking pattern were frequently articulated themes in the reviewed studies.

Conclusion: The currently available evidence base supporting the effectiveness of EPDVs and the year 1 first dental visit recommendation is weak, and more research is warranted. The benefits of EPDVs before the age of 3 years are evident among children at high risk or with existing dental disease. However, EPDVs may be associated with reduced restorative dental care visits and related expenditures during the first years of life.

Keywords: prevention, children, dental visits, anticipatory guidance, dental home, caries

Introduction

The importance of oral health in the early years of life is well documented, and advocated by professional and academic stakeholders worldwide.¹⁻³ Importantly, early childhood oral health influences and outcomes are considered pivotal in determining oral health trajectories across the life course, and can impact oral health and disease occurrence in adulthood.^{4,5} Specifically, early childhood caries, the most common chronic childhood disease, is known to disproportionately affect vulnerable parts of the population and confer substantial impacts to children, families, and health systems.⁶ The list of possible sequelae of early childhood caries is long, and includes dental and

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medical consequences, pain, diminished quality of life, lost time (children's from school and caregivers' from work or other activities), increased expenditures, and others.⁷

Despite significant strides in foundational sciences and the practice of clinical dentistry during the last few decades, the burden of childhood caries has persisted in most populations. In fact, evidence indicates that oral health disparities may actually be on the increase.^{8,9} Population-based strategies focused on prevention of oral disease are warranted to reduce these disparities. Moreover, efforts directed toward disease prevention are fundamentally superior to dental rehabilitation secondary to disease development when viewed from social justice, human rights, and health-promotion perspectives.¹⁰ Nevertheless, common preventive protocols, such as the schedule and periodicity of routine dental visits, are not supported by a solid evidence base.^{11,12} Similarly, uniform recommendations for early preventive dental visits (EPDVs) for infants and children have been challenged with regard to the evidence base supporting their timing and benefit to different population groups.¹³⁻¹⁵

Various recommendations regarding the timing of children's first dental visit are available in the public domain, emanating predominantly from nonauthoritative sources.^{16,17} Currently, major professional associations' (American Academy of Pediatric Dentistry, European Academy of Pediatric Dentistry, American Dental Association, Canadian Dental Association, Australian Dental Association, and American Academy of Pediatrics) recommendations converge to the first dental visit taking place early, at the time of the first tooth eruption (around age 6 months) or by age 1 year.¹⁸⁻²¹ Despite these recommendations, the presence of visible caries lesions or dental trauma appear to impel most children's first dental visit.^{22,23} Compounding this frequently problem-initiated pattern of care seeking, caregivers' ability to recognize early signs of dental caries in very young children is limited.²⁴

The current rationale for EPDVs, above and beyond the delivery of such preventive services as fluoride treatment, includes the concepts of establishment of a dental home, anticipatory guidance, and risk assessment.^{15,18,25,26} Because caregivers' role is a major influence on their children's oral health behaviors and outcomes,^{5,27,28} EPDVs offer an opportunity to educate caregivers of young children regarding optimal oral hygiene, feeding practices, and dental attendance, and prevention of early childhood caries and dental trauma.²⁹⁻³⁴ Nevertheless, evidence on the effectiveness of preventive dental visits from a young age in improving children's oral health outcomes is scarce. To add to the knowl-

edge base of EPDVs, we carried out a comprehensive review of recommendations and published evidence regarding the benefits of EPDVs. Accordingly, our aim was to systematically review and summarize current evidence regarding the effectiveness of EPDVs in improving children's oral health outcomes.

Materials and methods

We conducted a comprehensive literature search of PubMed and Embase via Elsevier electronic databases to identify relevant published studies. The search strategy combined sets of terms covering three concepts: early preventive dental visits, outcomes, and infants or preschool children. The following search was used in PubMed and modified for the Embase via Elsevier platform: (dental[tw] OR dentist*[tw]) AND (visit*[tw] OR appointment*[tw]) AND (prevent*[tw] OR early[tw]) AND (quality of life[tw] OR absenteeism*[tw] OR outcome*[tw] OR utilization[tw] OR economics[subheading] OR cost[tw] OR costs[tw] OR expenditure*[tw] OR nonpreventive[tw] OR restorative[tw] OR emergenc*[tw] OR health behavior[mesh] OR oral hygiene[tw] OR decay[tw] OR caries[tw] OR dmft[tw]) AND (infant [mesh] OR infant* [tw] OR baby [tw] OR babies [tw] OR newborn [tw] OR neonate* [tw] OR child, preschool [mesh] OR preschool child* [tw] OR young child* [tw]). No limits based on language, country or publication year were used. Gray literature, such as reports and conference proceedings, were excluded from Embase search results. The search was initially conducted in August 2013, and was last updated on October 30, 2013. During the last update, our knowledge of the newly released study online by Beil et al³⁵ made us aware that the complexity of language used to describe young children might exclude retrieval of articles not yet indexed in PubMed. As a result, we also searched using only the EPDV part of the search and examined all the nonindexed articles for relevance.

To aid in study identification, we developed inclusion and exclusion criteria (Table 1) based on the objective of this review, in the following categories: study population (children age 0-6 years), type of dental services (dental office-based oral evaluation and prevention services), and study outcomes (oral health-related clinical, behavioral, or expenditure outcomes). For this review, we excluded studies involving children with special health care needs and those published in languages other than English. First, the title and abstract were reviewed to determine potential relevance. Second, full texts of all potentially relevant articles were evaluated by two investigators (VB and KD), and the articles meeting the inclusion and exclusion criteria were

Table 1 Selection criteria for the inclusion of studies in the systematic review

Inclusion criteria			Exclusion criteria	
Study population	Type of dental services	Study outcomes	Health needs	Language
Children aged 0–6 years	Dental services including oral examinations and preventive measures such as fluoride application and dental prophylaxis, as well as anticipatory guidance for the primary caregiver	Studies examining children's dental clinical (ie, caries), behavioral (ie, subsequent dental visits), or cost (ie, dental-related expenditures) outcomes	Studies focusing on children with special health care needs	Studies published in languages other than English

selected for this review. Finally, the following data from included studies were abstracted in a summary table: location, title, first author's name, type of study, study population, and outcomes, and overall findings independently by two investigators (VB and KD). Although we did not intend a formal quality assessment of the included studies, we did critique their methodology and major findings, and where applicable, this is reported in the "remarks" column of the data-abstraction table.

Results

Our initial literature search identified 484 manuscripts in PubMed and 90 additional ones in Embase, 45 of which were duplicates, creating a total database of 529. One additional potentially relevant nonindexed article was identified in PubMed during the search update, for a total of 530. After initial screening of titles and abstracts, as described in the Materials and methods section, 24 manuscripts were selected for full-text evaluation. Based on our inclusion and exclusion criteria, four manuscripts were selected for inclusion in this review.^{35–38}

All four studies used a retrospective cohort study design and were carried out in the US (Table 2). With the exception of the Savage et al³⁶ report, which was published in 2004, the studies were published recently, in 2012–2013. All studies utilized public insurance (Medicaid, a US social health care program for families and individuals with low income

and resources) claims and had large sample sizes, ranging between 9,204 and 36,805 (Table 3). EPDVs were defined using dental claims for preventive care (comprehensive or recall examination, and preventive services including fluoride varnish and dental prophylaxis) with few between-study variations. Three of the studies examined future preventive and nonpreventive dental visits and related expenditures as the primary outcomes.^{36–38} Importantly, in the most recent study, Beil et al³⁵ merged public insurance claim files with state kindergarten dental surveillance data, and thus this was the only study using a clinical end point (dental caries, as measured by the decayed, missing, and filled teeth index) as the study outcome. All investigations employed multivariate modeling methods to control for established sociodemographic confounding factors and study-design characteristics. Notably, Sen et al³⁸ implemented an additional econometric multivariate modeling strategy based on "individual fixed effects", which according to the authors proved superior and more robust against the effects of selection bias compared to previously used "naïve" modeling approaches.

The Beil et al³⁵ study, among other comparisons, contrasted children who had their first preventive dental visit before versus after age 18 months and found no benefit of EPDV in future clinically determined dental caries levels when children were examined in kindergarten. Savage et al³⁶ found that children who had an EPDV by age 1 year ($n=23$, or 0.24% of the study sample) were more likely to have future

Table 2 List of studies included in the review of the effectiveness of early preventive dental visits in improving children's oral health outcomes

Study	PMID	Country (state)	Title	Study type
Savage et al ³⁶	15466066	USA (NC)	Early preventive dental visits: effects on subsequent utilization and costs.	Retrospective cohort study
Beil et al ³⁷	22525611	USA (NC)	Effect of early preventive dental visits on subsequent dental treatment and expenditures.	Retrospective cohort study
Sen et al ³⁸	23713098	USA (AL)	Effectiveness of preventive dental visits in reducing nonpreventive dental visits and expenditures.	Retrospective cohort study
Beil et al ³⁵	24134364	USA (NC)	Effects of early dental office visits on dental caries experience.	Retrospective cohort study

Abbreviation: PMID, PubMed ID.

Table 3 Summary of the reviewed studies investigating the effectiveness of early preventive dental visits (EPDV)

Study	Sample size	Definition of EPDV	Outcomes	Major findings	Remarks
Savage et al ¹⁶	9,204	Based on Medicaid claims data and defined as a nonrestorative dental visit (ie, comprehensive or periodic evaluation, dental prophylaxis, etc)	<ol style="list-style-type: none"> Age at future preventive, restorative, and/or emergency dental visits Medicaid expenditures for preventive, restorative, and emergency dental care 	<ol style="list-style-type: none"> Children who had an EPDV by age 1 year were more likely to have future preventive dental visits and were equally likely to have future restorative or emergency ones Age of first PDV was positively related to dental related expenditures Children who had their first PDV at age 2 or 3 years were more likely to have preventive, restorative, and emergency dental visits 	<ol style="list-style-type: none"> Only 23 children (0.2%) had their first dental visit before the age of 1 year A monotonic linear association of age with expenditures was assumed, and children with no dental services use were omitted Findings for ages 2–3 years indicate possible problem-driven care seeking Selection bias was acknowledged by the authors as a threat to the validity of the findings
Beil et al ¹⁷	19,888	Based on Medicaid claims data and defined as dental visits including elements of primary and secondary prevention (ie, comprehensive or periodic evaluation, fluoride application) excluding advanced restorative and hospital-based care within a 6-month window	<ol style="list-style-type: none"> Aggregate count of caries-related treatment procedures received at age 43–72 months Medicaid expenditures for dental caries-related treatment at age 43–72 months 	<p>Children who had an EPDV (primary or secondary prevention services) by the age of 18 months had no difference in subsequent dental outcomes compared with children in older age categories</p> <ol style="list-style-type: none"> Total 1,425 (7%) children had a preventive dental visit before the age of 18 months The authors found support for the preventive dental visit by age 1 year recommendation only for children with existing dental disease or at high caries risk, and suggested that other children could delay a first preventive visit until the age of 3 years, particularly where dental workforce is insufficient 	<ol style="list-style-type: none"> Total 1,425 (7%) children had a preventive dental visit before the age of 18 months The authors found support for the preventive dental visit by age 1 year recommendation only for children with existing dental disease or at high caries risk, and suggested that other children could delay a first preventive visit until the age of 3 years, particularly where dental workforce is insufficient
Sen et al ¹⁸	36,805	Based on claims data from the Alabama's Children's Health Insurance Program (CHIP) and defined using dental office-based preventive services procedure codes	<ol style="list-style-type: none"> One-year lagged nonpreventive dental care One-year lagged nonpreventive dental-related expenditures Overall dental and medical expenditures 	<ol style="list-style-type: none"> Preventive dental visits were associated with significant reductions in a child's subsequent nonpreventive dental visits Preventive dental visits were associated with lower nonpreventive dental expenditures Preventive dental visits were associated with increased overall program expenditures 	<ol style="list-style-type: none"> Introduced a novel analytical approach based on an "individual fixed effects" specification designed to circumvent the effects of selection bias inherent in this study type The authors concluded that although no cost savings associated with EPDVs could be supported for the program, EPDVs did improve (continuously enrolled) children's oral health, as measured by future nonpreventive dental visits
Beil et al ¹⁵	11,394	Based on Medicaid claims data and defined as dental visits including elements of primary and secondary prevention (ie, comprehensive or periodic evaluation, fluoride application) excluding advanced restorative and hospital-based care within a 6-month window	<p>Dental disease status at kindergarten, defined as the count of decayed, missing (molar teeth only), and filled (restored) primary teeth – DMFT index</p>	<ol style="list-style-type: none"> Children who had an EPDV by age 24 months had: <ol style="list-style-type: none"> Similar clinical disease status at kindergarten as children who had a visit at age 24–36 months, and Worse clinical disease status (higher DMFT index) compared with those who had a visit at age 37–60 months 	<ol style="list-style-type: none"> The findings are likely reflections of a problem-driven pattern of dental care seeking, with children with early disease having dental visits at a younger age The authors suggested that recommendations for a preventive dental visit before the age of 3 years could focus on children at high caries risk, especially where dental workforce is limited

Abbreviation: DMFT, decayed, missing, and filled teeth.

preventive dental visits and were equally likely to have future restorative or emergency ones versus children who had a preventive visit at a later age. These authors also reported a positive association between the age of the first dental visit and future dental-related Medicaid expenditures. In contrast, Beil et al³⁷ did not find any difference in subsequent dental outcomes between children who had primary or secondary prevention services by the age of 18 months and those that received services at an older age. These authors highlighted the possible issues of selection bias and problem-driven dental care-seeking patterns in this type of dental care-service research study. Finally, in the Beil et al³⁵ report, the authors found that preventive dental visits were associated with significant reductions in children's subsequent nonpreventive dental visits and related expenditures, appearing to benefit their oral health. However, they reported that preventive visits were associated with an overall increase in the program's expenditures during the study period.

Discussion

In this paper, we sought to critically and comprehensively evaluate the evidence base of the effectiveness of EPDVs in improving children's oral health, and found limited evidence in that direction. The only study that considered a clinical end point by investigating dental caries levels at kindergarten did not find any effect of EPDVs. Nevertheless, earlier preventive dental visits appear to be associated with more future preventive visits. Data on EPDVs' effects on subsequent dental treatment (nonpreventive) visits and related costs from three studies are mixed; however, the largest study to date reported an association of EPDVs with fewer future nonpreventive dental visits and lower nonpreventive dental expenditures. While these data provide partial support for EPDVs and the year 1 dental visit, particularly for children at high risk or with existing dental disease, more studies among diverse populations are warranted to add to the evidence base.

The fact that to date there are insufficient data to conclusively support the human and economic benefits of EPDVs for all children does not imply that these benefits do not exist. There is ample theoretical and philosophical support for the benefits of health promotion and primary prevention over disease management and treatment,³⁹⁻⁴¹ while EPDVs are consistent with the establishment of a "dental home".^{25,26,29} The latter is philosophically aligned to the American Academy of Pediatrics concept of a medical home, where comprehensive pediatric primary care is provided contiguously, in a setting where provider and families "should be able to develop a relationship of mutual responsibility and trust".⁴² Ideally, the

establishment of a dental home should take place at a time when provision of anticipatory guidance to caregivers and application of preventive modalities to children can have a true primary preventive effect, prior to the occurrence of disease or traumatic injury. The establishment of a dental home may be especially important for children of caregivers with low health literacy²⁸ or socioeconomic disadvantage,^{43,44} and generally those at high risk for dental disease.⁴⁵

Earlier preventive dental visits were associated with more subsequent preventive visits in both the Savage et al³⁶ and Sen et al³⁸ studies, with the total program oral health-related expenditures being positively associated with EPDVs in the latter. The observation that "prevention costs" may not result in immediate program savings is, to some degree, expected.⁴⁶ First, long-term benefits of EPDVs may not be discernible in the 2- to 5-year observation windows of the reviewed studies. Second, possible positive effects on oral health behaviors, wellness, quality of life, pain, and lost time averted due to restorative treatment needs are not easily quantifiable and cannot be readily juxtaposed to dollar expenditures. However, this also offers an opportunity for the conduct of future studies examining the effects of EPDVs using additional oral health-related outcomes, such as caregivers' oral health knowledge and behaviors, and children's oral health-related quality of life.

Despite current professional recommendations for the year 1 dental visit, very few children actually had such a visit, illustrating a complex problem. First, information available to caregivers (ie, freely available online) regarding their children's first dental visit is not always in agreement with the professional recommendations.^{16,17} As most authors noted, patterns of dental care seeking for very young children appear to be problem-initiated rather than driven by primary prevention. Moreover, it is well documented that shortages in the dental workforce (general and pediatric dentists) pose a barrier to access to care for large portions of the population, particularly those enrolled in public insurance and residing in rural areas.^{47,48} In an environment with limited resources, it appears reasonable to support a need- and risk-based prioritization of EPDVs,^{35,37} as low-risk groups may benefit the least from early dental office-based visits.⁴⁹ On the other hand, the task of determining clinical treatment needs and caries risk without an EPDV remains a challenge, because the actual oral health trajectory of individual children is otherwise unobservable.

In this regard, the potential role of nondental providers in screening all young children and referring those at high risk and with treatment is crucial. This model has been success-

fully implemented in North Carolina, as the Into the Mouths of Babes program,⁵⁰ resulting in improvement of oral health care-services utilization⁵¹ and reductions of dental caries-related treatments among preschool children.⁵² Although econometric evaluations of the program did not reveal any cost savings,^{53,54} this model offers an excellent avenue for the delivery of preventive oral health services (ie, fluoride varnish application) and the conduct of oral health screenings and referrals for specialist care. These services are not offered in a dental setting; however, these visits can be considered EPDVs and further research on their effectiveness in improving children's oral health outcomes is warranted.

Conclusion

The currently available evidence base supporting the effectiveness of EPDVs and the year 1 first dental visit recommendation is weak, and more research among diverse populations is warranted. Despite the strong theoretical and philosophical support for Benjamin Franklin's "an ounce of prevention is better than a pound of cure", evidence to date has shown benefits of preventive dental visits before age 3 years only among children at high risk or with existing dental disease. Nevertheless, EPDVs are associated with more subsequent preventive dental visits, and may be associated with reduced restorative dental care visits and related expenditures during the first years of life.

Disclosure

The authors report no conflicts of interest in this work.

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