Clinical Article OA

CROSS SECTIONAL STUDY

Do Early Dental Visits Reduce Treatment and Treatment Costs for Children?

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Abstract: ***Purpose:*** *The purpose of this paper was to determine if number and cost of dental treatments in high caries-risk children differs in children with early dental intervention compared to children with later intervention.* ***Methods:*** *Billing data from children age zero to seven years old, whose first dental visit was between January 1, 2004 and December 31, 2004, were collected from 20 corporate treatment centers serving children from lower socioeconomic status backgrounds. Data included age at first visit, dental treatment codes, and associated costs for eight years after the first dental visit. Treatment included restorations, crowns, pulpotomies, and extractions. First visit age was categorized into early starters (younger than four years old) and late starters (four years of age or older). Linear regression with cluster adjustment for clinic determined a difference in costs and dental treatments by early and late starters.* ***Results:*** *Of 42,532 subjects, 17,040 (40 percent) were early starters and 25,492 (60 percent) were late starters. There were 3.58 more dental procedures performed on late starters, over eight years of follow-up, than on early starters (P<.001). Late starters spent $360 more over eight years of follow-up than early starters (P<.001).* ***Conclusion:*** *In this study, number of procedures performed were fewer and cost of treatment less for children seen earlier versus later.* *(Pediatr Dent 2014;36:489-93) Received March 19, 2014 / Last Revision September 15, 2014 / Accepted September 19, 2014*

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According to a recent National Health and Nutrition Examination Survey (NHANES) report,[1] dental caries in the primary teeth of very young children had increased since the previous 1999 report, with the biggest increases in poor and minority children. In 2007, the Centers for Disease Control and Prevention reported that 28 percent of two- to five-year-olds had cavities, with 73 percent of these children requiring treatment.[2] The increase in caries in this age group poses significant problems regarding access to skilled and willing care providers; additionally, it can add to the problem of inappropriate emergency department use for palliative care and increase the occurrence of caries-related pain with its potential toxic stress implications.[3]

Since the late 1980s, the first appointment schedule,[4] the dental home, anticipatory guidance, and perinatal supervision[5] have been promoted by dental and medical organizations, federal agencies, and advocacy groups in an attempt to persuade health professionals to:

1. abandon the traditional approach to treat a child only when oral disease exists or the child is deemed manageable; and
2. embrace a philosophy of health promotion, with an early visit by one year old, with establishment of a dental home.

Yet, in 2000, Kanellis and Damiano found in their study of Iowa Medicaid children undergoing general anesthesia to treat early childhood dental caries that only three percent of one-year-olds had visited a dentist.[6] Even today, only a fraction of children visit the dentist by one year old. Medical intervention for oral health during well-baby visits has been suggested to help begin prevention earlier, but results have been mixed. In 2010, Lewis and Stout reported that, in a nationally representative sample, approximately 7.5 million U.S. children (one through 17 years old) had a toothache in the past six months; among this group, 88 percent had a preventive medical visit in the past year.[7]

Over the last decade, in spite of intense efforts at promotion and education of the pediatric community, the incorporation of oral health into pediatric medical practice has been limited.[8] Evidence suggests that spending on dental care increases as children age, and dental caries and its severity increase. In 2006, the Medical Expenditure Panel survey reported that 19 percent of children younger than five years old had dental expenditures of $729 million.[9] Primary prevention strategies, such as the age one dental visit, intend to avoid or slow the development of dental caries by eliminating or reducing factors related to this disease. Unfortunately, few studies have shown that early intervention concepts are effective clinically and also cost effective. Doykos reported that, for every year the first examination was delayed, subsequent fees increased incrementally by approximately $35 (or $247.92 in 2014 U.S. dollars).[10] In 2004, Savage reported that early preventive dental visits reduced restorative needs in subsequent visits.[11] Beil found that children who had a first visit by 18 months old had fewer treatment procedures and incurred less cost than those who first had a preventive visit at 25 to 36 months old.[12]

Additional evidence that early intervention in a high caries-risk child population can reduce dental disease and subsequent restorative care would add support to the concept of early dental intervention. We hypothesized that early dental intervention reduces the treatment burden and costs in high caries-risk children. Children who are seen by a dentist within the first few years of life should require less restorative care than those who wait until later in childhood to establish a

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dental home. The potential to reduce the occurrence of these more expensive aspects of care should result in cost savings. Additionally, the adjunctive costs of general anesthesia and the difficult-to-quantify costs of associated comorbidities could possibly be mitigated. Furthermore, existing workforce models have the potential to embrace the preventive and health promotional aspects of early intervention.

The purpose of this study was to compare treatment and its cost in children with early first dental intervention (prior to four years old) that continued every year to a group of children at similar caries risk, with later dental intervention (after four years old) that continued every year.

Methods

This study was conducted beginning in January 2012, using deidentified data made available by Church Street Health Management (**CSHM**), Nashville, Tenn., USA, which operates clinics across the United States and serves primarily children from low-income backgrounds and covered by state Medicaid programs. The CSHM system is uniform in its procedures, staff training, and quality assurance, making it a better source of data than aggregate independent Medicaid dental providers.

The Institutional Review Board of Nationwide Children's Hospital, Columbus, Ohio, USA, deemed this study exempt, as only deidentified data would be involved. The study design was a retrospective cohort study of children age zero to eight years old whose first dental visit was between January 1, 2004 and December 31, 2004, at centers affiliated with CSHM.

Sample selection. Twenty treatment centers from eight states were selected from over 100 affiliated with CSHM at the time of the study and met inclusion criteria of: (1) having been in operation long enough to provide complete data for the required study period; and (2) having data available for the services used as measures in the comparison. To be included in the subject count, a child had to have been seen at least once a year in that center over the eight-year study period.

Working assumptions. It was not possible to identify whether children had sought care elsewhere, either prior to or concurrently, but their return for periodic care at least annually for a minimum of eight years, from time of first enroll ment at the respective center, was verified for each child in the study. The assumption was made that a child's initial visit to a center was the first dental experience and subsequent visits were only to that CSHM center, thus constituting a regular and recurrent source of care which, for this study, was deemed the equivalent of a dental home. All children were assumed to be at high caries risk, since 95 to 97 percent of the CSHM patient population nationwide are covered for services by the Medicaid system and, thus, considered at higher risk for dental caries, based on income.[13] No attempt was made to characterize children by other clinical, ethnic, or social factors, due to the limitations of the data set.

Methodology and study rationale. Data collected included age at the first dental visit, specific dental treatments, and associated costs of those treatments over an eight-year period following the first dental visit. Treatment was combined into the following categories: fillings (amalgam and composite restoration); crowns; pulpotomies; and extractions (simple or surgical). Each treatment category was defined using the following CDT billing codes: 2140, 2150, 2160, and 2161 for amalgam restorations; 2330, 2331, 2331, and 2335 for anterior composite restorations and 2391, 2392, 2393, and 2394 for posterior composite restorations; 2930, 2931, 2933, and 2934 for stainless steel crowns; 3220 for pulpotomy; and 7111, 7140, and 7210 for simple or surgical extractions. Other treatment procedures, such as preventive and diagnostic services, space maintainers, or other appliances, were not included in this analysis. Since most of the care in CSHM is rendered by generalists, we used the most common and most likely procedures and respective codes attributable to general dentists.

The second part of the study attempted to translate differences in treatment into actual dollar amounts. The purpose of this second part of the study was to evaluate possible cost savings should earlier intervention be done routinely in high caries-risk populations. CSHM has centers throughout the United States, and Medicaid systems have varying fee schedules. For these reasons, we used actual fees from the states in which the study centers were located and attributable to those procedures for those patients.

Statistical analysis. Age at first visit was dichotomized into younger than four years old (early starters) versus four years of age or older (late starters). We used a liberal interpretation of three years old, since some parents may consider a dental visit by three years old to include that entire chronological period until a child is officially four years old. Descriptive statistics (means, standard deviations, and ranges) were calculated for age at the first dental visit, cost of dental treatment, and number of dental treatments by early and late starter groups. Linear regression with cluster adjustment for clinic was used to determine if there was a difference in the cost and number of dental treatments overall and within the four treatment categories by early and late starter groups.

Table 1. SUMMARY OF AGE AT THE FIRST DENTAL VISIT EARLY AND LATE STARTER GROUPS

	Early starter (age at first visit <4 ys old)	Late starter (age at first visit ≥4 ys old)
N (%)	17,040 (40)	25,492 (60)
Mean age±SD*	2.88±0.77	5.80±1.16
Age range	(0.06, 3.99)	(4, 7.99)

* SD=standard deviation.

Table 2. DENTAL COST OVER EIGHT YEARS OF FOLLOW-UP BY EARLY AND LATE STARTER GROUPS

Dental cost	Early starter (age at first visit <4 ys old)	Late starter (age at first visit ≥4 ys old)
	Mean±SD*	Mean±SD*
Fillings	$220.11±$272.53	$294.56±$388.30
Crowns	$299.74±$442.26	$466.97±$690.49
Pulpotomies	$129.71±$220.99	$201.53±$256.25
Extractions	$44.75±$91.49	$91.38±$179.67
Total	**$694.32±$815.13**	**$1,054.44±$1,229.13**

* SD=standard deviation.

Results

Of the 42,532 subjects, 40 percent were in the early starter category and 60 percent were in the late starter category (Table 1). The average cost of all dental treatment over eight years of follow-up was $694.32 (±$815.13 SD) in the early starter group and $1,054.44 (±$1229.13 SD) in the late starter group. Within both early and late starter groups, crowns was the treatment category that had the highest average dental cost over eight years of follow-up ($299.74±$442.26 and $466.97±$690.49, respectively; Table 2).

The average number of dental treatments over eight years of follow-up was 7.69 (±8.61) in the early starter group and 11.27 (±12.56) in the late starter group. The treatment category with the highest average number of dental treatments over eight years of follow-up in the early starter group and in the late starter group was fillings (3.11±3.77 and 3.96±5.09, respectively; Table 3).

Within each treatment type (fillings, crowns, pulpotomies, and extractions), a late starter had, on average, significantly higher dental treatment costs over eight years of follow-up than an early starter (P<.001 for all). On average, children whose age at the first dental visit was four years or older had a total dental cost over eight years of $360.13 more than children whose age at the first dental visit was younger than four years old (P<.001; Table 4).

Similarly, within each treatment type (fillings, crowns, pulpotomies, and extractions), a late starter had, on average, significantly more dental treatments over eight years of follow-up than an early starter (P<.001 for all). On average, children whose age at the first dental visit was four years or older had 3.58 more total number of dental treatments over eight years than children whose age at the first dental visit was younger than four years old (P<.001; Table 5).

Table 3. NUMBER OF DENTAL TREATMENTS OVER 8 YEARS OF FOLLOW-UP BY EARLY AND LATE STARTER GROUPS

No. of dental treatments	Early starter (age at first visit <4 ys old)	Late starter (age at first visit ≥4 ys old)
	Mean±SD*	Mean±SD*
Fillings	3.11±3.77	3.96±5.09
Crowns	2.28±3.35	3.47±5.13
Pulpotomies	1.57±2.66	2.42±4.27
Extractions	0.72±1.44	1.41±2.71
Total	**7.69±8.61**	**11.27±12.56**

* SD=standard deviation.

Table 4. ASSOCIATIONS BETWEEN DENTAL COST OVER EIGHT YEARS OF FOLLOW-UP AND EARLY AND LATE STARTER GROUPS USING LINEAR REGRESSION (WITH ADJUSTMENT FOR WITHIN CLINIC CORRELATION)

Treatment	Dental cost		
	Early starter (age at first visit <4 ys old) slope (95% confidence interval)	Late starter (age at first visit ≥4 ys old) slope (95% confidence interval)	*P*-value
Fillings	Reference	$74.44 ($51.08, $97.81)	<.001
Crowns	Reference	$167.23 ($124.11, $210.34)	<.001
Pulpotomies	Reference	$71.82 ($47.90, $95.75)	<.001
Extractions	Reference	$46.63 ($37.43, $55.83)	<.001
Total	**Reference**	**$360.13 ($286.56, $433.69)**	**<.001**

Table 5. ASSOCIATIONS BETWEEN NUMBER OF DENTAL TREATMENTS OVER 8 YEARS OF FOLLOW-UP AND EARLY AND LATE STARTER GROUPS USING LINEAR REGRESSION (WITH ADJUSTMENT FOR WITHIN CLINIC CORRELATION)

Treatment	No. of dental treatments		
	Early starter (age at first visit <4 ys old) slope (95% confidence interval)	Late starter (age at first visit ≥4 ys old) slope (95% confidence interval)	*P*-value
Fillings	Reference	0.85 (0.56, 1.13)	<.001
Crowns	Reference	1.19 (0.89, 1.49)	<.001
Pulpotomies	Reference	0.85 (0.57, 1.13)	<.001
Extractions	Reference	0.69 (0.57, 0.80)	<.001
Total	**Reference**	**3.58 (2.80, 4.36)**	**<.001**

Discussion

The purposes of this study were to: (1) see if children who engaged a dental home at an earlier age had less treatment performed than those who waited until later in childhood to begin care; and (2) assess a representative cost savings, if any, afforded by beginning care earlier in life. Although the argument for early intervention has been made for decades to maximize the potential benefits of preventive services,[14] adoption of infant oral health by both medical and dental providers has been slow.[8] Similarly, evidence to support early intervention by demonstration of improved oral health (less dental caries) and cost savings is limited. The few studies available suggest that seeing children earlier results in less overall treatment[10-12,15]; however, these studies have limitations, such as small sample size or, conversely, use of pooled data, with variability in treatment planning and other aspects of care. We engaged in this study because of the opportunities provided by a corporate dental system that included a very large pediatric patient pool with elevated caries risk, consistent treatment and quality control protocols across the system, and excellent data management and retrieval.

This study's results support advantages of early intervention, with the early starters having fewer treatment needs compared to those children starting while into their mixed dentition. In all categories of treatment, the mean number of services provided to children presenting for their first visit in the early starter age range was less than for those children starting later. If the mean number of treatment procedures for all age groups younger than four years old in aggregate are considered (Table 3) and compared to each age subcohort in the late starter group, this finding of less treatment persists, suggesting that the advantages of early intervention continue into the preschool ages. In other words, even if children were not linked to dental homes at one year old, they still

found benefit if they entered the care system within the early preschool years. This study also showed the trend, similar to one reported by Beil,[12] of a diminishing difference as children move into school age, perhaps as a result of loss of primary teeth or previous restoration of existing caries.

The benefits of early intervention are suggested by the results of this study, but clearly an additional economic cost-benefit analysis is needed.[16,17] At face value, the cost savings are impressive in terms of treatment cost differences between the two cohorts. Delaying entry until school age almost doubles the treatment cost (Table 2) for the late starter group. Missing, however, are costs of periodic diagnostic and preventive services accumulated over the preschool years that would be incurred by children engaged in a dental home; we selected children who stayed in the system, so we would assume that these services would be consistent across groups. Also missing, however, are the significant adjunctive costs of general anesthesia for some children delayed in seeking care but still young enough to require this expensive service. Some very young children would invariably need pharmacologic management, but the minor treatment needs revealed in this study would suggest that many very young children could be treated in an ambulatory setting. Additionally, the cost of emergency department visits for dental caries-related complications is not included but would add to the cost. A more detailed analysis of both treatment and diagnostic and preventive services would provide a more complete cost-benefit picture.

The treatment needs, as depicted in this study, follow a trajectory similar to the incidence of early childhood caries (**ECC**). It could be argued that early intervention might not alter the trajectory of ECC; hence, establishing a dental home might not equate with prevention or control of the condition. In fact, some evidence suggests that establishment of ECC predisposes a child to future caries and that subsequent preventive care may not alter that path.[18,19] The results of this study do not address that question, but they suggest that waiting creates an additional treatment burden. This snapshot of treatment requirements by increasing age confirms that the sooner a child is seen by a dentist the less his or her treatment needs will be. This finding has significant implications for policy and funding. Early intervention and a source of regular dental care may be the most desirable goals. A recent study from Colorado found that those with a regular source of care were twice as likely to have regular visits.[20] Although we did not follow the children in this study for preventive services, we did require that they stay in the center for at least one visit for some service each year for four years after initial visits, suggesting that the availability and provision of care in a dental home can be beneficial.

It could be argued that differences noted were the result of diligent parents who not only sought dental care earlier but also exhibited preventive behaviors that contributed to these differences. The presence of measurable treatment needs suggests, however, that parents may have been responding to identified problems and the difference reflects the effect of early preventive services. It was not until 2009 that CSHM instituted a system-wide infant oral health promotion.

Investments in school-based health and workforce change aimed at increasing restorative capacity may be less effective than wider adoption of early prevention utilizing the existing workforce. This raises the question of efficient use of the dental workforce and the wisdom of its diversion from other necessary treatment to early restorative treatment of young children. The following question needs to be asked: Should society's resources should be devoted to train a new workforce to handle the failed attention to early prevention instead of changing the culture and practice of the existing dental health care system?

The limitations of this study include its retrospective nature, lack of information about prior or subsequent dental care, and the consistency of and motivation for treatment decisions, which may have influenced the distribution of services. Other studies have tried to relate treatment to age using pooled data from Medicaid, with care provision by hundreds if not thousands of independent clinicians including students and residents. By contrast, this study used data from an established system with relatively well-controlled guidance on care delivery and limited providers. No attempt was made to determine whether a child had previous treatment that might have limited the need for additional treatment and, thus, the procedure count. We believe that, at least for the early starters, the likelihood of previous treatment was low; the fact that most of these children were covered by Medicaid also supports the likelihood that their caregivers sought care in the CSHM system, which is known in communities to welcome Medicaid patients. Because of the preponderance of Medicaid-covered children in the CSHM system, the results may not be generalizable to the general population.

A strength of this study is the careful management of billing and strong oversight of service provisions by the CSHM system to meet federal standards. The likelihood of erroneous billing and procedure counts is low. In summary, this study confirms that children seen early in life had fewer treatment needs than those who were first seen later in life. The results support the policy of many dental organizations to begin oral health intervention at one year old and may encourage pediatricians to overcome obstacles and make dental referrals.[21] The opportunity to reduce both monetary expense and human suffering while optimizing the use of the existing dental workforce devoted to children are supported by this study's results.

Conclusions

Based on this study's results, the following conclusions can be made:

1. Early starters (children who began dental care at younger than four years old) had less treatment for restorations, crowns, pulpotomies, and extractions than late starters (children who began dental care at four years of age or older).
2. Early starters had lower expenditures for treatment procedures than late starters.

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