

Effectiveness of Preventive Dental Treatments by Physicians for Young Medicaid Enrollees



WHAT'S KNOWN ON THIS SUBJECT: Mixed evidence exists regarding the effectiveness of preventive dental services in medical settings. Physicians and nurses are willing to provide preventive dental services, parents are satisfied with the services their children receive, and programs that encourage physician participation increase access.



WHAT THIS STUDY ADDS: Despite declines in effectiveness since fluoride treatment and referrals to dentists to treat existing disease, this study reports that oral health services by non-dental health care providers for Medicaid preschool-aged children lead to reductions in caries-related treatments.

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KEY WORDS

dental caries, Medicaid, fluoride varnish, dental treatment, preschool children, physicians

ABBREVIATIONS

ECC—early childhood caries
IMB—Into the Mouths of Babes

The content of this article is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute of Dental and Craniofacial Research or the National Institutes of Health.

www.pediatrics.org/cgi/doi/10.1542/peds.2010-1457

doi:10.1542/peds.2010-1457

Accepted for publication Dec 2, 2010

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PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

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FINANCIAL DISCLOSURE: *The authors have indicated they have no financial relationships relevant to this article to disclose.*

Funded by the National Institutes of Health (NIH).

abstract



OBJECTIVE: To estimate the effectiveness of a medical office–based preventive dental program (Into the Mouths of Babes [IMB]), which included fluoride varnish application, in reducing treatments related to dental caries.

METHODS: We used longitudinal claims and enrollment data for all children aged 72 months or younger enrolled in North Carolina Medicaid from 2000 through 2006. Regression analyses compared subgroups of children who received up to 6 IMB visits at ages 6 to 35 months with children who received no IMB visits. Analyses were adjusted for child and area characteristics.

RESULTS: Children enrolled in North Carolina Medicaid with ≥ 4 IMB visits experienced, on average, a 17% reduction in dental-caries–related treatments up to 6 years of age compared with children with no IMB visits. When we simulated data for initial IMB visits at 12 and 15 months of age, there was a cumulative 49% reduction in caries-related treatments at 17 months of age. The cumulative effectiveness declined because of an increase in treatments from 24 to 36 months, an increase in referrals for dental caries occurred with increasing time since fluoride application, and emergence of teeth not initially treated with fluoride.

CONCLUSIONS: North Carolina's IMB program was effective in reducing caries-related treatments for children with ≥ 4 IMB visits. Multiple applications of fluoride at the time of primary tooth emergence seem to be most beneficial. Referrals to dentists for treatment of existing disease detected by physicians during IMB implementation limited the cumulative reductions in caries-related treatments, but also contributed to improved oral health. *Pediatrics* 2011;127:e682–e689

Dental caries among children younger than 5 years (early childhood caries [ECC]), albeit preventable, remains highly prevalent in the United States.¹ As many as 11% of 2-year-old children are affected by ECC, and ECC prevalence increases rapidly to 44% in 5-year-olds.² Children with ECC experience many negative consequences including pain, difficulty eating and sleeping, and diminished quality of life.^{3,4} In addition, early onset of the disease increases children's risk for dental caries in their permanent teeth.⁵ A majority of children with ECC belong to low-income families and use dental care infrequently despite eligibility for these services through public insurance programs.² These disparities in the oral health of young children are particularly concerning because they are in stark contrast to older children and adults who experienced improvements in oral health during the 1990s.⁶ The pediatric primary care setting has become a popular site to deliver preventive oral health interventions because it allows access to preschool age children before they develop a trajectory of poor oral health.^{7,8} Although very young children are unlikely to get checkups at the dentist, they frequently make well-child visits to their primary care physician. Increasing evidence indicates that topical fluoride varnish, which is well suited for use by nondental providers, is effective in preventing caries.⁹ Recent evidence also supports the use of oral health counseling by pediatric providers to reduce ECC.¹⁰ Results of at least 2 surveys indicated that physicians were willing to help ensure that children maintain good oral health,^{11,12} and that caregivers were satisfied with the preventive dental services their children received in the medical office.¹³ Importantly, such programs increase access to preventive dental care through med-

ical offices without reducing access to dentists.^{14,15}

Like many other states, North Carolina has been grappling with rising rates of ECC within the context of a limited pediatric dental workforce and increasing numbers of children being born into poverty.¹⁶ In North Carolina, ~40% of children enter kindergarten having already experienced ECC, and in some counties, 2 of every 3 children have the disease at that age.¹⁷ To address this public health crisis, North Carolina Medicaid initiated a program called Into the Mouths of Babies (IMB) in January 2000 to provide oral health preventive services in medical offices.¹⁶ Physicians participating in the IMB program provide: (1) screening, risk assessment, and dental referrals if needed; (2) parent counseling about children's oral health; and (3) application of fluoride varnish to children's teeth. Details about these program components are provided in Table 1. During the period of this study, Medicaid-enrolled children could receive up to 6 IMB visits through 35 months of age. By 2006, each of the 100 counties in North Carolina had at least 1 pediatric practice, family medicine practice, or community clinic participating in the IMB program.

Preventive dental programs that include topical fluoride application are a recent innovation in the medical setting. Therefore, limited evidence exists for their effectiveness in reducing ECC.¹⁸ The purpose of this study was to determine the effectiveness of the IMB program in reducing the number of treatments related to dental caries in children who received IMB services in North Carolina during 2000–2006. The net effectiveness of programs such as IMB will likely depend on 2 offsetting factors: (1) a reduction in treatments for ECC because of improved oral health among the children (a preventive effect); and (2) an increase in treatments for

ECC because of detection of existing disease and subsequent referral by medical providers (a referral effect). These combined effects could result in an increase in caries-related treatments if the referral effect dominates, especially because IMB was implemented gradually over the study period and therefore was not available to all children in our sample at the time of earliest tooth emergence. We hypothesized that the preventive effects from improved oral health should result in an absolute reduction in ECC as long as young children are able to receive the full complement of IMB services during the period of primary tooth emergence.

METHODS

Sample and Design

This population-based cohort study included children who were enrolled in the North Carolina Medicaid program at 6 months old and were continuously enrolled for at least an additional 12 months during 2000–2006. We followed children until they were 72 months old or no longer enrolled in North Carolina Medicaid, whichever occurred first. Medicaid claims data were used to construct a longitudinal analysis file of monthly observations per child. We identified IMB visits and caries-related treatments in the claims using North Carolina Medicaid procedure reimbursement codes (for a complete list of codes see [Supplemental Appendix 1](#)). Caries-related treatments (performed in a dental office or hospital setting) included amalgam restorations, composite (tooth-colored) restorations, extractions, stainless steel crowns, and nerve-related treatments (pulpotomies/pulpectomies).

Analytical Strategy

We present descriptive statistics on: (1) the age (in months) at which IMB

TABLE 1 Description of North Carolina's Medical-Office–Based Preventive Dentistry Program, IMB

Intervention Component	Description/Provisions
Screening, risk assessment, and referral (if needed)	<p>Early caries screening and detection using a dental mirror and directed light</p> <p>Assess caries risk based on various factors such as:</p> <ul style="list-style-type: none"> Child consumes sweetened milk/formula and/or juice in between meals and/or at night Lack of tooth brushing, especially at night Not using fluoridated toothpaste <p>Report of other notable findings like obvious pathology of hard and soft tissues</p> <p>Prescription of a fluoride supplement if indicated, per the guidelines of the American Academy of Pediatrics</p> <p>Refer child with obvious dental caries or above-mentioned risk factors to the dentist</p>
Parent counseling	Based on results of the screening and risk assessment, preventive oral health and dietary counseling with the primary caregiver, including development of an age-appropriate preventive oral health regimen
Fluoride varnish application	<p>The provider and caregiver sit facing each other in a knee-to-knee position with the child's head in the provider's lap; alternatively, the child may be placed on an examination table</p> <p>The provider dries a few teeth at a time and paints a layer of fluoride varnish on the teeth; fluoride must be applied to all surfaces of all erupted teeth</p> <p>Caregiver receives verbal and written instructions after varnish application</p>

Services can be delivered by licensed physicians and physician extenders who are enrolled as Medicaid providers. Provider training is a required condition for participation in the IMB program and is provided in a 2-hour course with continuing medical education credits provided by the Academy of Family Physicians. From 2000 to 2006, IMB visits were reimbursed for children from the time of tooth emergence through age 35 months. Up to 6 visits could be reimbursed, with a minimum of 90 days between 2 IMB visits. Since November 1, 2007, IMB benefits have been extended to children through 41 months of age, with a minimum of 60 days between 2 IMB visits. Services can be provided at well-child checkups, during a sick visit, or at a separately scheduled visit. All components of the intervention must be provided at a visit and reported on the claim form to receive reimbursement. The fluoride varnish product recommended for use during the study period was Duraphat (Colgate Oral Pharmaceuticals, New York, NY).

Data source: Division of Medical Assistance. Physician fluoride varnish services: Clinical Coverage Policy No. 1A-23. Available at: www.ncdhhs.gov/dma/mp/1A23.pdf.

visits occurred; (2) child characteristics according to the number of IMB visits; and (3) use of medical and dental services. These descriptive statistics demonstrate the potential for IMB visits and the rate of IMB and dentist visits. We estimated 2 regression models to determine the effect of the number of IMB visits on caries-related treatments: 1 regression to estimate the probability each month that a child had any caries-related treatment, and a second regression to estimate the expected number of caries-related treatments among children who had caries-related treatment(s) that month.

The first equation was estimated using a logit regression model. The second equation was estimated using a zero truncated negative binomial regression model, which is an estimation technique that is appropriate for dis-

crete count variables such as the number of treatments (eg, fillings) received in a particular month by a child receiving some treatments.¹⁹ Both regressions controlled for:

- dummy variables that indicated the number for sequential IMB visits (eg, first, second, third, fourth, or more);
- interactions of the IMB visit variables with the age of the child at the time of the IMB visit (to allow for differences in treatment effect at different ages);
- child characteristics (gender, age, race, and Hispanic ethnicity);
- county-level variables including the number of general and pediatric dentists who treat children (not necessarily Medicaid dental providers) per 10 000 population, the number of pediatricians and family phy-

sicians per 10 000 population, the size of the county's Medicaid-eligible population younger than 18 years, the urban status of the child's county of residence,²⁰ and a categorical measure of the percentage of the county population with access to fluoridated public drinking water²¹; and

- a time indicator to control for unmeasured changes in socioeconomic conditions and provider supply during the study period.

To estimate the effect of IMB visits, we must combine the results from both regressions. Two factors (the use of separate regressions for the likelihood and number of caries treatments, and the interactions of the IMB treatment indicators with age) complicate determination of the effect of the IMB program directly from the regression coefficients. Therefore, the regression coefficient estimates (provided in [Supplemental Table 4](#) and [Supplemental Table 5](#)) were used to simulate the effectiveness of different numbers of IMB visits in reducing caries-related treatments at various ages. We present these simulation results 2 ways, as an absolute reduction by child's age and as a cumulative reduction in caries-related treatments according to age in months. The simulated absolute reduction provides an estimate of the benefit of the IMB program at a given age. The cumulative reduction illustrates the net effect of increasing numbers of IMB visits on caries-related treatments in children at any age from 12 to 72 months.

The SEs of the regression coefficients were adjusted for repeat observations at the child level. Bootstrapped 95% confidence intervals were obtained for the simulated estimates by using 200 iterations. This study was approved by the institutional review board at the University of North Carolina at Chapel Hill.

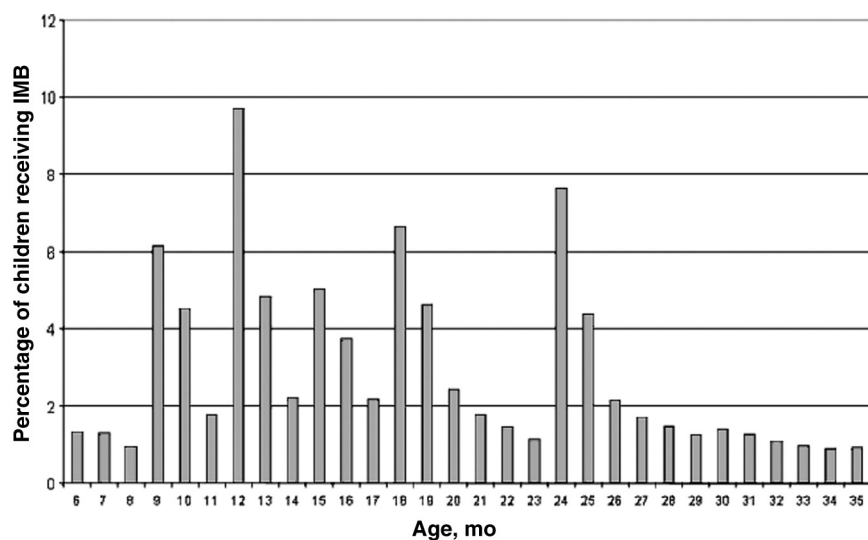


FIGURE 1
IMB frequency according to child's age.

RESULTS

Figure 1 shows that IMB visits were most frequent at the recommended ages for well-child visits for children aged between 6 and 35 months (9, 12, 15, 18, and 24 months). Figure 2 shows that both well-child visits, which provide the best opportunity for IMB visits, and other physician visits decreased as the age of children increased, but were more common for children who obtained greater numbers of IMB visits. Although medical visits (well-child or other) far outnumbered dentist office visits at any age, dentist office visits increased with children's age. Table 2 shows descriptive statistics for the sample according to total number of IMB visits received. The number of months of enrollment from age 6 months onward was roughly the same across groups, ranging from 42 months for children with no IMB visits to 38 months for children with only 2 IMB visits.

Table 3 lists simulated changes in caries-related treatments that we generated by combining estimates from the 2 regression models. The simulations compare children who had 1, 2, 3, 4 or ≥ 4 IMB visits versus those who never

received IMB services. The greatest reduction in estimated caries-related treatments on average over 6 years was found among children who had ≥ 45 IMB visits either at ages 9, 12, 15, 18, and 24 months (18.3%) or at ages 12, 15, 18, 24, and 35 months (17.7%), followed by children who had exactly 4 IMB visits at 12,

18, 24, and 35 months (10.9%). Estimates for caries-related treatments among children with fewer than 4 IMB visits compared with no IMB visits were not different at conventional levels of statistical significance.

The effectiveness of IMB in reducing caries-related treatments varied with age. Figure 3 shows that children who had ≥ 4 IMB visits had significant reductions in caries-related treatments between ages 12 and 17 months and then again at ages 40 through 72 months. In the simulation of cumulative percentage reduction, in which we compared 0 vs ≥ 4 IMB visits at 12, 15, 18, 24, and 35 months of age, children had a 49% reduction in caries-related treatments by age 17 months. The cumulative percentage reduction decreased as the child's age increased and was statistically insignificant from age 26 to 48 months (Fig 4). In children aged 49 months and older, the reduction was statistically significant and approached 20% over the entire age span.

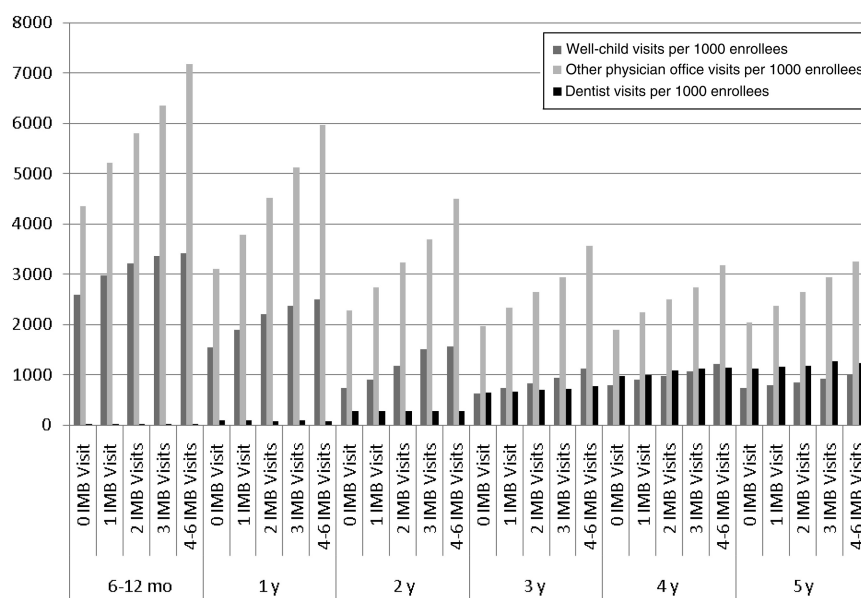


FIGURE 2
Annual medical and dental utilization for Medicaid-eligible children ages 6 to 72 months.

TABLE 2 Descriptive Statistics for Children Eligible for Medicaid and Aged 6 to 72 Months

	Total IMB Visits				
	0	1	2	3	≥4
No. of children	194 730	55 561	37 353	21 398	13 424
Average No. of months enrolled beyond age 6 mo	42.8	38.9	38.4	39.2	40.5
Demographic characteristics, %					
Male	50.7	51.3	50.9	51.8	52.3
Hispanic	12.6	15.1	14.6	15.0	14.7
Distribution according to race, %					
White	39.3	39.5	38.7	37.3	35.3
Black	39.0	36.3	37.2	37.7	40.1
Other	21.7	24.3	24.1	25.1	24.6
Special need: blind/disabled, %	2.5	2.4	2.4	2.2	2.2

DISCUSSION

In this longitudinal population-based study, we examined the effectiveness of physician-delivered preventive dental services for Medicaid-enrolled children in reducing treatments related to dental caries. Three important, age-related findings from this study of children who had ≥4 IMB visits include evidence for: (1) a preventive effect for caries-related treatments in children younger than 2 years; (2) a net referral effect for children aged 2 to 3½ years; and (3) a preventive effect for caries-related treatments for children aged 40 through 72 months. The observed small net referral effect of an IMB visit on caries-related treatments in children aged 2 to 3½ years most likely occurred because of increased detection of disease in teeth of children who received and benefitted from the pro-

gram. Such dental treatment was considered to represent an improvement in oral health status compared with untreated disease. In total, the reduction in caries-related treatments from preventive dental services represents a substantial improvement in the oral health of Medicaid-enrolled children, who historically have had high rates of dental caries but poor access to care from dentists.^{2,22}

The IMB program provided an opportunity for Medicaid-enrolled children to access preventive dental services at a crucial time when their first teeth were emerging and when oral health habits were being established. Previous research has established the effectiveness of fluoride varnish, applied 2 to 4 times per year, in preventing dental caries among children.⁹ A meta-analysis of 3 studies found a 33% (95%

confidence interval: 19%–48%) reduction in decayed, missing and filled primary-tooth surfaces.⁹ More recently, in 2 community-randomized controlled trials conducted among Aboriginal children in Canada and Australia, fluoride varnish applied twice per year and provided in conjunction with health education was effective in preventing new caries (prevented fraction for Canada: 24.5%; for Australia: 31%).^{23,24} This evidence suggests that fluoride varnish is effective in a variety of clinical and community settings.

Our finding of a threshold effect wherein at least 4 visits are required to obtain a detectable preventive benefit from IMB services is not consistent with some previous studies on fluoride varnish use among preschool aged children. Results of those studies revealed that increasing benefit was incurred from every additional fluoride varnish application beginning with a single application.^{23,25} In 1 of these studies a caries preventive fraction of 53% over 2 years was observed after a single application of fluoride varnish in children who were free of caries at baseline.²⁵ Our longer follow-up time of 6 years, and differences in study design (observational study versus randomized controlled trial) may account for the disparate results. Our results,

TABLE 3 Effect of IMB on Expected Dental-Caries-Related Treatments per 1000 Medicaid-Enrolled Children

Treatment Groups	Child's Age at Simulated IMB Visit, mo	No. of Children With IMB Visits ^{a,b}	Estimated Caries-Related Treatments Without IMB, <i>n</i>	Estimated Caries-Related Treatments With IMB, <i>n</i>	Estimated Change in Caries-Related Treatments	95% CI for Estimated Change in Caries-Related Treatments ^c	Change in Caries-Related Treatments, %
0 vs 1 IMB visit	12	55 561	2571	2564	−7	(−85 to 84)	−0.3
0 vs 2 IMB visits	12, 24	37 353	2575	2594	19	(−82 to 124)	0.7
0 vs 3 IMB visits	12, 15, 18	21 398	2583	2658	75	(−64 to 188)	2.9
	12, 18, 24	21 398	2583	2632	49	(−88 to 163)	1.9
0 vs 4 IMB visits	12, 18, 24, 35	9097	2590	2309	−281	(−469 to −58)	−10.9
0 vs ≥4 IMB Visits	9, 12, 15, 18, 24	13 424	2583	2110	−472	(−693 to −241)	−18.3
	12, 15, 18, 24, 35	13 424	2583	2125	−458	(−623 to −204)	−17.7

CI indicates confidence interval.

^a Of the 13 424 children with ≥4 IMB visits, 4327 had ≥5 IMB visits.

^b Number of children with 0 IMB visits, 194 730.

^c Confidence intervals were generated on the basis of 200 bootstrap iterations.

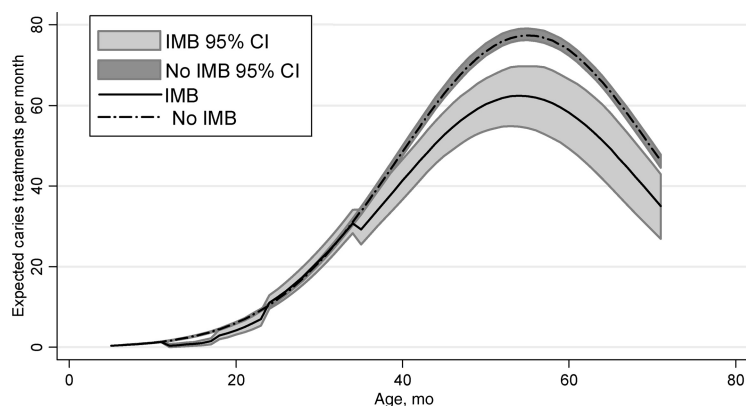


FIGURE 3

Simulated reduction in caries with IMB treatment at ages 12, 15, 18, 24, and 35 months. CI indicates confidence interval.

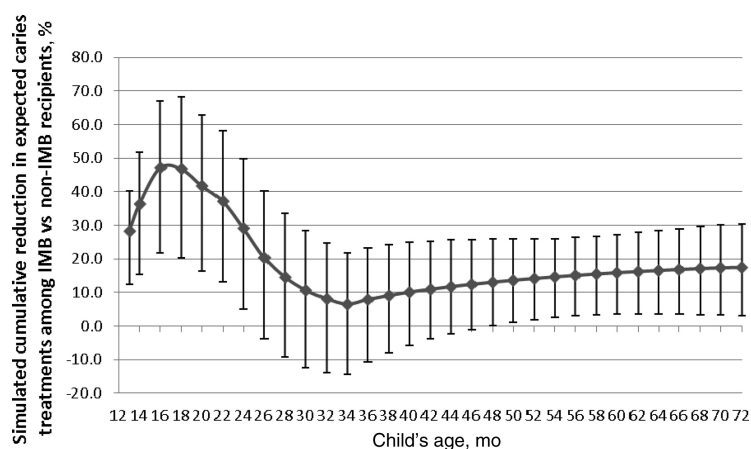


FIGURE 4

Simulated cumulative effect of IMB visits on caries-related treatment at each age based on the assumption of 0 IMB visits versus visits at ages 12, 15, 18, 24, and 35 months.

however, are consistent with an observational study that found a 35% reduction in caries experienced among American Indian children who received ≥ 4 (versus no) fluoride varnish treatments at well-child visits beginning at age 9 months, but no effect with fewer applications.²⁶ The variation in the benefit from a single fluoride varnish application may also be attributable to differences in the rates of ECC in the underlying population. In addition, we believe that using caries-related treatments as the outcome measure likely leads to underestimation of the benefit of the IMB intervention compared with a dental caries incidence measure. According to the

results of 1 reported study, 31% of North Carolina Medicaid-enrolled children aged ~ 5 years had experienced dental caries during 2000–2001.²² However, only 23% of these children received any caries-related treatment during the same time period.

The initiation of preventive dental services early in life and shortly after tooth emergence seems to be important for maintaining good oral health. IMB benefits ended at the child's third birthday and were limited to only 1 application of fluoride varnish every 3 months and a maximum of 6 applications during the time of this study. Therefore, for children to have all 6

IMB visits they needed to start receiving IMB services early in life. The ideal time to counsel caregivers about establishing good oral hygiene and dietary habits as part of daily routines also occurs early in a child's life. Our finding that the effectiveness of the IMB program in reducing caries-related treatments varies over time is not surprising. Soon after a topical fluoride is applied to tooth surfaces, the level of fluoride released in the mouth is high, but its concentration tends to diminish over time.²⁷ To maintain the preventive benefit from the fluoride varnish, especially among children at high risk, repeat applications of the varnish are necessary.²⁸ Thus, we found a cumulative reduction in caries-related treatments of 49% at age 17 months when we simulated IMB visits at ages 12 and 15 months. Although the results are not directly comparable, this estimate yielded values similar to those reported in the literature for prevented-fraction values for cavitated and noncavitated carious lesions.^{23,25}

The decrease in simulated effectiveness in children aged 2 to $3\frac{1}{2}$ years possibly occurred because of physicians' referrals for treatment of existing disease. Although the purpose of the fluoride varnish is to reduce ECC, the screening and counseling components of the IMB program should result in referrals to dentists for follow-up of problems identified during the IMB visit. The analysis covered the period when the IMB program was being implemented statewide, so the analysis sample may have had a preponderance of children who already had ECC at the time of their IMB visits. Results of previous research showed that pediatricians and family physicians, once trained, are able to detect ECC and provide referrals to children in need of dental care.²⁹ We believe this referral effect also likely reduced the estimated preventive effect for children who received

fewer than 4 IMB visits, as well as children who were older and had many teeth emerging during the early implementation phase of the program. For example, children who received their first and only IMB visit at age 24 to 35 months may have been more likely to have ECC and more likely to be referred to a dentist for treatment than children seen at a younger age.

Although well-child visits provide a good opportunity for provision of preventive oral health services, low-income families face many challenges in adhering to the recommended well-visit schedule.³⁰ Ultimately, the successful implementation of a medical office–based preventive dental program will rely heavily on caregivers' compliance with the well-visit schedule. During the very early stages of IMB implementation, children who received preventive dental services in medical offices had few repeat IMB visits or well-child visits (mean: 0.9 vs 1.3 visits, respectively), resulting in a recommendation that strategies to increase oral health visits in the medical setting would need to be tied to those directed at improving compliance with the well-visit schedule.³¹ In addition, barriers to implementation of preventive dental programs in primary care exist and need to be addressed to ensure successful implementation. The 2 most common barriers reported by IMB participants include difficulty in integrating the intervention into their practice routines and resistance from colleagues and staff.³² Policies to enhance program implementation have been instituted in North Carolina. For example, since November 1, 2007, the

North Carolina Medicaid program has extended IMB benefits to children through age 3½ years and decreased the time interval required between visits. These policy changes have enabled more flexibility in providing IMB services by taking into account irregular well-child visits.

This study has 3 important limitations. First, we were unable to control for possible selection bias wherein physicians may have been more likely to provide IMB services to children with existing ECC or those considered at high risk for ECC. If physicians tended to select patients who would benefit most from IMB services, our estimates of IMB effectiveness might be biased upward. In preliminary investigations we used statistical techniques to help address selection bias in nonrandomized studies.³³ Our investigations with these approaches did not provide evidence for selection bias but greatly reduced the precision of our estimates. We therefore relied on the use of observed control variables to offset the effects of any selection bias. Second, part of the analysis period coincided with the period when IMB was being implemented throughout North Carolina. Therefore, many children in the study did not have the opportunity to receive the full complement of 6 IMB visits starting at age 6 months. Nevertheless, this study provides estimates of effect for an entire statewide Medicaid population during implementation. Future studies will need to be performed to examine effects of the IMB program during its more mature stages. A third limitation was that we lacked any information about the

child's actual clinical status. We therefore could measure only differences in treated disease, and the total reductions in dental caries could have been greater than what we estimated from the use of claims data.

CONCLUSIONS

IMB, North Carolina's medical office–based preventive dentistry program for Medicaid-enrolled children, was effective in reducing caries-related treatments for children who had ≥ 4 IMB visits. Repeat applications of fluoride varnish and provision of oral health counseling around the time of tooth emergence seem to be most beneficial in reducing caries-related treatments. Future research should examine the cost-effectiveness of IMB services, the effects of these services on the actual oral health status of children, and the quality of life of families. Researchers also should explore strategies to improve the continuity of preventive dental services in the medical setting.

ACKNOWLEDGMENTS

This study was supported by National Institute of Dental and Craniofacial Research grants R01 DE013949 and R03 DE017350. Dr Pahel was partially supported by a National Research Service Award postdoctoral traineeship from the Agency for Healthcare Research and Quality, sponsored by the Cecil G. Sheps Center for Health Services Research, University of North Carolina at Chapel Hill, grant T32-HS-000032-20. We acknowledge the programming of Jeongyoung Park and John Cantrell to prepare the analytical datasets.

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