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Access to Preventive Services Following the Integration of Oral Health into Early Childhood Education and Medical Care

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INTRODUCTION

Clinical practice guidelines published by major pediatric health care organizations recommend that dental visits be initiated before the first birthday and continue on a routine schedule.^{1, 2} These visits are needed to provide risk-based preventive oral health services, which should be initiated at an early age because of the elevated dental caries risk of many children. Dental caries can begin at a very young age in children, progress rapidly, and lead to pain, infection and other outcomes that negatively affect the child and family.^{3, 4} In 2011–12, close to half of 2–5 year olds at <100% of the poverty threshold had experienced caries in some of their primary teeth, far exceeding those in higher income families (17.2%) and the rather modest national goal for 2020 of no more than 30%.⁵

Families face multiple barriers in obtaining oral health services for their children.⁶ The dental workforce overall is not prepared adequately or willing in some cases, to provide dental care for young children.^{6–8} General knowledge about visit schedules among the public is low and health literacy levels interfere with families' ability to gain this knowledge or navigate the healthcare system.⁶ In 2009, only 7.6% of children younger than 3 years of age had a dental visit in the United States, and only 1.7% received a topical fluoride treatment.⁹

The integration of oral health services into primary medical care developed in direct response to the high prevalence of dental caries and limited dental access experienced by many families. Multiple well-child visits occur during the first 3 years of life. Provision of

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preventive oral health services (POHS) such as checking on the development of the mouth, counseling on proper diet and the application of fluoride varnish is congruent with the goals of well-child visits. Support for this strategy has evolved over many years, and it now is considered an essential part of the well-child visits.^{1, 6, 10–13}

North Carolina (NC) has had a long-standing Medicaid program known as *Into the Mouths of Babies* (IMB) that reimburses medical professionals for providing oral health screening and risk assessment, counseling, fluoride therapy and dental referrals for up to six visits in the first 3 ½ years of life. POHS are provided in more than 500 clinical sites statewide.¹⁴ Studies from the implementation period, 2000 – 2006, demonstrate that the IMB program increases access to POHS.¹⁵ By 2006 the rate of POHS visits in medical offices was 40 per 100 enrollees, almost four times larger than the rate of dentist visits at 11 per 100 enrollees.¹⁵ Studies suggest that physician-delivered POHS reduce inequities in access to POHS and improve population oral health.^{16, 17}

As part of statewide efforts to address dental caries we supplemented IMB in 2009 with an intervention designed to educate staff working in all NC Early Head Start (EHS) programs about oral health. EHS is a Federal program that provides comprehensive services to meet low-income families' needs from pregnancy through a child's third birthday. An evaluation of the impact of the intervention, known as Zero-out Early Childhood Caries (ZOE) found that enrollment in EHS increased dentist visits compared to non-enrollment.¹⁸ Medical visits, an alternative source of POHS, were not included in that study. To our knowledge, no study has investigated the role of EHS on the use of POHS in the context of a statewide program like IMB, where oral health is integrated into primary health care.

The primary aim of this study is to examine the effect of NC EHS on the receipt of POHS from dental and medical providers. We hypothesized that EHS would improve the odds of receiving POHS from medical and dental providers compared to community controls because EHS has oral health performance standards that promote the establishment of a dental home. Further, EHS programs have resources and experience to coordinate services between medical and dental delivery systems.

As a secondary aim, we compared the receipt of POHS obtained from dental and medical providers within the EHS and non-EHS groups. Within the EHS group, we hypothesized a higher odds of receiving oral health assessment and fluoride application from dental providers compared to medical providers because EHS coordinates referrals to dental providers. Within the non-EHS group, we hypothesized the opposite, that there would be higher odds of receiving POHS from medical providers than dental providers because children in the non-EHS group do not benefit from EHS enrollment but make frequent well-child visits to medical practices that might be participating in the IMB program.

METHODS

Study design and data source.

We used data from the ZOE study, a longitudinal prospective study undertaken to estimate the effects of enrollment in EHS on oral health outcomes in young children. An EHS group

was compared with a matched control group of children not enrolled in EHS on the receipt of preventive oral health assessments and fluoride by medical and dental providers. Teachers and staff in NC EHS programs received up to two hours of didactic training in children's oral health to bolster awareness of EHS performance standards and help facilitate their implementation. The goal of this intervention was to promote maximum implementation of federal EHS oral health performance standards (tooth brushing with fluoridated toothpaste, oral health education, and determination of a child's oral health status by a dental professional), but with a practical intervention. The study was approved by the Institutional Review Board at the University of North Carolina at Chapel Hill.

Study population.

The sampling strategy for ZOE involved three stages, described in detail in a previous publication:¹⁹ (1) enrollment of EHS programs, (2) enrollment of parent-child dyads within EHS programs, and (3) enrollment of community-matched parent-child dyads to serve as controls. In stage one, all NC EHS programs were invited to participate, and all except one were enrolled. In stage two, parents of EHS children from all participating EHS programs were recruited by the research team. Five criteria were used for enrollment of EHS and non-EHS parent-child dyads: 1) child <19 months old; 2) parent >18 years old; 3) interviewee is the primary caregiver; 4) no plans to move from the county or, in the case of an EHS subject, withdraw from EHS; and 5) interviewee speaks English or Spanish fluently. In stage three, Medicaid-enrolled children of the same age, language, and ZIP code as already enrolled EHS parent-child dyads were selected from Medicaid files and recruited as the control group through direct mailings from the NC Medicaid program.

Trained interviewers administered structured, one-hour in-person interviews to parents at baseline when the child was <19 months old and at follow-up ~24 months after baseline interviews, which coincided with children aging out of the EHS program at 36 months old. English and Spanish questionnaires were administered, as appropriate. Baseline interviews were conducted from September 2010 to July 2012 and follow-up interviews from November 2012 to March 2014.

Variables.

The main independent variable, EHS enrollment, was supplied by EHS staff and confirmed by the parent at the baseline enrollment screening and interview.

Four dependent variables measuring cumulative life-time receipt of different POHS (oral health assessment by a medical provider, oral health assessment by a dental provider, fluoride application by a medical provider, and fluoride application by a dental provider) were determined by parent self-report at the follow-up interview and analyzed as binary variables.

We included four baseline covariates in the analyses because of their potential impact on all four dependent variables: parent health literacy, parent overall health, survey language and a generalized boosted model propensity score derived from 47 socio-demographic characteristics and EHS enrollment criteria.²⁰ Parent health literacy was measured at baseline using the Short Assessment of Health Literacy – Spanish and English (SAHL-

S&E), an 18-item word recognition and comprehension test validated in a low-income population with an established cut-off to identify families with low health literacy (SAHL-S&E ≤ 14).²¹ Parent health literacy was treated as a binary variable for low parent health literacy (SAHL-S&E ≤ 14) versus other literacy levels (SAHL-S&E > 14).²¹ Parent overall health was treated as a binary variable for excellent/very good/good/missing versus fair/poor. Missing values (n=4) were imputed with the mode, excellent/very good/good (n=934). Survey language was treated as a binary variable (English versus Spanish). The propensity score was included as a continuous variable.

Analytic Approach.

We performed an intent-to-treat analysis in which the treatment indicator (EHS enrolled or not) was as assigned. Before modeling the relationship between EHS and POHS use, we examined the unadjusted relationship between EHS enrollment and the four POHS dependent variables: medical assessment, dental assessment, medical fluoride, dental fluoride.

Alternating Logistic Regressions.—We used multivariate logistic regression estimated with the alternating logistic regressions (ALR) procedure.^{22, 23} ALR is an implementation of generalized estimating equations that can simultaneously estimate the marginal effects of EHS on each of the four types of POHS use (dental assessment, dental fluoride, medical assessment, and medical fluoride) and evaluate the associations between pairs of POHS outcomes.

The model included the following independent variables: 1) EHS enrollment indicator, 2) low parent health literacy at baseline (dichotomous), 3) parent overall health at baseline (dichotomous), 4) survey language (dichotomous) and 5) the estimated propensity score (continuous). In order to estimate the odds of receipt of POHS by a child in EHS relative to the odds of receipt for a child not enrolled in EHS while accounting for the within-child clustering of the four dependent variables, we fit the model to include interactions for all of the independent variables with indicators representing the distinct logits corresponding to those outcomes. This allowed for the effect of each independent variable to be unique for each dependent variable. Then, we removed non-significant interactions among the independent variables (parent health literacy and survey language) with the dependent variable. A non-significant interaction indicated that the effect of the independent variable was not different across the four dependent variables and therefore could be pooled.

Standard errors and 95% confidence intervals were generated. Data analysis was performed using SAS/STAT® version 9.4 (SAS, 2013).

RESULTS

We enrolled 60% (n=634) of an estimated 1,054 eligible participants enrolled in NC EHS programs and 9% (n=927) of the 9,967 children enrolled in Medicaid but not EHS. EHS enrolled children were less likely to identify as white than those not enrolled and more likely to have been homeless sometime during their first 3 years of life ($p < 0.01$) (Table 1). EHS children also were more likely to have received dentist or physician services at baseline than

non-EHS subjects ($p<0.001$) (Table 1). We found a large percentage of medical fluoride visits around 1 year of age (EHS=36.3%; non-EHS=30.2%) (Table 1). Follow-up interviews were completed with 479 EHS and 699 non-EHS parent-child dyads, a 75% follow-up rate for both groups.

Aim #1: The Effects of EHS Enrollment on Preventive Oral Health Services

Receipt of each of the four POHS and POHS overall by EHS group is presented in Figure 1. An average of 81% of children received POHS from either a dental or medical provider at the two-year follow-up. However, a larger percentage of EHS children had an oral health assessment from either a medical or dental providers than children not enrolled in EHS (89% vs. 76%, $p<0.001$) (labeled “either” in Figure 1). The unadjusted estimates for the percentage having fluoride treatments presented in Figure 1 did not substantively differ by EHS group.

For the primary aim, unadjusted proportions and covariate-adjusted odds ratios for the association of each of the four outcomes by EHS group are presented in Table 2 (the complete ALR results upon which these results are based are presented in supplemental materials). After controlling for parent health literacy, parent overall health, survey language and the propensity score, children in EHS had a greater odds of having had a dental assessment (OR=2.33; 95% CI=1.74–3.13) and dental fluoride (OR=1.53; 95% CI=1.16–2.03) at the follow-up compared to children not enrolled in EHS. Results of the ALR analysis also showed that dental assessment was highly associated with dental fluoride in the sense that these two services tended to be bundled together (Supplemental file; Table A.2). Children enrolled in EHS had a decreased odds of receiving a medical fluoride treatment compared to children not enrolled in EHS (OR=0.73; 95% CI=0.54–0.99).

Aim#2: Effects of Provider Type on Assessment and Fluoride within EHS and Non-EHS Groups

In the adjusted analysis for the secondary aim, children within the EHS group had a 3.65 (95% CI=1.84, 7.24) greater odds of receiving an oral health assessment from a dental provider than from a medical provider (Table 3). Within the EHS group, the odds of receiving fluoride did not differ by provider type (OR=1.79; 95% CI=0.94, 3.42). Within the Non-EHS group, we found no difference in the odds of receiving an oral health assessment (OR=1.45; 95% CI=0.86, 2.43) or fluoride treatment (OR=0.86; 95% CI=0.50, 1.46) by provider type.

DISCUSSION

The most important findings from this study are three-fold. First, a large percentage of children received POHS. Second, children enrolled in EHS had essentially the same rate of use for overall fluoride as children not enrolled in EHS but enrolled in Medicaid. Third, the similar rates for the two groups are achieved by the children using different provider types within their communities.

In a previous publication from the ZOE study, we reported that enrollment in EHS increased the likelihood of a dental visit of any type by 17.2% and a preventive dental visit by 19.0%

compared to non-enrolled community controls.¹⁸ The percentage of EHS children with a preventive dental visit by 3 years of age was 79% in EHS compared to 56% for those not enrolled.¹⁸ In the current study, 81% of children in both EHS and non-EHS groups reported having had POHS from either medical or dental providers by 3 years of age.

The prevalence of reported medical fluoride visits at study baseline was high in both EHS (36.3%) and non-EHS (30.2%) compared to national estimates. Child study subjects averaged about 1 year of age at baseline, which is the age recommended for the first dental visit.^{1, 2} We assume that these services were provided as part of the IMB program. IMB visits were promoted during EHS staff training as an alternative source of POHS in those communities where sufficient dental workforce to care for all children enrolled in their programs was unavailable.

While the receipt of fluoride was high in both EHS and non-EHS groups, the source of professional fluoride treatments was different. Children in EHS had a greater odds of receiving fluoride from a dental provider (OR=1.53) and a decreased odds of receiving a fluoride application from a medical provider (OR=0.73) compared to children not enrolled in EHS. These results suggest that EHS can help improve access to POHS by linking EHS children with a dental provider. Receiving POHS from a dental provider has the potential of helping children from low resource families establish a dental home early in life.

The current study adds to our knowledge about potential sources of POHS beyond the dental care system alone to include the medical setting and provides an evaluation of its impact on access to POHS. Our findings show that children in EHS received fluoride largely from dental providers and non-EHS children received high levels of fluoride from medical providers, resulting in high levels of fluoride receipt by both the EHS and non-EHS children. This finding demonstrates not only the potential for a social services program like EHS to contribute to oral health through staff support of parents, but the added contributions derived from the integration of oral health into primary health care. This approach provides a convenient source of POHS for young children that otherwise might be unavailable to them.

Short- and long-term success in achieving and maintaining oral health for those who obtained POHS in the medical setting during the first 3 years of life will depend on effective dental referral activities within medical practices.²⁴ Evidence is lacking on the extent to which these activities take place within primary care or their effectiveness.^{12, 25} However, a number of barriers exist that are difficult for the public to overcome that might negatively affect continuity of care.^{26, 27}

A number of organizations have promoted the integration of oral health into primary care as one method to improve access to POHS.^{1, 10, 12, 13, 28–31} Although the rationale for these programs is strong, few rigorous evaluations of the effects of these programs on access to dental care or oral health status have been conducted. Results of this study suggest that high rates of exposure to POHS can be achieved in these programs.

Limitations:

Our results may be subject to reporting bias. Parents may be more likely to report fluoride applications by a physician than a dentist because it is somewhat unusual and parents will take notice of the fluoride but not the assessment. Both are expected at the dental office. The results also are unlikely to be generalizable to states where the integration of oral health services into primary health care is not as widespread as in North Carolina. Additionally, we do not have information on either the number or the frequency interval with which POHS were provided. We cannot assess whether scheduled POHS were adherent to recommended guidelines.

Finally, the high utilization rates could be due partly to the way in which we calculated rates. The dental use rates presented in this paper are cumulative from birth until the follow-up interviews, which occurred at approximately 3 years of age. Rates usually are presented in the literature as percentages of the population with 1 or more dental visits in the past year, which is not comparable to our cumulative lifetime estimates. Nevertheless, differences in our estimates and those of others suggest that high and equitable rates of exposure to POHS can be achieved through integration. Rates reported to CMS by state Medicaid programs provide one example for comparison. In 2016, 15.3% of enrolled children younger than 3 years of age had 1 or more preventive visits to a dental provider; 8.2% received oral health services from a non-dentist provider.³² Our estimates for POHS use are 5 to 10 times greater than these national rates reported by CMS.

Summary:

These results: 1) provide evidence of the positive impact on access to preventive services from the combined availability of POHS by medical and dental providers; and 2) depict positive implications for improving access to POHS through early education programs like EHS, which target a considerable number of disadvantaged young children. Long-term follow-up, however, is needed to determine impact on oral health outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Bar Chart on the Unadjusted Receipt of Preventive Oral Health Services by a Medical‡ Provider and Preventive Dental Services by a Dental Provider in the First Three Years of Life, by Early Head Start (EHS) or Non-Early Head Start (Non-EHS) Group. ‡Medical providers delivered preventive oral health assessments and fluoride varnish through the Into the Mouth of Babies program. *P 0.001

Table 1.

Baseline Child Characteristics of the Zero-Out Early Childhood Caries Study Population, by Early Head Start (EHS) and non-Early Head Start (Non-EHS) Groups.

Characteristic	EHS (n=479) %	Non-EHS (n=699) %	p-value [†]
Age (months) [mean, SD (range)]	10.6, 4.8 (0–19)	10.3, 4.6 (1–19)	0.297
Gender			0.246
Male	53.7%	50.2%	
Female	46.3%	49.8%	
Race and ethnicity			<0.001
Non-Hispanic White	17.5%	36.8%	
Non-Hispanic Black	37.0%	19.5%	
Non-Hispanic Native American	2.3%	1.1%	
Non-Hispanic Other, Single Race/Ethnicity	0.2%	1.0%	
Non-Hispanic Other, Multiple Races/Ethnicities	7.5%	11.0%	
Hispanic	34.7%	30.3%	
Missing	0.8%	0.3%	
Language			0.403
English	74.1%	76.3%	
Spanish	25.9%	23.7%	
Enrolled in public health insurance			0.441
Yes	98.1%	98.9%	
No	1.7%	1.1%	
Missing	0.2%	0.0%	
Physical, learning, or mental health limitations			0.159
Yes	4.6%	3.0%	
No	94.6%	95.6%	
Don't know	0.8%	1.4%	
Ever been homeless or not had a regular place to live			0.006
Yes	4.6%	1.9%	
No	95.0%	98.0%	
Don't know	0.4%	0.1%	
Number of children in the household under 5 years-old [mean, SD (range)]	1.8, 1.0 (1–7)	1.4, 0.6 (1–5)	<0.001
Number of children in the household between 5 and 17 years-old [mean, SD (range)]	1.0, 1.2 (0–6)	0.7, 1.1 (0–5)	<0.001
Number of adults in the household over 17 years-old [mean, SD (range)]	2.1, 1.0 (0–7)	2.2, 1.0 (1–9)	0.004
Baseline Dental Visits	9.6%	2.0%	<0.001
Baseline Medical [‡] Assessments	33.0%	21.7%	<0.001
Baseline Medical [‡] Fluoride	36.3%	30.2%	0.027

N=number of subjects in stratum, SD=standard deviation, *Due to rounding, percentages may not add to exactly 100%.

[†]The p-values are for chi-square tests or t-tests comparing EHS and non-EHS groups. For the chi-square test, “don't know” and “missing” values were excluded, and categories were combined if the expected count for a particular cell was less than five to satisfy the test's assumptions.

[‡]Medical providers delivered preventive oral health assessments and fluoride varnish through the Into the Mouth of Babes program.

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Table 2.

Observed Proportions and Model-adjusted Odds Ratios for Early Head Start (EHS) versus Non-Early Head Start (Non-EHS) for the Receipt of Preventive Oral Health Services by a Medical Provider and Preventive Dental Services by a Dental Provider using Alternating Logistic Regressions[‡] (N=1,178)

	Unadjusted Proportions				Adjusted Odds Ratios		
	EHS (n=479)		Non-EHS (n=699)		Odds Ratio	95% Confidence Interval	p-value
	n	%	N	%			
Dental Assessment	364	76%	378	54%	2.33	1.74, 3.13	<.0001
Dental Fluoride	266	55%	317	45%	1.53	1.16, 2.03	0.003
Medical [‡] Assessment	276	58%	375	54%	0.93	0.70, 1.22	0.60
Medical Fluoride	329	69%	489	70%	0.73	0.54, 0.99	0.04

[‡]Medical providers delivered preventive oral health assessments and fluoride varnish through the Into the Mouth of Babes program.

[‡]The adjusted multivariate marginal logistic regression model controlled for parent health literacy, parent overall health, survey language and a generalized boosted model propensity score.

Table 3.

Estimated Log Odds Ratios on the Effect of Provider Type on the Receipt of Preventive Oral Health Services for both the Early Head Start (EHS) and Non-Early Head Start (Non-EHS) groups using Alternating Logistic Regression[‡] (N=1,178)

	EHS (n=479)					Non-EHS (n=699)				
	Est.	SE	OR	95% CI	p-value	Est.	SE	OR	95% CI	p-value
Effect of Dental versus Medical Provider [‡]										
Assessment	1.29	0.35	3.65	1.84, 7.24	0.0002	0.37	0.26	1.45	0.86, 2.43	0.16
Fluoride	0.58	0.33	1.79	0.94, 3.42	0.076	-0.16	0.27	0.86	0.50, 1.46	0.57

[‡]Medical providers delivered preventive oral health assessments and fluoride varnish through the Into the Mouth of Babes program.

Est.=Estimate, SE=Standard Error, OR=Odds Ratio, CI=Confidence Interval

[‡]The adjusted marginal logistic regression model controlled for parent health literacy, parent overall health and survey language and a generalized boosted model propensity score.