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Dental Screening and Referral of Young Children by Pediatric Primary Care Providers

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ABSTRACT. *Objective.* Several health care organizations recommend that physicians provide preventive dentistry services, including dental screening and referral. This study is the first to investigate characteristics of medical providers that influence their referral to a dentist of children who are at risk for dental disease.

Methods. A cross-sectional survey was undertaken of primary care clinicians in 69 pediatric practices and 49 family medicine practices who were enrolled in a study to evaluate a pediatric preventive dentistry program targeted toward Medicaid-eligible children in North Carolina. A 100-item, self-administered questionnaire with 23 items on some aspect of dental referral elicited providers' knowledge and opinions toward oral health, their provision of dental services, and their confidence in providing these services. We hypothesized that providers' dental knowledge, opinions about the importance of oral health, and confidence in providing oral health services would be associated with their propensity to refer children who are younger than 3 years and are suspected of having risk factors for future dental disease or a few teeth in the beginning stages of decay. We also hypothesized that providers' perceived referral difficulty would affect their referral activities. Patient characteristics (tooth decay status, insurance status, immigrant status, English speaking), practice characteristics (setting, number of providers, patient volume, busyness), practice environment (perceived and actual availability of dentists), and other provider characteristics (gender, type, practice experience, board certification, training in oral health during or after professional education, hours worked, teaching of residents, preventive behaviors) were assessed and used as control variables. Preliminary bivariate analysis (analysis of variance, χ^2) identified characteristics associated with referral activity. Multivariable logistic regression analysis using backward stepwise logistic regression tested the posed hypotheses, with provider, practice, and patient characteristics included as potential control variables.

Results. Nearly 78% of 169 primary care clinicians who participated in the survey reported that they were likely to refer children who had signs of early decay or high risk for future disease. Approximately half (54%) call a dental office sometimes or more frequently to make

an appointment for a child whom they refer, but the most common method is to give the caregiver the name of a dentist without additional assistance (96%). Bivariate analysis revealed that providers who had high confidence in their ability to perform screenings and reported low overall referral difficulty were more likely to refer children. Bivariate analyses also found that providers who were not in group practices, were board certified, graduated 20 years ago or more, saw 80 or more patients per week, had >60% of their total patients who were infants and toddlers, and saw >3.5 patients per hour were significantly less likely to refer at-risk children for dental care. No patient characteristics were associated with referral. The regression model revealed that an increase in odds of referral was significantly associated with confidence in screening abilities (odds ratio [OR]: 5.0; 95% confidence interval [CI]: 1.7-15.1), low referral difficulty (OR: 6.0; 95% CI: 1.0-34.5), and group practice (OR: 4.2; 95% CI: 1.4-12.1). Having a patient population of >60% infants or toddlers was significantly associated with a decrease in odds of referral (OR: 0.2; 95% CI: 0.1-0.7). Oral health knowledge and opinions did not help to explain referral practices.

Conclusions. Tooth decay remains a substantial problem in young children and is made worse by existing barriers that prevent them from obtaining dental care. Because most children are exposed to medical care but not dental care at an early age, primary care medical providers have the opportunity to play an important role in helping children and their families gain access to dental care. This study has identified several factors that need consideration in the further exploration and development of primary care physicians' role in providing for the oral health of their young patients. First, instructional efforts to increase providers' dental knowledge or opinions of the importance of oral diseases are unlikely to be effective in increasing dental referral unless they include methods to increase confidence in providers' ability to identify and appropriately refer children with disease. Medical education in oral health may need to be designed to include components that address self-efficacy in providing risk assessment, early detection, and referral services. Traditional, didactic instruction does not fulfill these requirements, but because the effectiveness of instructional methods for teaching medical providers oral health care, particularly confidence-building aspects, is untested, controlled evaluations are necessary. A second conclusion from this study is that the referral environment is more important than provider knowledge, experience, opinions, or patient characteristics in determining whether medical practitioners refer at-risk children for dental care. Most providers in this study held positive opinions about providing dental services in their practices, had relatively high levels of knowledge, screened for dental disease, accessed risk factors in their patients, and referred; they can be instrumental in helping young children get dental care, yet most providers

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face difficulties in making dental referrals, and changes in the availability of dental care will be necessary to decrease these barriers before referral can be most effective. The longer-term approach of increasing the number of dental graduates can be complemented in the shorter term by other approaches to increase dentists' participation in Medicaid, such as increases in reimbursement rates; training general dentists to treat young children; and community organization activities to link families, physicians, dentists, and public programs such as Early Head Start. Finally, pediatric primary health care providers can provide oral health promotion and disease prevention activities, thereby eliminating or delaying dental disease and the need for treatment at a very young age. However, effective and appropriate involvement of pediatric primary care clinicians can be expected only after they receive the appropriate training and encouragement and problems with the dental referral environment are addressed. *Pediatrics* 2004;114:e642-e652. URL: www.pediatrics.org/cgi/doi/10.1542/peds.2004-1269; *physicians, pediatricians, family practice physicians, nurse practitioners, physician assistants, oral, dental, screening, referral, knowledge, attitudes, self-efficacy, behaviors.*

ABBREVIATIONS. IMB, "Into the Mouths of Babes"; CME, continuing medical education; OR, odds ratio; CI, confidence interval.

The availability of effective preventive methods and technologically advanced dental treatment options has led many Americans to believe that children no longer suffer from dental problems,¹ yet 1 dental disease alone, tooth decay, is the most common chronic disease of childhood and can lead to health consequences as serious as reduced growth and development when disease is rampant.² The problem is particularly severe in young children who live in poverty, minorities, and those who are in poor health. Overall, as many as 2.5 million children who are 2 to 5 years of age in the United States have untreated tooth decay.³ Close to 75% of children who are 3 to 4 years of age have not made the number of dental visits recommended by Bright Futures, compared with ~19% who have not met the American Academy of Pediatrics' periodicity schedule for well-child visits.⁴ Public insurance provides limited assurances that dental care will be available. Only approximately 1 child of every 5 enrolled in Medicaid uses dental services.⁵ Attention focused on these disparities has led to proposed and actual interventions to improve oral health and access to dental care through 1 or a combination of 2 major approaches: changes in the dental workforce or the involvement of nondental health professionals in the provision of oral health services.

The medical office is considered an opportune site to reach large numbers of children who make a medical visit but not a dental visit.⁶⁻¹⁰ Physicians and their auxiliaries can assess risks for dental problems and counsel parents and their children about the prevention of these problems. They also can provide screening services for early detection of dental disease, provide advice about the need to seek dental care, and refer those in need. These services can help to prevent acute episodes of pain and infection that result in emergency department visits or the need for

extensive restorative treatment that often must be completed under general anesthesia. A key element of comprehensive care for children thus involves the coordination of services between medical and dental providers so that the appropriate health care professionals provide appropriate services at the appropriate ages.

This important interface between medical and dental practitioners has received only superficial study. We know that 90% or more of family physicians and pediatricians report in national studies that they conduct dental caries risk assessments in at least some of their patients, 87% or more screen for caries, and many have difficulty in referring patients for dental care, particularly patients who are uninsured or on Medicaid.^{11,12} Beyond these descriptive statistics, we know little about the patient-care activities thought to be important in promoting access to dental care. A recent systematic review found no studies on the accuracy of primary care providers in identifying children who are 0 to 5 years of age and are at elevated risk for future dental caries.¹³ Encouragingly, 3 studies found that after 2 to 5 hours of training, physicians, nurses, and physician assistants could perform oral screenings approaching the accuracy of dentists and suitable for the purposes of referral for a complete evaluation by a dentist.¹⁴⁻¹⁶ The systematic review by Bader et al¹³ identified only 1 study on the effectiveness of primary care clinicians in making a dental referral. That study of workers in the Special Supplemental Nutrition Program for Women, Infants, and Children suggested that they might be only partially effective in getting children into dental care. Indirect evidence on the percentage of children who receive early and periodic screening, diagnostic, and treatment services and have a dental visit also suggests that physicians might be ineffective in making dental referrals.¹⁷

Basic questions about the dental referral process and its outcomes remain unanswered. It is not known whether a recommendation for a dental visit results from some factor external to the medical care setting, such as the supply of dentists; some characteristics of providers or their medical practices; or some characteristics of children and their families. We are aware of no studies that have investigated the predictors of primary care clinicians' referral of young children to dentists. The purpose of this study was to examine the reported referral decisions of medical providers and factors that might influence their decisions. We hypothesized that the likelihood of medical providers' making a dental referral for at-risk patients is most strongly predicted by the level of difficulty that they experience in identifying a dentist to whom patients can be referred for care and their confidence in deciding who needs to be referred, their level of oral health knowledge, and their opinions about the importance of oral health and preventive dental care.

METHODS

Data Sources

This study uses information from baseline questionnaires completed by primary care clinicians in 69 pediatric practices and 49

family medicine practices who were enrolled in a randomized, controlled trial to evaluate a new Medicaid program in North Carolina.¹⁸ The aims of this Medicaid program, entitled "Into the Mouths of Babes" (IMB), are to improve medical providers' oral health knowledge, encourage them to incorporate preventive dental services into their practices and thus lower the incidence of tooth decay, and increase oral health screenings and make dental referrals for children who they suspect are at elevated risk for oral diseases or are already affected. The IMB program includes continuing medical education (CME) courses on screening children for oral problems, guidelines for referral to a dentist, counseling of primary caregivers on the care of children's mouths, and procedures for application of fluoride varnish to children's teeth during the office visit. Practices that responded to recruitment notices offering a free CME course in pediatric dental health for medical personnel were recruited to the trial. All primary care clinicians who are permitted to conduct well-child evaluations in North Carolina (physicians, physician assistants, and nurse practitioners) are included in this cross-sectional analysis.

Questionnaire Development and Data Collection

Information from providers was obtained using a self-reported questionnaire completed before attending the CME course for the IMB program. In development of the questionnaire, we considered 4 constructs regarding oral health (knowledge, opinions, behaviors, and self-perceived competency) and 6 activities (screening, risk assessment, referral, counseling, fluoride use, and follow-up). These constructs and activities were used to form a 4-by-6 matrix with 24 cells. The need for 1 or more questions for each of the matrix cells was assessed. When possible, we used questions from 2 recently completed national surveys of physicians.^{11,12} Other questions were developed to fill in the matrix and to meet the needs of the project. The resulting 100-item questionnaire with 23 items on some aspect of dental referral was pilot-tested with 3 pediatricians and 2 dentists, and minor revisions were made in wording.

Responses to the questionnaires were entered into a computer database and verified by double keypunching. The resulting file was converted into STATA format for data analysis. Missing information was coded as such, and observations were excluded when necessary information was missing.

Variable Construction

We developed a framework for the referral process to aid in the construction of variables and the analysis of factors that might influence providers' referral decisions (Fig 1). The framework is based on the approach used in a systematic review for the US Preventive Services Task Force in which screening, risk assessment, and referral for dental care are key activities that primary

care clinicians can perform in the care of their young patients.¹³ This approach assumes that the risks of dental caries vary from person to person and that not all children need referral to a dentist before 3 years of age as is recommended by some professional dental organizations.¹⁹ Rather, the referral decision is conceived as being based on the presence of risk factors in the absence or presence of disease or on either early-stage or advanced carious lesions alone.

We asked a number of questions about screening, risk assessment, and referral. Among the referral questions were those inquiring about the likelihood of referring children with various oral health characteristics, factors considered in making a referral, and methods used in making a referral. Because we expected most respondents to report some referral activity, we limited the analysis to providers who said that they refer, and examined their reported propensity to refer children who are younger than 3 years and are suspected of having "risk factors for future dental disease" or "a few teeth in the beginning stages of decay." For this analysis, providers who responded that they were "unlikely" or "very unlikely" to refer either category of child were categorized as "unlikely to refer," and other providers were categorized as "likely to refer." All questions about referral were asked with respect to children 0 to 3 years of age, regardless of their eligibility for Medicaid.

Factors that could potentially influence screening and referral behaviors were identified by adapting the principles of the social ecological framework regarding the impact of personal and environmental factors on behavior.²⁰ We considered the characteristics of the providers (provider type, gender, practice experience, board certification, training in oral health during or after professional education, hours worked, teaching of residents, oral health knowledge, opinions, confidence, and behaviors) and their practices (setting, number of providers, patient volume, and busyness [patients per hour]), their patients (tooth decay status, insurance status, immigrant status, and English speaking), and their practice environment (perceived difficulty of referral for routine or urgent care and perceived or actual availability of dental care providers) that could influence the referral decision-making process.

Responses to questions related to oral health knowledge were grouped to create 3 variables: knowledge of prevention (5 items), pathology (5 items), and fluoride (9 items). The mean number of questions with correct responses in each knowledge category was calculated and converted to a percentage score. We also created an overall knowledge score by averaging the 3 individual composite scores for prevention, pathology, and fluoride.

Composite scores for opinions, confidence, and preventive practices were constructed as means of Likert-type responses to several questions. Opinions toward the importance of having an office-wide approach to prevention in general and preventive

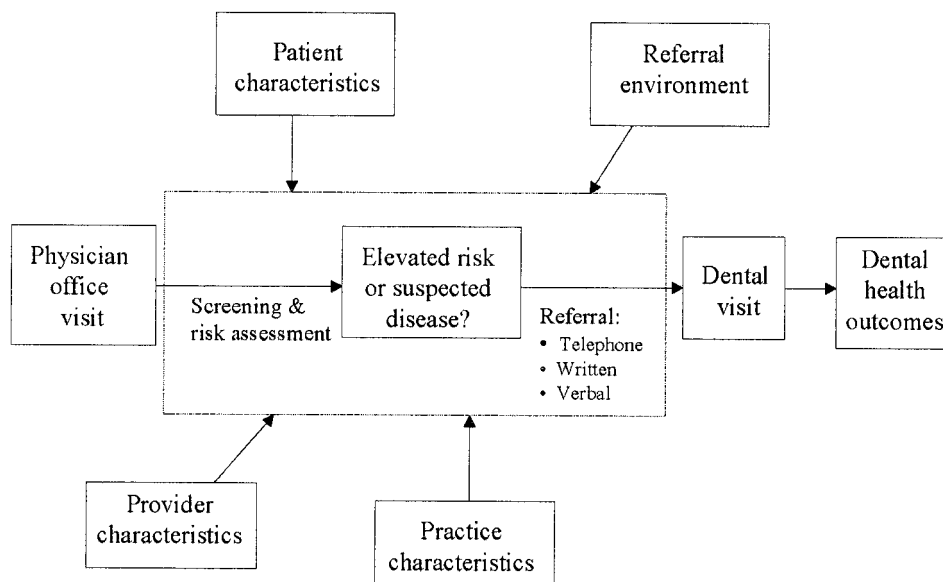


Fig 1. Screening and referral process.

dentistry in particular were assessed with 1 question each (very low priority = 1 to very high priority = 5). Two other variables assessed opinions about whether a screening-risk assessment (2 items) or oral health counseling (1 item) should be part of routine well-child care (strongly disagree = 1 to strongly agree = 5). Providers' confidence was measured using variables for self-assessed abilities to provide oral health counseling (5 items), screening-risk assessment (4 items), and referral (1 item), all requiring a response on a 3-level scale (not confident = 1, somewhat confident = 2, very confident = 3). Providers' reported preventive behaviors were estimated for 4 areas of practice: general medical prevention (6 items), caries risk assessment (4 items), caries screening (1 item), and preventive oral health counseling (3 items) using variables created from questions on frequency with which specified tasks are performed for infants and toddlers (never = 1, rarely = 2, occasionally = 3, very frequently = 4).

Data Analysis

Differences in group means for all continuous variables such as mean knowledge scores or years since graduation for those who refer versus those who do not were tested using analysis of variance. To facilitate interpretation and address the skewed distribution of some data, we created binomial variables from continuous variables by using either the upper or lower 15% to 30% of the responses as 1 category and the other responses as another. The percentage of practitioners who reported that they were likely to refer was compared among subgroups and evaluated using a χ^2 test. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated for these comparisons.

We tested our hypotheses about the effects of referral difficulty and provider knowledge, confidence, and opinions on providers' likelihood of referral using multivariable analysis. The associations of the various measures of these characteristics and referral behavior were examined using backward stepwise logistic regression, with the selected provider, practice, and patient characteristics included as potential control variables. All variables associated with referral in either the analysis of variance or χ^2 bivariate analyses at a significance of .2 or less were included in the initial logistic regression model. No statistical interactions were evaluated in the logistic regression model because of the small sample sizes. All analyses were performed using STATA Release 7.

RESULTS

Descriptive statistics for screening, risk assessment, and referral activity are presented in Table 1. Of the 183 providers surveyed, only 1% reported that they rarely examined a child for dental disease, and only 6% did not refer. Of providers who refer, approximately half (54%) call to make an appointment for a child whom they are referring. Most providers report referring infants and toddlers for dental care as part of their regular practice. Nearly 78% of primary care clinicians who refer do so for children who they suspect of having early decay or are at risk for developing decay. The distribution of this reduced sample, which is used in the analysis for this article, is presented in Table 2 according to provider, practice, patient, and environmental characteristics. Minimal differences were observed in the distribution of the reduced sample compared with the full sample on these characteristics.

Results of the bivariate comparisons of mean values by referral activity did not differ from the bivariate analysis of percentage of practitioners who refer, so our presentation of bivariate associations concentrates on the latter. Results of this analysis for characteristics that were associated with referral at a statistical significance level of $P \leq .1$ are presented in Table 3. Fewer physicians referred than physician assistants or nurse practitioners. Providers of all types who were not in group practices, were board

certified, graduated 20 years ago or more, saw 80 or more patients per week, had >60% of their total patients who were infants and toddlers per week, and saw >3.5 patients per hour were also significantly less likely to refer at-risk children for dental care. Providers who had high confidence in their ability to perform screenings and risk assessments or their referral decisions, had a high opinion of the value of screening for disease and risk, and frequently performed caries risk assessments were more likely to report referral of children. No patient characteristics were associated with referral at this level of significance. The only environmental characteristic found to be important was low overall referral difficulty, which had a positive effect on referral behavior.

Regression analysis of the odds of referring at-risk children for dental care yielded a model that contained 11 variables (Table 4). Missing responses from some survey participants reduced the usable sample size from 169 to 146. Confidence in screening and risk assessment abilities was the only provider characteristic that was associated with referral at a significance level of $P < .05$. Providers with a high degree of confidence were 5 times (95% CI: 1.66–15.12) more likely to refer than other providers. Those who reported low referral difficulty were 5.9 times (95% CI: 1.03–34.50) more likely to refer than those who reported other levels of difficulty. Hypothesized provider characteristics such as oral health education in professional training and knowledge did not help to explain referral practices. Two practice characteristics were significant predictors of referral. Providers who were in group practices were more likely to refer (OR: 4.14; 95% CI: 1.419–12.13) than those who were not. Those who reported that >60% of their patients were infants and toddlers were less likely to refer (OR: 0.24; 95% CI: 0.08–0.69) than those who reported seeing fewer patients.

DISCUSSION

Study Limitations

Providers in this study are participants in a randomized, controlled trial of adoption of preventive dentistry behaviors. They were recruited to the trial because they responded to advertisements offering CME through a new, Medicaid-reimbursed preventive dental program for infants and toddlers. As expected, most providers included in this study reported Medicaid patients as a large percentage of their total patients (family physicians: 51%; pediatricians: 40%)—nearly twice the percentage of pediatricians in other surveys (26%)—and somewhat more infants and toddlers each week than do participants in national surveys (family physicians: 19% vs 14%; pediatricians: 72% vs 57%).^{11,12}

Characteristics of the sample resulting from enrollment criteria and reasons for participation in the trial itself could limit the external validity of our findings. Because 1 of the most important determinants of dental caries risk is low socioeconomic status, patients of these practitioners who treat large numbers of Medicaid children are more likely to have dental

TABLE 1. Descriptive Statistics for Dental Screening, Risk Assessment, and Dental Referral Activity

Question	n	Mean, %	SD	Mean Likert Score	SD
How frequently do you or your staff examine a child's teeth for signs of dental decay?	181	Frequently or occasionally 98.9	10.5	1 = never to 4 = frequently 3.83	.41
Assess the potential for developing tooth decay?	180	86.1	34.7	3.38	.78
As part of your regular practice, do you refer infants and toddlers for dental care? Yes*	183	Sometimes or frequently 94.0	23.8	1 = no to 3 = frequently 2.33	.59
How likely are you to refer a child younger than 3 years of age who has risk factors for future dental disease?	167	Very likely or likely 50.3	50.1	1 = very unlikely to 5 = very likely 3.46	1.20
Has a few teeth that you believe might be in the beginning stages of decay?	169	85.2	35.6	4.34	.96
Has extensive tooth decay?	169	98.2	13.2	4.89	.49
Has a chipped tooth, probably the result of a fall?	167	65.8	47.6	3.74	1.27
Has a draining fistula caused by a decayed tooth?	169	96.4	18.6	4.86	.57
Has other soft tissue pathology?	168	87.5	33.2	4.54	.80
Has a low probability of existing dental disease based on screening? Cannot be screened thoroughly?	168	25.6	43.8	2.53	1.39
How often do you consider the following factors when referring infants and toddlers to a dentist?	164	40.3	49.2	3.24	1.16
Availability of dentists	167	90.4	29.5	4.27	1.07
Family resources	169	89.9	30.2	4.11	1.05
Child's age	169	93.5	24.7	4.28	.89
Probability of existing dental disease from screening	169	96.4	18.6	4.32	.81
When you make a dental referral for a child younger than 3 years, how frequently do you or your staff		Always, usually, or sometimes		1 = never to 5 = always	
Call a dental office to make an appointment for the child?	168	53.6	50.0	2.67	1.16
Give the caregiver the name(s) of a dentist?	169	95.9	19.9	4.12	.83
Simply tell the caregiver that their child needs to see the dentist?	167	76.6	42.4	3.19	1.06
How difficult is it for you to find a local dentist for a patient who is younger than 2 years of age?	167	Very difficult or difficult 64.1	48.1	1 = not at all to 5 = very 3.72	1.48
Has a significant developmental disability?	163	62.6	48.5	3.73	1.41
Receives Medicaid dental benefits?	167	73.1	44.5	4.04	1.26
Receives SCHIP benefits?	153	64.0	48.1	3.75	1.27
Is uninsured and needs a sliding scale?	164	77.4	41.9	4.24	1.02
Has private dental insurance and has an emergency dental problem at night or on the weekend?	160	56.9	49.7	3.56	1.26
Is uninsured and has an emergency dental problem at night or on the weekend?	161	82.0	38.5	4.35	.99

SCHIP indicates state children's health insurance program.

*Those who answered "no" did not respond to subsequent questions on referral.

TABLE 2. Descriptive Statistics for Characteristics of Providers, Practices, Patients, and Referral Environment for Those Who Refer At-Risk Children for Dental Care

Characteristics	<i>n</i>	Mean or %	SD
Provider characteristics			
General characteristics			
Physician	169	78.1%	41.5
Pediatrician	169	54.4%	49.9
Family physician	169	23.7%	42.6
Female	168	61.3%	48.9
Board certified	169	79.9%	40.2
Years since graduation	164	12.9	9.6
Hours worked/wk	166	38.9	11.7
Part time (<30)	166	11.4%	31.9
Normal (30–50)	166	72.9%	44.6
Overtime (>50)	166	15.7%	36.5
Oral health education			
None	169	46.2%	50.0
Professional school	169	23.7%	42.6
Residency	169	23.7%	42.6
CME	169	25.4%	43.7
All 3	169	2.37%	15.2
Teach	166	57.2%	49.6
Knowledge			
Prevention, % correct	169	82.4%	15.0
Prevention score >80%	169	29.0%	45.5
Oral pathology, % correct	169	73.3%	16.9
Pathology score >50%	169	93.5%	24.7
Fluoride, % correct	169	62.3%	17.7
Fluoride score >50%	169	62.7%	48.5
Overall, % correct	169	71.9%	11.0
Overall score >60%	169	84.0%	36.8
Opinions, scale 1–5			
Office preventive services priority	167	4.29	0.74
Office preventive services priority ≥ 4	167	84.4%	36.4
Dental preventive services priority	167	4.74	0.38
Dental preventive services priority ≥ 4	168	58.3%	49.5
Oral examination and risk assessment	167	4.69	0.47
Oral exam importance ≥ 4.5	167	83.8%	36.9
Oral health counseling	167	4.68	0.55
Oral health counseling importance = 5	169	71.6%	45.2
Confidence, scale 1–3			
Oral health counseling	167	2.43	0.42
Counseling mean ≥ 2.8	167	19.2%	39.5
Oral screening	167	2.02	0.52
Screening mean ≥ 2	167	73.7%	44.2
Referral decision	166	2.29	0.58
Referral ≥ 2	169	93.5%	24.7
Behavior frequency, scale 1–4			
General prevention	168	3.78	0.26
General prevention ≥ 3.75	168	70.2%	45.9
Oral health counseling	168	3.71	0.41
Oral counseling ≥ 3.25	168	86.9%	33.8
Caries screening	168	3.84	0.38
Caries screening = 4	168	84.5%	36.3
Caries risk assessment	168	3.28	0.43
Caries risk assessment ≥ 3	168	83.9%	36.8

decay or be at risk for decay than patients of other practitioners. Slightly more than 73% of medical providers in our study reported seeing dental decay at least once a week compared with 16% nationally.¹¹ Their experiences in caring for a large number of children with dental problems coupled with their interest in enrolling in a new preventive dental program could result in their having a higher level of oral health awareness than other practitioners and placing more importance on the prevention and treatment of dental problems. Providers who have chosen to enroll in this dental study might be interested because they are having a difficult time referring young patients with dental caries (76% report

difficult or very difficult to refer Medicaid-eligible children for dental care vs 38% nationally¹¹), and they recognize that preventive efforts to decrease the level of disease are one of the ways that they can contribute to improvements in the oral health of their patient population. Therefore, the characteristics that motivate the providers in our study to assess dental disease risks, screen for disease, or refer patients for dental care may not be the same as for other providers who have less need to refer or do not have difficulty referring.

Nevertheless, pediatricians included in our study were similar to those who participated in a recent national dental survey of pediatricians on a number

TABLE 2. Continued

Characteristics	n	Mean or %	SD
Practice characteristics			
Setting			
Solo	168	13.1%	33.8
Group	168	72.0%	45.0
Other	168	14.8%	35.7
Number of well-care providers			
10 or more providers	164	6.32	3.89
Well-care visits, % of all child visits			
>50% well-care visits	156	40.1%	19.6
Patients/h			
Patients/h ≥ 3.75	156	19.9%	40.0
Infants & toddlers/wk			
Infants and toddlers/wk ≥ 80	163	2.95	1.36
Patient characteristics (infants and toddlers)			
Frequency decay, scale 1–6			
See decay at least 1/wk (≥ 6)	164	5.49	0.79
% enrolled in Medicaid			
$\geq 15\%$ Medicaid	164	61.6%	48.8
$\geq 15\%$ Medicaid	169	43.3%	26.9
% enrolled in Health Choice			
>5% Health Choice	169	83.4%	37.3
% uninsured			
$\geq 10\%$ uninsured	169	7.1%	7.3
% immigrant			
$\geq 20\%$ immigrants	169	46.8%	50.0
% non-English speaking			
$\geq 20\%$ non-English speaking	169	7.7%	8.7
Environment characteristics			
Difficulty of referral for dental care, scale 1–5			
Routine referral			
Routine difficulty <2.8	169	3.87	1.08
Emergency referral			
Emergency difficulty ≤ 3	161	21.3%	41.1
Emergency difficulty ≤ 3	161	3.94	0.99
Overall referral difficulty			
Overall difficulty <3	161	26.1%	44.1
Overall difficulty <3	169	3.88	0.94
Availability of dental providers, scale 1–3			
Provider availability ≤ 2	167	18.9%	39.3
Provider availability ≤ 2	167	1.73	1.07
Ratio of Medicaid enrollees/dental provider			
Patient/provider ratio >181	169	85.0%	35.8
Patient/provider ratio >181	169	148	92
Patient/provider ratio >181	169	28.4%	45.2

of provider and practice characteristics not used as enrollment criteria, including the percentage who were female, board certification, years in practice, hours spent providing patient care, and total number of patients seen per week.¹¹ They also were generally similar to the national sample of pediatricians on the percentage who correctly answered 4 general dental knowledge questions (62% vs 54%), agreed that 3 dental activities should be part of a well-child visit (71% vs 65%), and frequently performed 6 preventive dental practices (72% vs 71%). Our sample of family physicians included a larger percentage of women than in a national survey (53% vs 30%), saw a larger number of infants and toddlers per week (19 vs 14), and had fewer years in practice (9 vs 13), yet their knowledge of fluoride as assessed by 4 questions was similar to responses in the national survey (64% vs 66%).¹²

Major Findings

Practitioners in this study reported a high level of referral activity. More than 90% reported referring infants and toddlers for dental care as part of their regular practice, and of these, close to 80% refer for elevated risk of disease or for cases without overt tooth decay but for which they believe the child might have a few teeth in the beginning stages of decay. These findings suggest that many physicians

included in this study not only refer for obvious conditions such as an abscessed tooth but also practice risk-based referral in which children who they believe to be in the early stages of dental caries or have risk factors that place them at risk of disease are referred.

Professional guidelines on the recommended age of the first dental visit of some medical organizations are not in agreement with some dental organizations. The disagreement centers on the care of children younger than 3 years, children who have exceptionally poor access to dental care. The findings from this study suggest that the majority of medical practitioners do not wait until tooth decay is in an advanced stage or the child is in pain before they refer, providing the basis for an encouraging “middle ground” between referring all children when they are either 1 year of age or 3 years of age, regardless of their characteristics. Additional research is needed to determine the accuracy with which medical practitioners can identify children who are at risk for dental disease and to ensure their performance.

Although referral activity is high, a substantial number of practitioners (27%) rarely refer any children or are unlikely to refer those at risk, and several findings suggest that referral might not be entirely effective in getting dental care for their patients. The most common method of referral is to give the care-

TABLE 3. Bivariate Relationships for the Likelihood of Referring Patients Who Are at Risk for Dental Disease

Covariates	<i>n</i>	% Likely to Refer	OR (95% CI)	<i>P</i> Value
Provider characteristics				
Profession type				
Physician	132	74.2	0.349 (0.115–1.059)	.063
Physician's assistant or nurse practitioner	37	89.2		
Board certification				
Yes	135	74.1	—	.029 (χ^2)
Other	14	100		
Years since graduation				
<5	31	87.1	0.578 (0.164–2.035)	.393
5–<10	49	79.6		
10–<20	42	76.2		
20+	42	66.7		
Opinions, 1 = low to 5 = high				
Perform oral assessment ≥ 4.5	140	80.0	2.353 (0.972–5.696)	.058
Other	27	63.0		
Confidence, 1 = low to 3 = high				
Screening and risk assessment mean ≥ 2	123	83.7	3.565 (1.653–7.689)	.001
Other	44	59.1		
Referral decision ≥ 2	158	79.1	3.157 (0.907–10.987)	.071
Other	11	54.6		
Behaviors, 1 = never to 4 = frequent				
Caries risk assessment ≥ 3	141	80.1	2.374 (0.981–5.746)	.055
Other	27	63.0		
Practice characteristics				
Practice setting				
Group	121	81.8	2.323 (1.086–4.970)	.030
Other	47	66.0		
No. of infants and toddlers per week				
80 or more	39	59.0	0.310 (0.141–0.681)	.004
Other	124	82.3		
Proportion of all patients infants and toddlers				
>0.60	61	67.2	0.425 (0.201–0.897)	.025
Other	99	82.8		
Busyness				
All patients/hour >3.5	42	66.7	0.444 (0.202–0.980)	.044
Other	121	81.8		
Referral environment				
Referral difficulty, 1 = not at all to 5 = very				
Emergency referral mean ≤ 3	42	88.1	2.494 (0.898–6.927)	.079
Other	119	74.8		
Overall referral mean <3	32	93.8	5.347 (1.216–23.512)	.027
Other	137	73.7		

TABLE 4. Logistic Regression Model for Likelihood of Referring At-Risk Children for Dental Care

Variable	OR (95% CI)	<i>P</i> Value
Provider characteristics		
Physician versus PA/NP	0.532 (0.133–1.899)	.311
Years since graduation	0.965 (0.913–1.020)	.210
Work 50 or more h/wk	0.267 (0.070–1.012)	.052
Office prevention priority high or very high	1.448 (0.409–5.122)	.566
Assess caries risk for infants and toddlers occasionally or frequently	1.875 (0.602–5.833)	.278
Confidence in screening, risk assessment	5.020 (1.667–15.116)	.004
Practice characteristics		
10 or more well-care providers	0.524 (0.148–1.854)	.317
Group versus not	4.149 (1.419–12.130)	.009
Proportion of all patients who are infants/toddlers >0.6	0.242 (0.083–0.699)	.009
All patients/hour >3.5	0.372 (0.122–1.131)	.081
Environment characteristic		
Low referral difficulty	5.950 (1.026–34.495)	.047

N = 146; pseudo R^2 = .274.

give the name of a dentist rather than to make the appointment for the child, an approach that provides little help in negotiating barriers to dental care, particularly for low-income families, who face other obstacles in life. In addition, many practitioners in this study report difficulties with referral. Greater than

60% have difficulty in referring children with developmental delays, the very young, and those who are on Medicaid or are uninsured. Even referral of privately insured patients with an emergency is difficult for physicians in this study, with 57% reporting some difficulty. This situation significantly affects the oral

health of low-income children in North Carolina because physicians in our study reported a much higher level of dental disease in their patients than those in national studies.

The 2 most important factors affecting the likelihood of referral of high-risk children were confidence in screening-risk assessment and self-perceived referral difficulty. Providers who expressed confidence in their abilities to screen for dental disease were more likely to refer than those without confidence. No previous studies have assessed the effect of medical care practitioners' confidence on their oral health practice patterns, and self-efficacy is a relatively unstudied factor in physician behaviors. This area of investigation seems to be an important one because low self-efficacy might be a deterrent to delivery of prevention services for primary care physicians. This relationship is supported by behavioral theory²¹ but only a few empirical studies.²² It might be important for dental health services in particular because physicians who choose to provide oral health services are practicing in an area for which they may have had little formal training. No validated practice guidelines or tools are available to inform screening and referral practices, and there are no screening or diagnostic tests available; thus, a decision on screening results requires referral to a specialist, in this case a dentist with whom they might not interact on a frequent basis. Not surprising, 24% of those who refer infants and toddlers are not confident in their abilities to screen and perform risk assessments. Physicians might benefit from interventions that are designed to improve skills and self-efficacy in the care of the oral health of their patients,²³ but because studies also demonstrate the lack of effect of educational interventions on self-efficacy in some areas of practice, controlled trials are needed to determine whether changing one's confidence in doing screenings and risk assessments will increase the likelihood of referral and improve oral health outcomes.²⁴

The overall environmental composite measure of perceived difficulty in making a dental referral was strongly associated with referral of high-risk patients. This finding provides both face validity to rising concerns about access to dental care and guidance for what might need to be done to help resolve these problems. Nationally, the ratio of dentists to population is declining.²⁵ In the 1990s, one half of states lost dentists compared with their population size.²⁶ The decline in the dentist workforce is projected to continue through 2020, when the nation will have only ~53 dentists per 100 000 people, not too different from the supply in the 1950s. Access to dental care is particularly acute for young children because general dentists are not trained or experienced in the treatment of young children and the small number of pediatric dentists are inundated with demand for care.²⁷

Several policy documents recently have called for placing a priority on educating pediatric primary health care providers in oral health promotion and disease prevention. A recent US Surgeon General's workshop resulted in a strong recommendation that

preventive oral health care and risk-based dental referrals be provided in physicians' offices.²⁸ The American Academy of Pediatrics and the American Academy of Pediatric Dentistry also encourage non-dental health care providers to use caries risk assessment in the care of children.^{7,29} However, difficulty in making dental referrals reported by medical practitioners in this study, which likely reflects actual problems with access to dental care for young children, reveals a major barrier to the effectiveness of interventions designed to increase physicians' involvement in oral health screening, risk assessment, and referral for follow-up dental care. Such efforts directed toward the medical community will be ineffective unless sufficient attention is given to dental workforce issues. Successful models that both develop the dental workforce and integrate it with medical care need to be developed before substantial progress can be made in resolving problems in access to dental care. A number of professional organizations have made policy recommendations that should help to address these issues if implemented,^{1,30-32} and the effectiveness of some interventions to address these barriers to care has been demonstrated.³³⁻³⁵

Contrary to what we hypothesized, knowledge and opinions were not important in referral. Knowledge is an important prerequisite for most effective patient interventions but may not be related to dental referral for a number of reasons. Physicians may use some characteristics of the patients or other factors not measured in this study to decide on a referral. Such a factor might not even depend on knowledge but evolve from some sort of pattern recognition, such as decay in front teeth, a phenomenon believed to exist in dental caries diagnosis among dentists.³⁶ We also may not have constructed the questionnaire to measure that knowledge necessary for a dental referral or may not have measured accurately the knowledge constructs derived from the questionnaire. Dental caries has multiple risk factors, and its clinical presentation can vary depending on its stage of development and on the particular tooth or tooth area affected. We did not test comprehensively for these concepts. Finally, our sample exhibited a relatively high level of knowledge and opinions about oral health in medical practice. They answered correctly an average of 72% of the 19 knowledge questions and averaged >4.0 on the 5-point Likert scale for the priority that they would give to dental disease prevention. This lack of variability could have precluded us from detecting referral effects with the available sample size.

Other Findings

Group practice and patient volume, 2 characteristics included as control variables, also were found to influence providers' referral behavior. Providers in group practices were more likely to refer than other providers, and those who reported seeing large numbers of infants and toddlers as a percentage of all patients referred less. A related construct, busyness (infants or toddlers per hour), was of borderline significance ($P = .08$), but like providers with a large

patient volume, those who were busier reported a lower likelihood of referring. Providers in group practice are likely to have their awareness of oral disease influenced by other providers in the practice through discussion of dental problems or referral barriers and general sharing of knowledge. Group practices also are more likely to be located in larger cities that have dentists who treat young children. Also, the larger number of providers in a single practice may increase the number of professional contacts and thereby increase the number of dental referral sources. Medical providers are under increasing pressure to see more patients, and those who do may have less time per patient to engage in screening and referral for dental problems.³⁷ More than 60% of pediatricians in Washington State reported that they had inadequate time to cover anticipatory guidance related to oral health, and more than half of all respondents said that they excluded certain topics because of limited time.³⁸ Nevertheless, providers who see a large number of infants may be more efficient and comfortable providing preventive dental services.

CONCLUSIONS

Tooth decay remains a substantial problem in young children and is made worse by existing barriers that prevent them from obtaining dental care. Because most children are exposed to medical care but not dental care at an early age, primary care medical providers have the opportunity to play an important role in helping children and their families gain access to dental care. This study has identified several factors that need consideration in the further exploration and development of primary care physicians' role in providing for the oral health of their young patients.

First, instructional efforts to increase providers' dental knowledge or opinions of the importance of oral diseases are unlikely to be effective in increasing dental referral unless they include methods to increase confidence in providers' ability to identify and appropriately refer children with disease. Medical education in oral health may need to be designed to include components that address self-efficacy in providing risk assessment, early detection, and referral services. Traditional, didactic instruction does not fulfill these requirements. Because the effectiveness of instructional methods for teaching medical providers oral health care, particularly confidence-building aspects, is untested, controlled evaluations are necessary.

A second conclusion from our study is that the referral environment is more important than provider knowledge, experience, opinions, or patient characteristics in determining whether medical practitioners refer at-risk children for dental care. Most providers in this study held positive opinions about providing dental services in their practices, had relatively high levels of knowledge, screened for dental disease, assessed risk factors in their patients, and referred. They can be instrumental in helping young children get dental care, yet most providers face difficulties in making dental referrals, and changes in

the availability of dental care will be necessary to decrease these barriers before referral can be effective. The longer-term approach of increasing the number of dental graduates can be complemented in the shorter term by other approaches to increase dentists' participation in Medicaid, such as increases in reimbursement rates; training general dentists to treat young children; and community organization activities to link families, physicians, dentists, and public programs such as Early Head Start.

Finally, pediatric primary health care providers can provide oral health promotion and disease prevention activities, thereby eliminating or delaying dental disease and the need for treatment at a very young age. However, effective and appropriate involvement of pediatric primary care clinicians can be expected only after they receive the appropriate training and encouragement and problems with the dental referral environment are addressed.

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Dental Screening and Referral of Young Children by Pediatric Primary Care Providers

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