A Clinical Vignette–Based Study of Physicians' Adherence to Guidelines for Dental Referrals of Young Children

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ABSTRACT

OBJECTIVES: The American Academy of Pediatrics (AAP) recommends an oral health risk assessment and referral to a dental home by a child's first birthday. We evaluated the adherence of primary care providers (PCPs) to AAP dental referral guidelines for children age <4 years and barriers to implementation of these guidelines.

METHODS: A cross-sectional survey of PCPs randomly selected from the 435 practices in North Carolina identified as providing well-child visits for Medicaid children age <4 years was completed in 2013. The PCPs' referral recommendations were assessed using 4 vignettes of 18-month-old children at various risk of dental caries (low, moderate, high, or highest) and different levels of dentist supply (adequate or inadequate). Barriers to guideline adherence specified in the Cabana framework were analyzed for their associations with PCP adherence, using logistic regression models stratified by caries risk and dentist supply.

RESULTS: The survey yielded 219 (50%) usable responses from the sample of 435 PCPs. On average for all vignettes, 61% of providers chose a referral recommendation in agreement with guidelines. Underreferral averaged 40%. With adequate workforce, guideline-adherent responses varied from 26% for low-risk children to >90% for high-risk children. An inadequate workforce reduced adherence for most levels of risk. Generally, correct knowledge of risk status, barriers to risk assessment, and pediatric practice were associated with adherence, but not always in the hypothesized direction.

CONCLUSIONS: PCPs' adherence to referral guidelines varies according to caries risk and dentist supply, but generally they underrefer low- to moderate-risk patients by a significant degree.

KEYWORDS: adherence; dental referrals; guidelines; pediatrics

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WHAT'S NEW

This study is the first to evaluate the adherence of primary care physicians (PCPs) to American Academy of Pediatrics guidelines for dental referrals. It identifies barriers affecting PCP adherence, providing insight into complex implementation strategies needed to improve guideline adherence.

ACCORDING TO NATIONAL statistics for 2011–12, almost 1 in 4 children age 2 to 5 years in the United States is affected with dental caries.[1] Roughly 1 in 10 are affected to an extent considered severe. To help avert the early onset of dental caries, professional guidelines recommend that all children receive preventive oral health services starting in infancy.[2,3] Among the recommended professional services are visits to a dentist, which should start no later than age 12 months. An insufficient number of dentists are available to meet these guidelines, however. In 2009, only 8% of children age <3 years had a dentist visit, <2% with professional fluoride treatments.[4]

To help overcome the delayed entry of young children into the dental care system, primary care physicians (PCPs) are playing an increasingly active role in providing preventive oral health services.[5] The American Academy of Pediatrics (AAP) recommends dental caries screening and risk assessment starting at age 6 months. Guidelines

also recommend a dental referral at age 1 year, along with provision of other preventive oral health services, such as parent counseling and fluoride treatments, particularly when the dentist workforce is limited.[2] The American Academy of Family Physicians (AAFP) and other primary care organizations have endorsed the integration of oral health into primary care.[6,7]

Primary care referrals to dentists are difficult because of the longstanding divide between medicine and dentistry and challenges to patients in navigating the dental care system, with its many barriers to access.[8,9] Evidence from at least a half-dozen state surveys and a national survey suggests that most PCPs screen for obvious dental caries in young patients, but not on a routine basis.[10-16] A large percentage of physicians report referrals for young patients with untreated dental disease, but referral is highly variable for other patients, and outcomes for all referrals are largely unknown.[17]

North Carolina initiated the "Connecting the Docs for Children's Oral Health" program to encourage PCPs to counsel families with young children about the importance of a dental home and to link them with a dentist. As part of this initiative, we undertook a survey of PCPs and dentists to better understand referral practices. Results of the dentists' surveys have been reported previously.[18,19]

The aim of the present study was to report findings from the statewide survey of North Carolina physicians providing care for young children enrolled in Medicaid and CHIP. Specifically, we report on physicians' adherence to recommended guidelines for referral of children age <4 years and on barriers and facilitators associated with their adherence to risk-based referral guidelines.

METHODS

We conducted a cross-sectional vignette-based survey of North Carolina PCPs who perform well-child visits for Medicaid-enrolled children age <4 years. We assessed the PCPs' classification of caries risk and their recommendations for dental referral using 4 clinical vignettes of 18-month-old infants with various levels of caries risk and at various stages of the dental caries process. Respondents made referral recommendations under conditions of an adequate supply and an inadequate supply of dentists. We assessed potential barriers and facilitators for dental referrals for their associations with PCPs' adherence to AAP referral recommendations. This study was approved by the Institutional Review Board of the University of North Carolina at Chapel Hill (07-1942).

SAMPLE DESIGN AND SELECTION

The goal of our sampling strategy was to identify one physician who performs well-child visits in every practice site in North Carolina where at least one physician provides these types of visits for Medicaid-enrolled children age <4 years. Age 4 years was chosen to coincide with the age (≤42 months) when children in North Carolina are eligible for oral health services delivered in primary care and reimbursed by Medicaid. A single source for this information was not available, so we relied on multiple-frame sampling methods to develop the list of eligible practices and providers.

All potential primary care pediatric providers and their practice addresses were identified initially using 2 data sources: National Provider Identifier records contained in the National Plan and Provider Enumeration System database and licensure files provided by the North Carolina Medical Board. Clinics located in the 4 academic health centers in the state and all community health centers were excluded from the sample frame.

To determine Medicaid participation, we linked our resulting file of primary care physicians with paid Medicaid claims files by practice and provider. The resulting list was checked against other provider lists, such as those found on the Medicaid website and Medicaid-generated reports used to monitor the North Carolina fluoride varnish program for physicians. We also checked practice websites before finally telephoning all practices to verify information in our sample frame, including practice address, physicians within the practice, and whether or not they performed well-child visits.

The resulting sample frame included a total of 435 practices and 1364 physicians (mean number per practice, 3.1). One provider was randomly selected from each practice site with one-time replacement of nonresponders and those who were no longer with the practice or who did not meet the inclusion criteria, providing a final sample of 435 physicians.

QUESTIONNAIRE DEVELOPMENT AND DATA COLLECTION

A 13-page survey with 4 clinical vignettes and 46 items was developed using the framework for studying barriers to clinical practice guideline adherence proposed by Cabana et al[20-22] as a conceptual guide. Survey items for screening, risk assessment, and referral for each of the constructs included in the framework were based primarily on practices recommended by the AAP.[2,23] Two premises underlie these guidelines. First, the delivery of preventive oral health services by primary care providers is important and should be linked to clinical and behavioral risk factors assessed beginning at about 6 months of age. Second, referrals to dentists should be made by 1 year of age but might need to be prioritized, also according to risk, because of an insufficient supply of dentists in many communities, particularly those who will see infants for the recommended first dental visit by age 1 year.

The survey was distributed according to the tailored mixed-design survey method for data collection.[24] Up to 3 paper copies of the questionnaire were mailed to each provider between August and November 2013 with follow-up reminder postcards and telephone calls. Sampled physicians could return the survey using a prepaid envelope or respond via an online survey. All responders were entered into a lottery for 1 of 5 Kindle Fire HD e-readers valued at $200.

STUDY VARIABLES

The dependent variable assessed the PCPs' adherence to the AAP referral recommendations based on 4 vignettes presenting clinical and behavioral findings from a typical oral health screening and caries risk assessment of an 18-month-old child. The vignettes depicted the child as being in good oral health with no clinical evidence of dental caries but with risk factors, dental caries in its initial noncavitated stages, or untreated caries in an advanced stage. Respondents were given multiple-choice options for reporting the patient's caries risk status (high, moderate, low, and not sure) and referral recommendation (refer now; refer at age 3 years with continued dental screenings; refer at age 3 years but continue screening and provide preventive dental services, such as counseling and fluoride treatments, during well-child visits; not sure; and other). Participants were asked to respond to each of the vignettes assuming an adequate number and an inadequate number of dentists in the community. A binary variable (1 vs 0) was created for each of the 8 clinical and dentist supply conditions by coding the recommended referral as being adherent or nonadherent with AAP referral recommendations.

Potential barriers to guideline adherence included PCPs' knowledge, attitudes, and behaviors (external barriers) as specified in the Cabana framework.[20] (Details on variable construction and descriptive information about items making up each scale are included in the online Supplementary materials.) Knowledge was assessed using 2 variables: guideline awareness and familiarity (on a scale of 0−3) and knowledge about oral health risk (4 vs 0−3 correct responses). Four scales assessed attitudes toward elements of the AAP guidelines: agreement with risk assessment (score of 0−16); agreement with referral (score of 0−24); screening, risk assessment, and referral self-efficacy (score of 0−10); and outcome expectancy for parental advice about referrals (score of 0−9). Two composite scales measured external barriers to risk assessment (score of 0−8) and referral (score of 0−8).

Seven practice characteristics that might function as barriers were included as binary or continuous variables. Dummy variables were constructed for each of 6 patient characteristics that could make dental referrals difficult (1, very or somewhat vs 0, not at all difficult or not sure). We also included physician characteristics (years since graduation, years in current practice location, sex) in the regression models as control variables.

ANALYTICAL APPROACH

Known practice characteristics were compared between nonrespondents and respondents using the Chi-square test. Descriptive statistics for the 8 clinical workforce vignettes were calculated. Unadjusted odds ratios (ORs) and 95 percent confidence intervals (CIs) were determined for the association of each independent variable and the 8 binary guideline adherence variables.

Separate multivariate logistic regression models were developed for 6 of the 8 vignette-workforce conditions. The vignettes for the 2 high-risk patient scenarios and adequate workforce did not have sufficient variation in adherence to be analyzed in multivariate models. We stratified the analysis on risk status and workforce supply because of the strong association of these 2 variables with adherence. Sample weights were used in preliminary analyses to adjust for nonresponse according to practice size and population density of practice location but were not used in the final analysis, to prevent reductions in the efficiency of the maximum likelihood estimations.

Given the large number of independent variables, we used a backward stepwise selection method to develop a parsimonious model that best fit the data. Variables were included in the final regression models if they were statistically significant ($P < 0.05$) or, if not, they passed the specification test and goodness-of-fit test. The specification of each final model was tested using the link test ($P > .05$), and the goodness of fit was tested using the Hosmer−Lemeshow goodness-of-fit test ($P > .05$).[25] Robust ORs, 95% CIs, and Z-tests were used to report the association between adherence and key influential variables. All tests were performed using Stata version 12 (StataCorp, College Station, Tex).

RESULTS

We received 219 usable responses (including 19 online) from the 435 PCPs solicited, for an overall response rate of 50.3%. Responding physicians were less likely than nonrespondents to be in solo practice (28.6% vs 42.3%; $P = 0.022$, χ^2). No differences were observed by population size of practice location (metro, 77.3% in respondents vs 78.6% in nonrespondents; $P = 0.839$, χ^2).

Characteristics of the weighted and unweighted sample of physicians and their practices are presented in Table 1. The respondents were mostly pediatricians (83.1%) in nonsolo practices (81.3%) located in metro areas (77.2%) and with a large volume of infants and toddlers (48.6% of all patients).

Dental referral recommendations for each of the clinical vignettes, stratified by workforce supply condition, are presented in Table 2. The physician's recommendation to refer an 18-month-old child increased with increasing caries risk under both workforce conditions. Responding physicians were 3.1-fold (vignette 1) to 1.2-fold (vignette 4) more likely to refer when an adequate number of dentists was available in the community than when an adequate number of dentists were not available. Most notable, however, are the high rates of underreferral for several clinical-workforce condition combinations compared with recommended guidelines. Underreferral was particularly high in those children with low risk and adequate workforce (25.5%) and in those with moderate risk under both workforce supply conditions (47.2% and 21.1%). The majority who did not refer the 18-month-old indicated that they would wait and refer at age 3 years, but would continue to provide preventive oral health services until a successful referral could be made.

Multiple regression results are presented for each vignette-workforce condition in Tables 3 and 4. Each of

Table 1. Physician and Practice Characteristics of the Survey Sample, 2013

Characteristic	Physician Eligible Population (SE)* (n = 435)	Physician Sample (SD) (n = 219)
Physician characteristics		
Years since medical school graduation, mean	22.29 (0.75)	22.46 (10.89)
Years in current practice location, mean	10.76 (0.72)	11.08 (10.09)
Male sex, %	38.0	38.5
Training in oral health, %	70.6	70.6
Practice characteristics		
Communication difficulty due to language differences, %		
Never	18.9	18.4
Sometimes	77.6	78.4
Often or always	3.6	2.2
Patients age <3 years, %	48.5	48.6
Patients per hour, mean	2.40 (0.052)	2.39 (0.703)
Practice ownership, %		
Physician or physician group	72.4	72.4
Academic health system	10.5	11.5
Hospital not part of academic center	16.2	15.2
Other	0.89	0.92
Pediatric specialty, %	83.4	83.1
Electronic health record, %		
All electronic	79.1	79.0
Part paper, part electronic	10.5	10.1
None	11.4	11.0
Size		
Solo practice, %	20.8	18.7
Number of providers, mean	3.12 (0.17)	3.28 (2.39)
Metro location, %	75.8	77.2

SE indicates standard error; SD, standard deviation.
*Estimates weighted by practice size and response rates.

the domains has at least 1 variable associated with adherence to guideline recommendations when all 6 vignette-workforce conditions are considered; however, most of the variables associated with adherence differ among the vignette-workforce conditions. The strongest and most consistent associations of predictor variables with adherence were knowledge of dental caries risk and pediatrician specialty. Notably, some of the effects are in the

Table 2. Percent Distribution of Dental Referral Recommendations for Each Clinical Vignette, by Workforce Condition

	Adequate Workforce				Inadequate Workforce			
Dental Referral Recommendation	Vignette 1: Low Risk (n = 219)	Vignette 2: Moderate Risk (n = 218)	Vignette 3: High Risk (n = 218)	Vignette 4: High Risk (n = 219)	Vignette 1: Low Risk (n = 219)	Vignette 2: Moderate Risk (n = 218)	Vignette 3: High Risk (n = 215)	Vignette 4: High Risk (n = 219)
Refer child now, %	**25.5**	**47.2**	**91.2**	**97.7**	8.2	**21.1**	**54.4**	**83.1**
Wait and refer child at age 3 y, but continue dental screenings during well-child visits, %	16.8	4.1	0.0	0.4	17.8	3.2	1.3	0.9
Wait and refer child at age 3 y, but continue dental screenings and preventive dental services during well-child visits, %	52.9	44.4	4.1	0.9	**68.4**	67.8	34.4	10.5
Not sure, %	0.4	1.3	0.4	0.4	2.2	3.2	1.8	1.8
Other, %*	4.1	2.7	4.1	0.4	3.1	4.5	7.9	3.6

Oral health screening and risk assessment results for an 18-month-old child:

Vignette 1: No untreated tooth decay or oral pathology; no behavioral or clinical risk factors for caries.

Vignette 2: No untreated tooth decay or other pathology; frequent exposure to sweetened drinks between meals; no tooth brushing; and family history of bad teeth.

Vignette 3: White-spot lesions (ie, beginning stages of decay) on upper central incisors; frequent exposure to sweetened drinks between meals; and no tooth brushing.

Vignette 4: Untreated tooth decay on 2 upper central incisors; frequent exposure to sweetened drinks between meals; no tooth brushing; family history of bad teeth.

Numbers in bold type represent AAP guideline–adherent choices, which were used as the dependent variable in all analyses.

*Themes for "other" responses were as follows: provide preventive services without referral (39.7%); provide preventive services and refer at age different from vignettes (10.8%); policy is to refer at ages different from vignettes (21.6%); try to find dentist outside own community (19.2%); do not screen or refer routinely (8.4%).

Table 3. Association Between Knowledge, Attitude, and Barrier Variables and Adherence to Referral Guideline Recommendations for Each Clinical Vignette, Adequate Workforce

Variable	Vignette 1: Low Risk (n = 187; 27.8%), OR (95% CI)	Vignette 2: Moderate Risk (n = 186; 48.9%), OR (95% CI)
Knowledge		
Familiar with guidelines	1.964 (0.840–4.508)	1.255 (0.614–2.565)
High knowledge	0.449 (0.202–0.997)**	0.368 (0.189–0.716)***
Attitudes		
Agree with risk assessment	0.918 (0.743–1.135)	±
Agree with risk-based referral	0.809 (0.695–0.942)***	0.943 (0.838–1.061)
Self-efficacy	±	1.007 ((0.845–1.200)
Outcome expectancy	1.247 (0.972–1.600)*	±
Barriers		
Barriers to risk assessment	0.828 (0.663–1.033)*	0.961 (0.729–1.154)
Barriers to referral	1.090 (0.883–1.344)	1.054 (0.880–1.263)
Difficult referring child		
Age <2 y	0.733 (0.269–1.997)	0.559 (0.269–1.162)
With Medicaid	0.825 (0.310–2.198)	±
Who is uninsured	0.519 (0.190–1.417)	0.763 (0.326–1.786)
With private insurance and emergency	1.664 (0.756–3.663)	0.590 (0.290–1.200)
Number patients / hour	1.070 (0.619–1.849)	1.218 (0.789–1.880
Pediatrician	3.657 (1.078–12.400)**	6.057 (1.888–19.420)***
Academic health center	3.220 (1.022–10.140)**	1.732 (0.631–4.745)
Solo practice	0.349 (0.093–1.305)	0.839 (0.355–1.982)
Metro location	2.496 (0.874–7.123)*	±
Years since graduation	0.980 (0.944–1.018)	0.959 (0.926–0.993)**
Male	0.550 (0.235–1.288)	±

CI indicates confidence interval; OR, odds ratio; ±, variable dropped from the regression model.
*$P < .10$.
**$P < .05$.
***$P < .01$.

Table 4. Associations Between Knowledge, Attitude, and Barrier Variables and Adherence to Referral Guideline Recommendations for Each Clinical Vignette, Inadequate Workforce

Variable	Vignette 1: Low Risk (n = 187; 71.1%), OR (95% CI)	Vignette 2: Moderate Risk (n = 185; 20.5%), OR (95% CI)	Vignette 3: High Risk (n = 187; 58.8%), OR (95% CI)	Vignette 4: High Risk (n = 185; 85.5%), OR (95% CI)
Knowledge				
Familiar with guidelines	1.179 (0.498–2.789)	0.401 (0.159–1.011)*	0.756 (0.356–1.607)	1.510 (0.543–4.203)
High knowledge	1.907 (0.893–4.072)*	0.294 (0.128–0.678)***	0.881 (0.457–1.696)	0.583 (0.212–1.599)
Attitudes				
Agree with risk assessment	1.299 (1.092–1.546)***	±	±	0.903 (0.674–1.210)
Agree with risk-based referral	1.124 (0.959–1.136)	0.871 (0.734–1.035)	0.941 (0.834–1.061)	0.963 (0.807–1.150)
Self-efficacy	±	1.469 (1.080–2.000)**	1.115 (0.931–1.337)	1.224 (0.901–1.663)
Outcome expectancy	0.863 (0.685–1.087)	±	1.117 (0.909–1.373)	1.021 (0.770–1.354)
Barriers				
Barriers to risk assessment	1.168 (0.972–1.403)*	0.995 (0.783–1.265)	0.911 (0.767–1.083)	0.908 (0.710–1.319)
Barriers to referral	±	1.113 (0.868–1.428)	±	0.942 (0.735–1.206)
Difficult referring child				
Age <2 y	3.730 (1.333–10.44)**	0.584 (0.210–1.622)	0.748 (0.345–1.622)	2.572 (0.862–7.676)*
With Medicaid	0.292 (0.113–0.756)**	±	1.154 (0.565–2.354)	±
Who is uninsured	4.162 (1.549–11.18)***	0.802 (0.310–2.076)	±	±
With private insurance and emergency	0.359 (0.157–0.824)**	0.794 (0.337–1.873)	0.594 (0.301–1.174)	0.271 (0.099–0.736)**
Number patients/hour	1.281 (0.799–2.054)	2.080 (1.148–3.768)**	1.413 (0.916–2.180)	1.498 (0.758–2.960)
Pediatrician	1.297 (0.469–3.586)	4.897 (1.053–22.760)**	1.991 (0.794–4.993)	4.971 (1.581–15.63)***
Academic health center	0.567 (0.193–1.666)	2.561 (0.792–8.279)	1,584 (0.609–4.124)	2.605 (0.519–13.070)
Solo practice	1.870 (0.687–5.085)	0.341 (0.083–1.392)	0.420 (0.186–0.949)**	0.137 (0.041–0.455)***
Metro location	0.919 (0.347–2.429)	±	±	±
Years since graduation	0.981 (0.943–1.020)	0.985 (0.946–1.025)	0.972 (0.940–1.005)*	1.016 (0.964–1.071)
Male	0.765 (0.344–1.702)	±	1.328 (0.648–2.270)	1.506 (0.514–4.411)

CI indicates confidence interval; OR, odds ratio; ±, variable dropped from the regression model.
*$P < .10$.
**$P < .05$.
***$P < .01$.

opposite direction than hypothesized; for example, the odds of adherence for respondents with higher knowledge scores are lower than those for respondents with lower knowledge scores in vignette 2 (OR, 0.368; 95% CI, 0.189−0.716).

DISCUSSION

This study provides insight into the dental referral decision making of PCPs. The results document the adherence level of PCPs to professional guidelines on dental referrals for an 18-month-old child. We found that on average, across the 8 clinical-workforce vignettes, 61% of providers chose a referral recommendation in agreement with AAP guidelines. However, adherence varied considerably according to vignette, from lows of 21.1% for a moderate-risk child with an inadequate workforce and 25.5% for a low-risk child with an adequate workforce to highs of 91.2% and 97.7%, respectively, for the 2 high-risk vignettes with adequate workforce.

Adherence to guidelines should result in an immediate referral at the time of the screening for all vignettes except that for a low-risk child with an inadequate workforce supply. The absence of a referral when recommended by AAP guidelines, evident in all 7 of the clinical-workforce vignettes necessitating referral, averaged 39.9%. Underreferrals ranged from a low of 2.3% for the most urgent clinical need and favorable workforce supply to highs of 74.5% and 78.9% for low-risk, adequate workforce vignette and the moderate-risk, inadequate workforce vignette, respectively.

Most of the inappropriate referrals in this study can be considered delayed referrals. Large percentages of the respondents whose referral recommendations were nonadherent recommended referral at age 3 years, most with the provision of preventive oral health services in the interim. For example, although only 25.5% of respondents made a referral recommendation in agreement with guidelines for a low-risk child with adequate workforce, 52.9% recommended a referral at age 3 years with continued screening and provision of preventive oral health services. Unfortunately, late referrals can delay the establishment of a dental home and prevent access to early prevention, disease detection, and treatment.

AAP guidelines recommend that all children be referred when a sufficient supply of dentists is available. When the supply is limited, children with elevated risk, regardless of disease status, should be given priority in referrals. Our results suggest that dental referrals by PCPs are triaged, but not according to guideline recommendations. Their referrals appear to be disease-based. Even with an adequate workforce, only 25.5% of providers in this study recommended a referral for a low-risk child with no untreated dental caries or other pathology, and 47.2% for a moderate-risk child with no obvious disease. In contrast, referral percentages for those with dental disease and adequate workforce exceeded 90%.

Physicians appear to relate to dentists as they do to medical specialists whose services are needed for young patients with diseases that they are unable to treat. Various factors could explain these findings. Many risk factors for dental caries, such as sugary beverage consumption and inappropriate bottle use, as well as risk factors for other conditions such as obesity, already are addressed routinely in parent counseling sessions during well-child visits; thus, physicians might believe risk factors for caries are being addressed adequately in their practices.[26] This perspective on oral health services might be reinforced inadvertently by training in oral health. Almost three-quarters of survey participants had been trained in the provision of oral health services. We found that physicians with high knowledge levels of screening and risk assessment were less likely to make an immediate referral. Findings also could be influenced by confusion over recommendations contained in different guidelines and changes over time, particularly for a low-risk child.

Most surveys of PCPs do not explore dental referral decision making in sufficient depth to determine the single or joint effects of clinical status and workforce supply, rather choosing to focus on whether referral is made at age 1 year. Results from at least 2 studies support our findings on disease-based referral decisions. A survey of pediatrician members of the Indiana Medical Association found that only 13% recommended referral for high-risk children at 18 months of age.[11] A study of pediatricians' records designed to collect oral health information found that all child clinical dental conditions included were associated with referral recommendations, whereas none of 5 behavioral risk factors showed an association.[27]

Notable in our regression results are the small number of variables related to adherence in any of the 6 analytical models and the relative lack of consistency in variables identified as important across the 6 models. One possible explanation for these findings is the strong effect of the 2 stratification variables, clinical status and workforce supply. We found large variation in referral adherence to guidelines both within and across workforce conditions. When clinical condition and workforce supply are controlled for in the analysis, little variation remains, and thus only a small number of variables are associated with adherence. One conclusion derived from these findings about the number of variables and their consistency is that the Cabana framework cannot be applied to all situations, not even for different levels of risk and disease status for a single disease. Factors that are important in guideline adherence for one patient and provider might not be important for another.

External barriers represent an important domain in Cabana's guideline adherence framework, but the scale used in this study was not associated with adherence. Individual items in the scale for referral barriers might provide some insight into this finding. The 2 most frequently reported barriers to dental referrals were low parent motivation and a shortage of dentists (online Supplementary materials). These beliefs and others held by providers might lead to underreferral, particularly if providers have low confidence in their ability to change parents'

behaviors, as was found in this study and others.[28] Underreferral could occur even when providers know that guidelines recommend otherwise. The effects of beliefs on provider adherence need further study, which might be best conducted via qualitative analyses.

An apparent important barrier to successful referrals is a discrepancy between the opinions expressed by the PCPs in this study about who should be referred and opinions of general dentists reported in a related study about whom they believe physicians should refer. Compared with physicians for whom large percentages reported in this survey that they would refer the child with dental caries, particularly with adequate workforce, only 35% of general dentists in North Carolina reported being willing to accept a referral when untreated caries are present.[19] The discrepancy between physicians' and dentists' opinions on priority-risk–based referrals seems to be an unexplored barrier in the integration of pediatric medicine and dentistry.

STUDY STRENGTHS AND WEAKNESSES

Generalization of results beyond the analytical sample is limited in several ways. We focused on 18-month-old children because this age falls within the recommended age for the first dental visit; however, we cannot generalize provider referral practices to other ages. Likewise, we are unable to generalize to practices and providers who do not provide well-child visits for children enrolled in Medicaid or CHIP. However, more than one half of North Carolina's population of infants and toddlers are enrolled in these programs. We also consider the results most applicable to locations where physicians have been exposed to training in oral health.

We consider the use of vignette-based case studies for measuring outcomes as a strength of this study. Based on published studies, we would expect our estimates of guideline adherence to accurately reflect decision making by the PCPs participating in this study.[29-31] Nevertheless, the vignettes have not been validated and might not reflect actual practices. Referral recommendations are based on respondents' perceived caries risk and clinical status of an 18-month-old child and on dentist supply, which is described as adequate or inadequate. Research is needed to test the reliability and validity of these vignettes, particularly a respondent's interpretation of an adequate or inadequate number of dentists. In some communities, particularly in rural areas, the number of dentists is insufficient.[32] In others, it might appear to be sufficient but the actual number available to the very young Medicaid population is limited because of access issues. Research is needed beyond questions about the validity of the survey instrument into how PCPs might identify dentists in their communities who are willing to treat young, Medicaid-insured children.

CONCLUSIONS

Overall, AAP guideline adherence by PCPs providing well-child visits for an 18-month-old child is modest but varies from poor to excellent depending on the child's clinical condition and dental workforce supply. In general, PCPs underrefer at the time of the 18-month-old well-child visit screening, particularly patients who have no untreated dental disease and are considered at low or moderate risk for dental caries. Rather, they limit their referrals to those children who already have untreated disease, putting their referral practices at odds with dentists' opinions about who they should refer. Large percentages of respondents recommended a delayed referral at age 3 years, with the provision of preventive oral health services during well-child visits in the interim. A small number of variables other than the clinical oral health status of the child and workforce supply were associated with adherence. The same variables were not consistently present in the different regression models controlling for clinical status and workforce supply, suggesting that barriers and facilitators of referral practices for one patient might differ from those in another patient. This finding suggests the need for complex, multilevel interventions to improve adherence. Future studies should focus on the entire referral process, not just the decision making stage as we have done, and test interventions to improve guideline adherence and outcomes.

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SUPPLEMENTARY DATA

Supplementary data related to this article can be found online at http://dx.doi.org/10.1016/j.acap.2018.05.013.

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