

Infant Oral Health Education for Pediatric and Family Practice Residents

Joanna M. Douglass, BDS, DDS¹ Alan B. Douglass, MD² Hugh J. Silk, MD³

Abstract

Purpose: The purpose of this study was to investigate whether an infant oral health curriculum implemented in pediatric and family medicine residency programs could improve physicians' oral health knowledge and practice behaviors and promote the age 1 dental visit.

Methods: Residents and faculty members completed a baseline current practices survey and knowledge test before receiving a 1- or 2-hour training session followed by a knowledge post-test. Existing well child care forms were updated with oral health prompts to reinforce newly learned skills. At 1-year follow-up (1 YFU), participants completed a current practices survey and knowledge test. In addition to the residency programs, medical students and advanced practice registered nurses participated in baseline data collection, training, and immediate posttest data collection.

Results: A total of 245 people participated, with 78% trained in person and 22% trained via the Web. Of these, 120 were the targeted residents and faculty—of whom 82% completed the 1 YFU. Practice behaviors improved from baseline to 1 YFU, with only 28% of practitioners at baseline referring children to the dentist at age 1, compared to 73% at 1 YFU ($P < .05$). Knowledge scores were greater at 1 YFU than at baseline ($P < .05$), and the mode of training showed no difference in knowledge outcomes. Knowledge and prescribing practices regarding fluoride were poor at baseline and showed limited improvement at 1 YFU.

Conclusions: An infant oral health education program can improve physicians' oral health knowledge and behaviors, particularly regarding promoting the age 1 dental visit. Behavior changes regarding fluoride prescribing, however, appear harder to achieve. Web-based training had similar success to in-person training. (*Pediatr Dent* 2005;27:284-291)

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Dental caries is the single most common chronic disease affecting children today.¹ A statewide oral health survey in Arizona involving 5,171 preschool children found that children as young as 10 months have frank cavities on their maxillary incisors² and 22% of 2-year-olds have caries.³ Children most likely to develop caries come from families of low socioeconomic status. They are 3 times as likely to have unmet dental care needs as those from high-income families.⁴ This lack of care is most frequently ascribed to issues associated with socioeconomic status, Medicaid insurance, geographic misdistribution of

clinicians, and a relative lack of pediatric dentists who are more likely to see young children.⁵

Recently, the major professional organizations with interest in children's oral health reached consensus on the periodicity of dental care. The American Academy of Pediatric Dentistry (AAPD) recommends the first dental visit by the age of 1,⁶ and the American Academy of Pediatrics (AAP) recommends that a dental home be established by age 1 for those children at caries risk.⁷ Few children, however, receive the recommended preventive dental care. Among 3- and 4-year-olds, only 26% received recommended preventive dental care, while 80% received recommended medical well child visits.⁸ Based on the Arizona data, it is evident that there is little or no restorative care delivered to children under the age of 3 years who have dental disease.³

Parent's contact with health professionals during their child's first year of life is mostly with their primary care

¹Dr. J.M. Douglass is associate professor, Department of Pediatric Dentistry, School of Dental Medicine, and ³Dr. Silk is assistant professor, Department of Family Medicine, School of Medicine, both at the University of Connecticut, Farmington, Conn.; ²Dr. A.B. Douglass is assistant director, Family Medicine Residency Program, Middlesex Hospital, Middletown, Conn.
Correspond with Dr. J.M. Douglass at douglass@nso.uchc.edu

physician. Without education, motivation, and help from this physician, parents are unlikely to solicit dental care of their own accord prior to age 3. Although over 90% of physicians report that dental counseling and examinations should be part of the well child visit, 37% reported no dental health education in medical school and 42% no training in residency. Only 9% of physicians correctly answered 4 questions on infant oral health.⁹ An inventory of oral health training confirms that most physicians are not well trained in oral health.¹⁰ Furthermore, even though physicians believe they should provide dental screening for children, the majority do not screen for early tooth decay, an important indicator of future caries risk.¹¹

Infant oral health promotion in physicians' offices can improve children's dental health by reducing the risk of development and progression of caries and ensuring that dental treatment is initiated before disease becomes extensive. Physician education, however, is required. Delivering effective education after completion of residency training is challenging, as evidence suggests that traditional didactic continuing medical education does not improve physician performance.¹² In contrast, education provided during residency training, before practice patterns have become rigidly established, has been successful.^{13,14} Changes in practice patterns are most likely to be realized if programs include a variety of educational methods. Effective modalities include interactive techniques such as:

1. case discussion¹²;
2. enabling methods such as patient education materials^{12,15,16};
3. system interventions that reinforce newly acquired skills in clinical situations, such as flow sheets.^{14,15}

This study's aim was to develop, implement, and evaluate an infant oral health education program in the pediatric and family medicine residency programs in the state of Connecticut. Through this program, physicians would be able to provide dental prevention and screening and promote the age 1 dental visit.

Methods

Overview

All Connecticut family medicine and pediatric residency programs were invited to participate, and 4 of 5 agreed. These programs operated 8 outpatient offices based at 5 different institutions and utilized 6 different sets of well child care forms. Faculty and residents completed a baseline survey examining practice behaviors and a knowledge test. They then received oral health training. Immediately following the training, a knowledge posttest was administered. The existing sets of well child care forms were reviewed for the presence of oral health prompts and updated with standardized prompts to reinforce daily practice of the learned skills.

One year after the training session, trained faculty members and residents completed a follow-up survey examining

practice behaviors and a knowledge test. In addition to the targeted residency programs, 1 medical school and the local advanced practice registered nurses (APRN) association participated in baseline data collection, training, and immediate posttest data collection. These participants were not actively targeted for follow-up.

Training and well child care forms

The training comprised a 1-hour slide presentation covering infant oral health and age of dental referral, with emphasis on Early Childhood Caries prevalence, etiology, and prevention. This was developed in conjunction with the State of Connecticut's OPENWIDE infant oral health program. A second hour was spent on a series of case-based learning exercises that focused on Early Childhood Caries and correct fluoride prescribing. A pocket-sized handout, also available for personal digital assistants, was distributed. All the materials could be delivered in person or viewed via the Web. The majority of participants received live presentations. Those who could not be present completed their training via the Web. Faculty and APRN participants only completed the 1-hour slide presentation due to time constraints.

The revised well child care forms included age-specific oral health prompts (Table 1). These were developed in relation to the key teaching points in the slide presentation lecture and case-based exercises. Every attempt was made to ensure that the prompts were consistent across all sites, but some minor variation did occur. One site was not able to modify their well child care forms.

Evaluation and data analysis

The baseline practice behavior survey and the identical 1-year follow-up survey comprised closed answer questions on referral practices and barriers, dental screening techniques, preventive advice, fluoride-prescribing practices, and previous oral health education. As this survey was examining actual practice behaviors of those currently providing direct patient care, students and unidentified participants (those who did not identify their occupation on the survey) were not included in analysis of this data.

The knowledge test given at baseline, posttest, and 1-year follow-up (1 YFU) was administered to, and the results analyzed for, all participants. It comprised 39 true/false questions on dental caries prevalence, etiology, risk factors, prevention advice, fluoride prescribing and screening, and referral recommendations.

Data on the use of the well child care forms were collected through a chart audit that did not use personal medical identifiers. One person trained in data abstraction performed all chart audits. Any prompt that was circled, checked, or received a written comment next to it was considered addressed. Any prompt left blank was considered not addressed. For each modified set of well child care forms (total of 5 sets), 100 charts completed after the oral health training but prior to the 1 YFU date were identi-

Table 1. Well Child Care Prompts Incorporated Into Residency Program Well Child Care Flow Sheets*

Well child visit				
4 mos	6 mos	12 mos	18 mos	24 mos
No bottle propping	No bottle propping	Discard bottle	Discard bottle	Healthy snacks
Determine H ₂ O F	Introduce cup	Tooth-brushing	Healthy snacks	H ₂ O F level
	Tooth-brushing	H ₂ O F level	H ₂ O F level	Fluoride Rx
	H ₂ O F level	Fluoride Rx	Fluoride Rx	Caries/defects (yes/no)
	Fluoride Rx	Caries/defects (yes/no)	Caries/defects (yes/no)	Oral hygiene (good/poor)
	Caries/defects (yes/no)	Oral hygiene (good/poor)	Oral hygiene (good/poor)	Dental visit in last 6 mos
	Oral hygiene (good/poor)	Schedule first dental visit	Dental visit in last 6 mos	

*Actual wording and layout varied according to residency program preferences.

fied. Charts were consecutively audited until approximately 10 charts for each well child care visit at 4, 6, 12, 18, 24, and 36 months were completed.

Statistical differences between total scores on the knowledge test were evaluated using the Student's *t* test. Differences in the current practices survey were evaluated using chi-square analysis, as were differences in the successful use of well child care forms between those that were and were not trained.

Institutional Review Board approval

Institutional Review Board applications were made at each individual institution for both the training, testing, and chart audits. As the project was considered to encompass standard medical education and the chart audit did not contain personal medical identifiers, all sites but 1 considered the project exempt from Institutional Review Board oversight. One site required oversight in the expedited category.

Results

A total of 245 people received training, which included 120 out of a possible 147 from the original target group of residents and associated faculty members (Table 2). Among participants, 78% received the training in person and 22% completed the training via the Web. Baseline testing was completed on 86% of the participants, posttesting on 78% participants, and 1 YFU on 39% of participants. Among the original target group that was aggressively pursued, 82% completed 1 YFU testing.

Practice behaviors

Data on practice behaviors were collected from 156 practicing providers at baseline and 86 at follow-up (Table 3). The baseline comprised 40 faculty members, 78 residents, 31 APRNs, 5 registered nurses (RNs), and 2 physicians

Table 2. No. of Participants Who Completed Testing and Training by Provider Type

	Baseline test	Trained	Post test	1-year follow-up test
Faculty	40	44	37	22
Residents	78	85	73	50
Medical students	49	49	32	11
APRN/RN/PA*	38	57	43	11
Unidentified	9	12	7	0
Total	214	245	192	97

*APRN=advanced practice registered nurses; RN=registered nurses; PA=physicians assistants.

assistants (PAs). Follow-up comprised 22 faculty members, 53 residents, 7 APRNs, 3 RNs, and 1 PA. There was no significant difference in the distribution of providers between the baseline and follow-up score (chi-square; *P*<.05). A comparison of those who completed the follow-up survey and those who did not was made to examine selection bias. The only difference found among the responses at baseline was that those who completed follow-up surveys were more likely to refer at a younger age.

At baseline, the majority of providers referred children when they were dentally healthy, rather than waiting for a problem to develop. Only 28%, however, referred children by the first birthday. Most referred at the third birthday. Nearly one third of those who referred 0- to 2-year-olds for dental care encountered problems locating dental providers. Another third of providers encountered problems locating dentists for just their Medicaid-insured patients. The majority provided some form of dentally related nutrition advice, and, although most discussed initiation of tooth-brushing, only 31% provided more detailed instructions. Over half of all respondents either assumed that well water did not contain fluoride and prescribed empirically or did not routinely prescribe fluoride supplements (Table 3).

At 1 YFU, statistically significant changes (*P*<.05) were seen for the distribution of responses for all questions except for the question regarding problems locating dentists

for 3- to 5-year-old patients (Table 3). Nearly three quarters of respondents now referred children for a dental visit at age 1 compared to just over one quarter at baseline. The percentage of respondents always giving dental nutrition advice and detailed tooth-brushing instruction also was greater. The number of respondents incorrectly assuming that well water did not contain fluoride or not routinely prescribing fluoride was also significantly lower.

Knowledge

The scores on the knowledge test significantly improved from baseline to the posttest, and although the mean score dropped at follow-up, it remained statistically significantly greater than baseline (Table 4). There was no significant difference in mean score at baseline or follow-up for those who received the training in person or those who received the training via the Web. Faculty members scored signifi-

Table 3. Responses to Select Questions From the Current Practices Survey for Faculty, Residents, APRNs, RNs, and PAs*

Question (only 1 response per question allowed)	Baseline % (N=156)	1-year follow-up % (N=86)
When do you normally refer children to the dentist?		
a. When they are healthy	91	98†
b. When they have a problem	9	2
At what age do you currently refer children for their first dental visit?		
a. First birthday or when you notice a problem, whichever is earlier	28	73†
b. Second birthday or when you notice a problem, whichever is earlier	22	18
c. Third birthday or when you notice a problem, whichever is earlier	42	9
d. When they start elementary school or when you notice a problem, whichever is earlier	5	0
e. You don't normally refer children to the dentist	3	0
Do you have problems locating dentists for your 0- to 2-year-old patients?		
a. Yes, for all my 0- to 2-year-old patients	23	21†
b. Yes, but only for 0- to 2-year-old patients on Medicaid	23	34
c. No	30	42
d. I do not routinely refer 0- to 2-year-old patients	25	4
Do you have problems locating dentists for your 3- to 5-year-old patients?		
a. Yes, for all my 3- to 5-year-old patients	15	14
b. Yes, but only for 3- to 5-year-old patients on Medicaid	27	35
c. No	52	52
d. I do not routinely refer 3- to 5-year-old patients	7	0
Do you currently discuss how to prevent cavities by providing dental nutrition advice?		
a. Always	53	71†
b. Sometimes	44	28
c. Never	3	1
How would you describe the level of tooth-brushing instruction you give parents?		
a. I do not discuss tooth-brushing	8	0†
b. I tell parents when to start brushing their children's teeth, but do not provide instructions	61	44
c. I tell parents when to start brushing their children's teeth and explain in detail how to position the child and how to brush the teeth	31	56
If a 10-month-old child is drinking well water, do you currently:		
a. Prescribe systemic fluoride supplements assuming the well water contains no fluoride	39	22†
b. Test the water in all cases and prescribe systemic fluoride supplements based on results	44	68
c. Not prescribe systemic fluoride supplements	17	10
During your professional training, did you receive at least 1 hour education devoted to infant oral health?		
a. Yes	44	Not asked at
b. No	54	follow-up

*APRN=advanced practice registered nurses; RN=registered nurses; PA=physicians assistants.

†Distribution of question scores statistically significantly different between baseline and 1-year follow-up (chi-square, $P<.05$).

cantly better than other groups at baseline ($P<.05$). At follow-up, however, no differences in mean score were detected. Prior to the start of the present intervention, 2 residency programs did provide 1 hour of infant oral health lectures every other year within their curriculum. The mean baseline score for residents from these programs was 28.5 compared to 25.5 from the other programs ($P<.05$). This statistically significant difference persisted at follow-up (32.4 vs 29.5; $P<.05$).

At baseline, participants had good knowledge on many topics, but some areas were clearly deficient (Table 5). Less than

half of the participants understood the maternal origin of mutans streptococci. Even fewer had a good working knowledge of how to correctly brush or examine children's teeth. Knowledge regarding dentally healthy snack selections for caries prevention was variable, while knowledge regarding systemic fluoride was consistently weak. Many participants thought all public water supplies were fluoridated, and many did not know that the fluoride content of well water is variable. Furthermore, there was a clear disconnect between knowledge and current practices. At baseline, among those who prescribed fluoride, 28% of respondents who knew the fluoride content of well water was variable still prescribed fluoride without testing. At follow-up, this percentage fell to 16%.

At 1 YFU, the majority of responses in areas of identified weakness were significantly improved (Table 5). Knowledge about the fluoridation of public water supplies, however, did not improve.

Table 4. Knowledge Tests Results for All Participants

	Baseline (N=214)	Posttest (N=192)	1-year follow-up (N=97)
Mean score*±SD	28.5±3.7	34.5±3.0	32.2±3.1
% of participants with score >34 (out of possible 39)	5%	57%	26%

*Difference between each mean score was statistically significant (analysis of variance with post hoc testing; $P<.05$).

Table 5. Percentage of Correct Answers for Selected Topics for All Participants

Topic*	Baseline % (N=214)	Posttest % (N=192)	1-year follow-up % (N=97)
Dental caries prevalence and sequelae			
Dental caries is the most common chronic childhood disease	75	96	91†
Untreated dental caries may lead to hospitalization	86	98	99†
Dental caries may be seen as soon as teeth erupt	75	96	91†
Dental caries etiology			
Mutans streptococci typically originate from the mother	41	98	75†
Frequency of sugar consumption is more important than quantity	94	97	98
Risk factors			
Inadequate fluoride	98	99	98
Low socioeconomic status	96	100	100
Frequent use of training cup containing juice	95	100	100†
Oral hygiene			
Correct positioning of adult to brush child's teeth	37	91	71†
Generous stripe of toothpaste inappropriate	85	98	89
Brushing with toothbrush should start as soon as teeth erupt	86	100	98†
Systemic fluoride			
All public water supplies are not fluoridated	45	65	51
Well water cannot be assumed to have no fluoride	65	89	80†
Excess fluoride causes white speckled tooth defects	78	94	89†
Dentally healthy snacks			
Honey Nut Cheerios is unhealthy	69	88	80†
Cheese is healthy	88	90	85
Dental screening in the medical office			
Best position to examine child's teeth	25	86	66†

*Wording of questions has been altered and abbreviated for presentation in table form.

†Number of correct responses was statistically significantly different between baseline and follow-up (chi-square; $P<.05$).

Well child care forms

The 6 different sets of well child care forms were surveyed for oral health prompts present prior to the study. The oral health information was generally sparse and often did not occur at the appropriate age, or only occurred once when multiple age prompts would have been appropriate. Prompts about bottles in bed occurred on 4 sets, but on 2 sets the prompts occurred too late. Weaning from the bottle was only mentioned on 3 sets. Healthy snacks, limiting sugars or junk foods, and balanced meals were only consistently seen on 1 set, and was mentioned at only 1 age on 2 other sets. Oral hygiene was not mentioned on any set at the 6-month visit, when teeth are most likely to start erupting. Two sets mentioned this topic at 12 months, 2 sets at 24 months, and 2 sets never mentioned the topic. Reference to gaining regular dental care was sporadic, with 1 set mentioning it at 12 months, 1 at 15 months, and 1 at 18 months. The rest did not mention this topic until 36 months. Only 1 set mentioned Early Childhood Caries, although all sets listed teeth. No sets differentiated between healthy and unhealthy teeth. Fluoride supplementation was mentioned on all sets, but 4 introduced the topic too early.

A total of 503 charts from the residency programs were audited for use of the new well child care prompts. Between 70 and 90 charts were audited for each age of well child care visit. Of the charts audited, 73% were from trained providers. With the exception of prompts relating to fluoride levels and prescribing, prompts were addressed greater than 65% of the time, with most prompts being addressed (Table 6). Caries or defects were noted in 5% of charts and 31% of children were noted to have had a dental visit in the last 6 months when this prompt was addressed. The fluoride prescription prompt was only used 25% of the time. Among the city-based residency programs, this

prompt was only addressed 4% of the time. When the use of prompts between trained and nontrained providers was analyzed, only the use of the “schedule first dental visit” and “healthy snacks” prompts were significantly different, with providers who received training more likely to use these prompts ($P < .01$).

Discussion

Current oral health training for physicians is inadequate,¹⁰ and may result in poorer health outcomes.⁵ Although the present study also found evidence of limited physician oral health education, it demonstrated that an educational intervention, combined with modified well child care form prompts, was feasible and had a significant positive impact on infant oral health knowledge and practices at 1 YFU. Long-term beneficial impacts from these programs can be expected, as providers at institutions with some pre-existing infant oral health training in place prior to this study had better baseline and follow-up scores.

The consistent improvement of participant knowledge and practice behavior testifies to the robustness of the study outcomes, especially considering that this study was conducted in a real world setting with the attendant challenges of scheduling, meaningful participation, and follow-up. Not all trainings and testing were delivered in identical settings, and not all subjects completed the case-based learning exercises. In addition, well child care prompts were not identical across all sites due to limitations in space and variations in format. Ideally, control groups examining the separate effects of education and well child care prompts would have been included. As this project was to provide statewide training involving as many providers as possible, this was not feasible.

As part of this “real world” intervention, education could be obtained either in person or via the Web. Although

Table 6. Percentage of Audited Well Child Care Visit Prompts That Were Documented as Addressed

Prompt	No. of charts with prompt	Prompt addressed	Details
No bottle propping	139	73%	
Determine H ₂ O F	78	68%	
H ₂ O F level	425	45%	
Fluoride Rx	425	25%	
Tooth-brushing	210	82%	
Caries/defects (yes/no)	425	85%	5% of charts with topic addressed had caries/defects noted
Oral hygiene (good/poor)	357	84%	4% of charts with topic addressed had poor hygiene noted
Healthy snacks	343	78%	
Introduce cup	81	77%	
Discard bottle	141	84%	
Schedule first dental visit	88	67%	
Dental visit in last 6 mos	230	85%	31% of charts with topic addressed indicated visit in last 6 mos

many articles have been published on Web-based learning, none were located that examined knowledge retention compared with more traditional learning methods. The present study found no difference in 1 YFU scores between those that received Web-based learning and those that received traditional education.

The use of well child care prompts was considered a key component of the program, as isolated educational interventions are less effective than those combined with ongoing reinforcers as part of routine clinical care.¹⁵ Overall, the prompts were used greater than two thirds of the time. As few or no prompts were present on forms prior to the study, a baseline analysis was not possible. It was interesting that there was no difference in the use of the prompts between those with and without training—except for the “schedule first dental visit” and “healthy snacks” prompts. It may be that, without education, physicians simply do not understand the importance of the first dental visit. This concept may also extend to the snack prompt. Other prompts may have been more frequently used because they seemed intuitively important to medical providers.

One group of prompts that did not receive consistent use was related to fluoride prescribing. This is of concern, as physicians typically initiate fluoride prescribing. Among the audited charts, 68% indicated steps were taken to determine the water fluoride level and 45% documented the actual level. Only 25% of charts indicated whether fluoride was prescribed. The majority of these providers and their patients were located in fluoridated city communities. It may be that these providers deemed the prompts unnecessary.

The accuracy of fluoride prescribing by physicians has long been a concern, and inappropriate prescribing has been cited as a major contributor to the development of fluorosis.¹⁷ Seventy percent of physicians in one study did not determine the fluoride content of water before prescribing supplements, and 13% incorrectly started prescribing at birth.¹⁸ In another study, 40% of physicians prescribed fluoride at too early an age.⁹ Results from the knowledge tests in the present study supported these findings, with over half of respondents incorrectly or not prescribing fluoride at baseline and almost half unknowledgeable about the potential fluoride content of wells and public water supplies. Although there were some improvements in both knowledge and prescribing practices at the 1 YFU, these gains were modest. In a previous residency-based study aimed at improved fluoride prescribing behaviors, a similar problem in improving physician performance in this area was noted.¹⁹

Prescribing fluoride may be a unique skill for physicians, as it typically requires community-based knowledge and external testing outwith the medical system. These factors may explain the poor results found in this and other studies. Further studies aimed at understanding this better and developing effective ways to change physician behavior are necessary.

In contrast, the present study found strong improvements in referring children at age 1. At baseline, only 25% of physicians referred children for dental care at age 1. One year after the intervention, however, nearly 75% of respondents referred children at age 1. Approximately half of all responders, however, had problems referring children younger than 3 to a dentist—illustrating one of the challenges presented in enacting the AAP and AAPD recommendations regarding the age 1 dental visit. In a 2001 survey of general dentists, only 14% believed that the first dental visit should be at age 1.²⁰ In another report, 73% of general dentists did not treat children aged 6 to 18 months.²¹

General dentists need to be an important component of the pediatric care delivery system, however, as they make up 80% of the dental workforce.⁵ When combined with the dental workforce's general reluctance to accept Medicaid patients due to low reimbursement rates, locating dental homes for 1-year-olds continues to be very challenging. All those responsible for child health, including physicians, dentists, and policymakers, need to come together to develop solutions to this problem.⁵ In the meantime, educating physicians on this issue can bring another active voice into the debate.

Conclusions

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

1. Physicians' knowledge and practice behaviors regarding infant oral health are not optimal prior to additional education.
2. Well child care forms contain limited oral health prompts, which are often inaccurate.
3. Implementation of a multimodal infant oral health education program for pediatric and family medicine residents can improve physicians' oral health knowledge and promotion of the age 1 dental visit.
4. Positive physician behavior changes that persisted at 1 YFU included:
 - a. more frequent 1-year dental referrals;
 - b. increased advice concerning dental nutrition and tooth-brushing;
 - c. increased knowledge about well water and fluoride.
5. Compared to other findings, physician gains in knowledge and practice behaviors regarding fluoride prescribing were modest, and further work in this area is needed.
6. Web-based training had favorable outcomes when compared to in-person training.

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