THE RELATIONSHIP BETWEEN EARLY CHILDHOOD CARIES AND CAREGIVERS' ORAL HEALTH KNOWLEDGE AND BEHAVIOR AMONG MEDICAID-ELIGIBLE CHILDREN IN NORTH CAROLINA

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ABSTRACT

Voronina L. McKinney: The Relationship between Early Childhood Caries and Caregivers' Oral Health Knowledge and Behavior Among Medicaid-eligible Children in North Carolina
(Under the direction of R.Gary Rozier)

Dental caries is increasing among low-socio economic children. A demonstration project, "Into the Mouths of Babes" (IMB), utilized physicians to prevent dental caries in Medicaid-enrolled children. The purpose of this study is to characterize oral health knowledge and behaviors among caregivers of Medicaid-enrolled children and to assess their association with early childhood caries in these children.

A four-paged questionnaire with 36 closed and open-ended questions was administered to parents of children who were approximately 1 year of age. The questionnaires were linked with patient encounter forms. Data were analyzed descriptively and bivariately using SAS.

The 549 caregivers included in this study had a high level of dental knowledge and importance about most areas of oral health. Inappropriate bottle use and age were strong predictors of ECC. Studies should continue on the effectiveness of counseling caregivers and promoting healthy dental behaviors that improve the oral health of children enrolled in Medicaid.

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LIST OF ABBREVIATIONS

ECC - Early Childhood Caries

FPL- Federal Poverty Level

IMB- Into the Mouth of Babes

CME- Continuing Medical Education

IRB- Institutional Review Board

NC-IOM- North Carolina Institute of Medicine

MID- Medicaid Identification Number

PED- Practice Identification Number

LEH- Linear Enamel Hypoplasia

INTRODUCTION

Dental caries is the single most common chronic disease and the greatest unmet health need of children in the United States.[1] Early Childhood Caries (ECC), once thought of as the most severe form of the disease, now is defined as the occurrence of any dental caries on any tooth surfaced in preschool-aged children from birth to 71 months of age.[2, 3] Children at or below 100% of the Federal Poverty Level (FPL) are affected at a high rate and most disease in these children goes untreated. Nearly 80% of children 2-5 years of age at or below 100% of the FPL have unrestored carious teeth.[4] Although the dental profession advocates for early intervention, approximately 20 million children younger than 5 years of age have not had dental examinations.[5] This unfortunate situation recently has received increased attention in the United States. The American Academy of Pediatric Dentistry and the American Dental Association recommend that children have an oral examination within six months of the first erupted primary tooth.[6]

A number of factors contribute to the high prevalence of dental disease in young children and to its lack of treatment. Among some of the more common risk factors for ECC in infants and children are unhealthy eating habits, including extended use of bottle feedings or breastfeeding beyond 12 months.[3] Dental caries also is associated with social and behavioral characteristics. Because parents are the primary caretakers of their children, their oral health knowledge, values and preventive practices are directly related to the oral health of their children.[7] Some parents have limited understanding of dental disease prevention and depend on professionals to meet the dental needs of their children once disease occurs.[8] Because of the attitudes and beliefs of the caregiver, many children get dental disease and suffer with the consequences.[9]

Many dental practitioners are not prepared to provide treatment to patients younger than 3 years of age because of a lack of behavioral cooperation on the part of the child.[10] Low-income children also have reduced access to dental care because of the small number of dentists who participate in the Medicaid program.[12] Access to dental care is especially acute for Medicaid-eligible children in North Carolina.[13] In 1996, less than 50% of Medicaid eligible children had a dental visit.[12] In 1998, 68% of children received medical services, but only 12% received dental services.[13] Another barrier to dental care for very young children is the supply of pediatric dentists. In 2000, 4,001 pediatric dentists practiced in the United States, of which only approximately 50 were located in North Carolina.[12]

A number of innovative programs have been started in North Carolina to help address the high rates of dental disease and reduced access to dental services in low-income children compared to children of other socio-economic levels. One of these programs, "Smart Smiles", began in the mid-1990s as a community outreach intervention in the Appalachian Region. Ten counties with the greatest need for dental services in the region were identified for a program that focused attention on children younger than 3 years of age. Before the Smart Smiles program was incorporated into a similar statewide effort, more than 3,000 children received oral health screenings and fluoride varnish applications, while their caregiver's received counseling about oral health care of their child.

Another innovative program known as the "Into the Mouth of Babes" (IMB) program was established in early 2000 by the North Carolina Division of Medical Assistance. Building on the success of "Smart Smiles," the IMB program was design to

help prevent dental disease in the Medicaid population younger than 3 years of age. This physician-based intervention consisted of three primary components: (1) a risk assessment based on clinical and interview information; (2) the application of fluoride varnish; and, (3) caregiver education about care of their child's oral health. As part of this program physicians are required to complete an AMA-approved CME course before they are eligible for reimbursement from Medicaid. Participating physicians can be reimbursed for up to six medical visits within the child's first three years of life. IMB has grown from one in which 6,259 preventive dental visits were provided in medical offices in 2000 to almost 80,000 visits in 2004. Included in these statistics are about 40% of 1- and 2-year-old children who receive one or more follow-up visits.[14]

The IMB demonstration program had a number of evaluation studies associated with its implementation. As partial fulfillment of her undergraduate research internship in the Spring of 2001, the author of this Master's Thesis assisted in the development and pilot testing of a parent questionnaire to be used in the evaluation of the impact of IMB counseling services on parents. Research reported in this Thesis extends that work in an analysis of data collected with the final questionnaire as part of the baseline survey of parents of children participating in IMB. The questionnaire assessed caregivers' knowledge about oral health, opinions about oral health, and behaviors that might be related to dental caries in their children. The potential for the parent questionnaires to provide valuable information is enhanced in this research by linking them to patient encounter forms completed by physicians during the child visit in which IMB services were provided. These patient records included a number of demographics characteristics of the child, oral health behaviors, pre-existing risk factors, and, most importantly for

purposes of this research, the child's oral health status. Thus, a risk assessment and oral health status provided by physicians can be used to supplement information provided by parents in their questionnaires.

The purpose of this study is to characterize oral health knowledge, values and behaviors among caregivers of Medicaid-enrolled children receiving services through the IMB program, and to assess their association with early childhood caries in these children. Dental caries in Medicaid children is provided by the results of physicians' screenings as recorded in the encounter forms. Oral health knowledge and behaviors of caregivers is available from questions included in the parent questionnaires. A number of sociodemographic variables available from these questionnaires are used as control variables in the analysis.

LITERATURE REVIEW

Etiology of Early Childhood Caries (ECC)

ECC results from an imbalance of a number of factors in the mouth and it is almost entirely preventable. In order for the decay process to begin, a tooth must be exposed to a sugary substance in the presence of bacteria organized as plaque. Decay occurs in a three-step process. First colonization of the infecting bacteria establishes a cavity-causing flora in the mouth of the infant.[15] Second, a microbial shift must occur, resulting in an increased amount of the infecting bacteria.[15] If the pH of the oral environment is lowered because of the high levels of cavity-causing sugars in the diet and it occurs over a sustained period, the tooth surface is demineralized and can eventually lead to cavitation of the enamel.[2,15] The carious lesion first manifests itself as a white spot, most often along the gingival margin in young children.[2] If the lesion is not detected at this very early stage and preventive measures taken, it may rapidly progress to a cavitation. In anterior teeth of young children, caries often appears as a non-cavitated or cavitated band around the gingival third of the crown of the tooth.[16]

Primary maxillary incisors are usually among the first teeth to erupt (between the ages of six to nine months) and therefore are exposed to the oral environment longer than any other teeth in children younger than 6 years of age.[16] Thus, they are among the most susceptible primary teeth in the mouth. The next most susceptible teeth to ECC are the primary mandibular first molars, erupting between the ages of 12-18 months.[16] The teeth that erupt after this time frame are at less risk of ECC, assuming that the child has been weaned from the breast or the bottle and other harmful dietary practices are not taken

up.[16] Other biological factors also can increase an infant's susceptibility to caries. The bacterial flora and the immune system are in the process of developing and are not fully established in young children.[15] Newly erupted teeth may have developmental defects or immature enamel that increases susceptibility.[15]

Streptococcus Mutans is the main type of bacteria causing coronal caries. Studies indicate that concentrations of the organism can reach up to 50% of the composition of flora in the mouth and up to 10% in the saliva.[17] The child typically is infected by saliva from the mother, by the placement of a pacifier in the child's mouth that she has first cleaned in her own mouth, by kissing the child directly on the mouth, or by pre-tasting/chewing food before it is fed to the child.[18] However, in some cases, salivary transfer between mother and child can be protective.[18] Frequent exposure to the mother's saliva can possibly build a resistance to the bacteria resulting in less dental caries than children with rare contact.[18] Lactobacillus alone is less likely to activate the caries process than Streptococcus Mutans.[18] However, the plaque acidic levels may increase in the presence of either type of bacteria.[18] Although the two types of bacteria may increase the risk of dental caries, Toi et al.[19] suggest these same bacteria appear in caries free children.

In order for bacteria to increase to levels sufficient to cause caries, a large amount of sugar, typically in the form of sucrose, glucose or fructose, has to be present in the child's diet.[17] These substances must also be consumed frequently to build up a level of bacteria that can be damaging to the child's teeth.[17] The saliva contributes to the remineralization of the tooth enamel, but requires sufficient time after an acid attack in order to have an optimal effect.[17] When the buffering effect from saliva is overwhelmed

by the frequency of sugar intake in the diet, demineralization caused by high acid levels in the mouth will result.[17] An important factor to consider with ECC is the amount and frequency of sugar use before and during periods of sleep.[17] The flow of saliva decreases during sleep, allowing more time for the sugar substrate to interact with the bacterial plaque in the mouth.[17]

Caregivers' Oral Health Knowledge, Value Placed on Oral Health and Behaviors

Caregivers with children affected with ECC are more likely to be single parents with less education, obese, show less concern for their own oral health and are more indifferent about the cariogenic potential of milk and sugary liquids in bottles used for night time feedings than caregivers' of children unaffected by ECC.[16] However, other than feeding practices, little consideration has been given to the effects of pre-existing parental attitudes, knowledge and behaviors on dental outcomes in very young children.[7] The following paragraphs review caregivers' self-reported knowledge about oral health of children, the importance they place on oral health and their practices that might affect the oral health of their children. The review focuses on the relationships of these caregiver characteristics and ECC in their children.

Many parents believe that tooth decay in their children is detrimental.[20] However, in regard to very young children, a long-standing societal belief is that primary teeth are not that important because they will "fall out" and therefore do not need treatment unless causing pain in the child or disturbing the family in some way.[21] The importance of primary teeth can be devalued because of poor access to dental care or the need to give dental treatment a low priority because of other family concerns.[21]

Caregivers widely report proper knowledge of tooth brushing frequency and the need to limit sugary snacks, and some studies show a direct effect of this knowledge on oral health behaviors.[7] Although knowledge about dental topics can be increased through appropriately designed educational interventions, use of this knowledge can decrease over time and often does not effect behaviors.[20] In a Canadian study, parents gained preventive information about nursing caries through the nursing station, the local radio station, or from relatives or friends. Even with observed increases in awareness and knowledge among caregivers participating in this study, 54% of their children were affected with ECC.[16] Moreover, 52.2% of children born to Mexican-American caregivers who were educated in dental caries prevention before the birth of their child had ECC.[16]

Mothers consider breastfeeding safe, economical and nutritious.[16] However, infants who sleep with their parents while breastfeeding are at increased risk for linear enamel hyplasia (LEH), a "developmental disorder of the teeth associated with malnutrition during pregnancy and early life."[16] LEH itself is a risk factor for dental caries.[16] Dietary bottle habits also are difficult to change. Sixty-eight percent of parents reported being unsuccessful in substituting water at nap or nighttime in the bottle/cup for cariogenic liquids.[16] Many parents reported giving into the demands of the child's dislike for water to avoid stress associated with nightly bedtime crying.[16]

Improper tooth bushing and snacking between meals with sugar substances are behaviors that lead to dental caries in children.[7] The likelihood of children being caries free increases when parents begin limiting sugar between meals at an early age and clean their child's teeth at least twice a day with fluoride toothpaste.[7] Parents in the white-

collared workforce show greater involvement in the oral hygiene of their children than their blue-collared counterparts.[18] Actual level of dental knowledge about tooth brushing and diet usually is less important than practicing these behaviors.[22]

The lack of a strong relationship between acquisition of oral health knowledge and changes in practices has important implications for health education interventions. The most effective intervention for changing oral hygiene practices is individualized instruction with demonstration and skill building.[3, 9] Even if initially successful, a lack of reinforcement when just beginning to learn oral hygiene skills can lead to a decline in behaviors within 3-6 months.[9]

Targeting the oral health of young mothers increases the possibilities of improving oral health knowledge and creating healthy dental beliefs.[9] These healthy attitudes may not only affect dental behaviors at home, but result in regular dental visits.[8] Health education, support and parenting skills are paramount to developing applicable knowledge, attitudes and behaviors, but interventions must be targeted to both parent and child.[9]

Public Insurance Programs

The Medicaid program has existed for about 40 years. Public insurance was expanded in 1997 with implementation of the State Children's Health Insurance Program (SCHIP). With the Medicaid population steadily increasing and implementation of SCHIP, 3 million children who were previously ineligible for Medicaid have gained dental insurance in the United States.[23] North Carolina SCHIP, known as Health Choice, began on October 1, 1998 with a targeted enrollment of 63,901 for fiscal year 1999.[24]

Total enrollments for subsequent years included 64,352 children in fiscal year 2000, 65,639 in 2001, 66,952 in 2002, and 68,291 in 2003.[24] Dentists in North Carolina have found it difficult to adequately accommodate the rapidly growing population with public insurance coverage.

Dental expenditures have consistently averaged about 1.2 percent of total Medicaid expenditures in North Carolina.[24] In contrast to expenditures that have remained level, the Medicaid population in the state almost doubled over two decades, from 8% in 1980 to 15% in 2000.[24] The steadily increasing number of children enrolled in the Medicaid program but limited amount of funds being allocated for dental care has created an environment of litigation to help ensure that children's basic dental needs are being met. In recent years, 16 of 22 litigation cases against Medicaid agencies have been resolved in favor of the plaintiff.[25] The result of this litigation has been to increase access to dental care in those states with rulings favorable to the public.

Dental Access Problem in North Carolina

Nationally, 6.1% of children have unmet dental needs compared to 1.9% who have unmet need for medical care.[5] Factors contributing to patients having unmet dental needs include the following: difficulty in finding a dentist who will treat low income patients; low reimbursement rates in insurance programs; administrative requirements of public insurance programs; and, frequent missed scheduled appointments among low-income people.[23]

Access to dental services has been particularly problematic for some segments of the North Carolina population, particularly during the 1990s. Since 1990 Head Start programs have labeled access to oral health services as their number one unmet health

need.[26] Dental care was listed as the number one legislative priority by North Carolina's local health departments in 2001.[26] In comparison to other states, North Carolina ranks 47th in the ratio of its number of dentists to its population size.[27] The ratio is 38 dentists to 100,000 people in North Carolina compared to 60 dentists per 100,000 people in the United States.[27] In 2000, North Carolina's population totaled 8,049,313, but only 3,985 dentists were licensed in the state, and only 3,112 of those were active. Consequently, the ratio of active dentists to population was 1 to 2,587.[24]

Access to dental care for children enrolled in Medicaid is likewise restricted. North Carolina ranks 44th out of the 50 states in the proportion of dentists actively participating in the Medicaid program.[28] Four counties have no dentist at all, and 36 counties have no dentists who provide dental services to Medicaid participants.[5] Dentists' participation in the Medicaid program is limited because of low reimbursements rates, which until very recently were from 42% to 62% of market fees.[3] In the late 1990s, only about 50 pediatric dentists were practicing in North Carolina and only about 20% of general dentists saw as many as 40 child Medicaid patients each year.[29,30] In 1998, 940 (83%) of 1,139 dentists contacted by Head Start staff refused to provide services for Medicaid enrolled children.[31] Residents of Mecklenburg County, the most populated county in the state, reported in a telephone survey experiencing greater difficulty in obtaining dental care than any other type of health service.[31] Another factor that limits access to dental care is the geographic distribution of dentists. Nearly 80% (79 of 100) of North Carolina counties are considered federally designated dental shortage areas.[12]

Consequences of Untreated Dental Disease in Children

Untreated dental disease can have a substantial impact on the oral health-related quality of life of children and their families. It can result in pain, inability to eat, poor speech patterns, days missed from school and weight loss.[12] ECC can progress to the point of requiring hospitalization and use of sedation or general anesthesia.[13] Young children in particular may require dental treatment in the operating room under general anesthesia.[13]

The estimated costs for a child needing extensive dental treatment in the hospital can be as much as $6,000.[32] In 1996-97, Louisiana's total Medicaid dental reimbursement for children aged 1-5 years was $5,814,754.[33] Only 2,142 patients needing hospitalization increased that total to $7,207,054.[33] A study of 1,482 emergency room dental visits to Seattle's Children's Hospital and Medical Center indicated that 60% were for trauma, and the remainder (40%) for infection or other reasons.[34] In 1997, the North Carolina Medicaid program paid $1,686,565 for 62,000 preventable emergency dental treatments.[13]

Prevention of Early Childhood Caries

Few well-designed clinical trials have been conducted to test preventive methods for ECC.[2] However, Berkowitz suggests that three general types of approaches can be used to prevent ECC. They include: (1) community-based education about dietary habits as well as community water fluoridation and other preventive programs in high-risk communities; (2) professionally-based dental examinations and preventative care in

dental clinics; and (3) home-based development of appropriate dietary and self-care habits.[35]

All of these approaches depend at least in part on educating the caregiver. However, studies provide little evidence that patient education is an effective means of improving oral health.[35] Given current problems with access to dental care for preschool-aged children and the extent of dental disease in this population, a multi-disciplinary approach to deal with this problem has been proposed for North Carolina. A final report of a study commissioned by the state legislature and completed by the NC Institute of Medicine recommended up to 23 actions that should be taken to help alleviate dental problems in North Carolina.

One approach to fill the gap in access to dental services recommended by the NC-IOM was greater integration of medicine and dentistry, a recommendation consistent with the Surgeon General's Report on Oral Health.[36] The specific recommendation called for the expansion of the medical model being tested in Smart Smiles, which trained non-dental healthcare workers to provide screening and referral services, parental counseling and fluoride varnish applications.

Among these three services, the strongest evidence for effectiveness is available for fluoride varnish. Over 40 clinical trials have been conducted on the clinical efficacy of Duraphat® (5% NaF in a resin carrier; 2.26% fluoride).[37] A systematic review of 14 studies revealed caries reductions in permanent teeth of 38% (95% CI=25, 50).[38] Fewer studies of effectiveness for primary teeth have been done, but a Swedish study found a reduction of 1.6 surfaces per child in a two-year randomized control trial when varnish applications started in three-year-old children.[39] A more recent study of Head Start

children aged 3-5 years found that 81.2% of active enamel lesions became inactive after a nine-month fluoride varnish treatment phase.[39] Unlike other professionally applied fluoride products, fluoride varnishes can be used safely in very young children.[39]

In summary, the combination of factors causing ECC, including improper feeding patterns of infants and toddlers, mother to child transmission of caries causing bacteria and not enough exposure to fluoride provide the rationale for early intervention in its prevention.[40]

METHODS

Overview of Study

This study evaluates caregivers' oral health knowledge and behaviors about oral health, and their relationship to dental caries in their children using information from parent-completed questionnaires and physician-competed encounter forms. The survey questionnaires were collected as part of a study of physicians and their patients in 118 medical practices. This randomized controlled trial was designed to determine which if any of three different methods of continuing medical education (CME) was most effective in encouraging adoption of a preventive dentistry package of screening, dental health education and fluoride varnish application. Encounter forms were required of physicians for each visit to ensure and document appropriate risk assessments and delivery of services.

Physicians participating in the trial were divided into three groups. The first group received a two-hour continuing medical education (CME) lecture only. The two-hour lecture included a lecture/slide presentation and a videotape of fluoride varnish application. The lecture also addressed the objectives and methods of oral screening, educating caregivers in good oral health habits, the caries process and nutrition. Participating physicians received additional information documenting the effectiveness, safety, and application techniques for fluoride varnish, as well as printed information to aid in caregiver education, a listing of where to purchase materials, supplies for six clinical screenings and varnish applications, and a copy of the videotape of the application of fluoride varnish.

Physicians in the second CME group participated in bi-weekly conference calls in addition to the two-hour lecture provided to the first group. The third group of physicians received the same CME course and information as the other two groups and the conference calls as did the second group, but also had in-office technical support provided by experts in pediatric oral health as requested over a period of three months.

Pre- and post-CME questionnaires in all three CME groups evaluated the physicians' and parents' knowledge of oral health, attitudes about oral health and practices related to their child's oral health. Only the questionnaires from the baseline assessments for parents are used for this study. The patient encounter form was to be completed for each IMB visit. It identified the child by Medicaid ID number and name, but also provided date of birth and the provider's Medicaid ID number. Physicians asked the caregivers' to respond to five "yes/no" questions on oral health. To indicate pre-existing oral health risk factors for the child, the treating physician used nine boxes on the questionnaire. Five oral health questions included: does someone clean the child's teeth daily, do they use toothpaste containing fluoride, does the child take fluoride supplements, does the child go to bed with a bottle, does the child use a pacifier. In addition, four procedure questions were asked of the physician referencing if: fluoride varnish had been applied, education completed, parental counseling and if a dental referral was needed, and if a dental referral for caries/pathology was made by the physician. A tooth diagram was used to record the child's oral health status as determined by clinical screening. Placing an "X" on the corresponding tooth in the diagram designated an unerupted or missing teeth. A darkened circle identified teeth with obvious carious lesions. At the completing of the oral health risk assessment and screening,

"yes/no" questions were answered by the physician to document application of fluoride varnish, counseling of the parent, the need for a dental referral and if one was made.

Development and Pilot Testing of Parent Questionnaires

The parent questionnaires were designed over a period of eight weeks. A four-person team, consisting of dental and non-dental health professionals, designed the questionnaire. Its purpose was to evaluate the effect of non-dental healthcare providers' IMB services on caregivers' oral health knowledge and behaviors. The domains included in the parent questionnaire consisted of oral health beliefs, attitudes, knowledge, behaviors and background demographics of the parent and family. English and Spanish language versions of the questionnaire were pilot tested in both the University of North Carolina at Chapel Hill, School of Dentistry pediatric clinic and the Orange County Health Department dental clinic. An interview of subjects completing the pilot test of the questionnaire was administered immediately following its completion.

The questionnaire was designed to evaluate the child's diet, history of dental pathology, fluoride exposures, frequency of dental visits and general dental needs. In addition to obtaining information about the child, the parent was evaluated on their oral health knowledge, attitudes, behaviors, beliefs and demographic characteristics. The questionnaire was revised after being pilot tested and submitted for approval by the Institutional Review Board (IRB) at the University of North Carolina at Chapel Hill.

Final Parent Questionnaire

The final four-page questionnaire consisted of 36 questions divided into four major sections—care of the child's teeth, the child's dental health, opinions about children's dental health, and information about the respondent. Questions were drawn from exiting surveys instruments eliciting information from parents of young children or developed specifically for this survey.

Data Collection Procedures

Upon IRB approval of the questionnaires, they were distributed by mail to all medical offices participating in the study along with instructions about distribution to a sample of parents. Questionnaires were distributed by the front office staff in the participating offices to the first 30 caregivers whose children were enrolled in Medicaid and were to receive preventive dental services. The physicians' offices were instructed to return the parent questionnaires by mail to the UNC-CH, Department of Dental Ecology. Completed questionnaires were double entered, checked for data entry errors and corrected when any were found.

Construction of Study Variables

The survey asked questions in a variety of formats including open- and closed-ended questions, the latter providing multiple-choice selections (yes, no, don't know) or 3- or 5-item Likert-scale type responses (e.g., very important to not at all important; agree strongly to disagree strongly). Domains on knowledge and beliefs included a total of 15 questions—five questions using the stem, "How important is it to you…" and 10

questions using the stem, "We would like to know your opinions about children's dental health." An overall knowledge score was constructed for each person on a scale from 0 to 100% by calculating the percent of questions (9 items) answered correctly. The questions assessing importance (5 items) placed on oral health (yes, no, and don't know) were analyzed individually and as an overall score, which was constructed as all items yes, some items yes, and all items no or don't know.

Data Manipulation and Analysis

Parent questionnaires were matched with an electronic file of the patient encounter forms using the child's Medicaid Identification number (MID), name, sex, ethnicity, date of birth, practice name, and the provider's name and practice identification number (PED).

Descriptive statistics were produced for all variables. The relationships between the primary independent variables (knowledge and importance) and ECC were tested in a bivariate analysis using the Chi-square statistic. Because of the importance of age in the incidence of ECC, an analysis of the association between the primary independent variables and ECC also was tested in each of three age strata (<12 months, 12-23 months, 24-36 months), also with the Chi-square statistic using Fisher's exact test because of the small cell sizes. P-values less than or equal to 0.05 were considered statistically significant. All analyses were conducted using SAS software v8.0.

RESULTS

Pilot Test

The pilot test of the parent questionnaires, which included a debriefing, was conducted among 10 patients receiving dental treatment in the pediatric dental clinic at the School of Dentistry, the University of North Carolina at Chapel Hill. Patients provided verbal informed consent, an approach considered to be acceptable for a pilot test of a questionnaire because the information was not to be kept and the parents were not to be contacted again. Three of the 10 parents had children who met the targeted age of 6-36 months and thus are considered in pilot test results presented here. The Medicaid status of these patients is unknown because no record of payment is kept or required upon check-in and we did not inquire about payment source.

The three parents answered all questions completely and felt that the questionnaire was easy to read and of acceptable length for participants to answer honestly and accurately. We focused on 13 questions in the pilot questionnaire in the analysis of pilot test results. The average age of the children of the three participants was 2 years. Two parents reported having had brushed or wiped their child's teeth. The parent who did not clean the child's teeth reported that the child had a history of being sedated for restorative treatment. All parents reported that their children currently do not sleep with a bottle at night. All parents also reported that it is important to them that they brush their child's teeth every day and that their child makes visits to a health care professional. Parents reported not knowing when to start using toothpaste with fluoride, which bacteria can cause cavities, and that adults who have cavities can pass tooth decay germs on to their

children. They also were unaware of the use of fluoride varnish for the prevention of dental caries. Mothers who answered the questionnaire were on average 33 years of age. All three mothers were Caucasian, two being married and the other single and never married. They had completed between 10 and 12 years of education, and two mothers reported having had their teeth cleaned professionally. The questionnaire took an average of 10 minutes to complete.

The objective of assessing performance and acceptability of the parent questionnaire was met in this pilot test. After initial analysis of the information and presentation of the results to the research team, a few questions were changed because of their ambiguity. Caregivers either poorly understood these questions, or sentence structure or word choice needed to be changed. Some questions were reformatted, the logo of the funding organization placed on the questionnaire and the completed questionnaire submitted to the Institution Review Board (IRB) for approval.

Sample Results

A total of 561 baseline questionnaires were matched with encounter forms. The population consisted of Medicaid-eligible children 6-36 months of age and their caregiver who completed the questionnaire. Of the children who participated in this study 19% were younger than 12 months old, 67% were 12-23 months old, and 14% were 24-36 months old (Figure 1).

Caregivers' Demographics

Demographic characteristics of the caregiver sample are noted in Table 1. The sample was 6% American Indian/Alaskan, 2% Asian, 41% African-American, less than 1% Native Hawaiian or other Pacific Islander, and 55% White. About 5% classified themselves as Other race/ethnicity. Forty-two percent of the population was married, 11% divorced, widowed or separated, 34% single/never married, and 13% unmarried couples. Only 1% of the sample of caregivers reported that their level of education was between 0-6 years, 59% reported 6-12 years of education, 35% 13-17 years, and 5% 18 years or above. Twelve percent of the caregivers had never had their teeth cleaned professionally. Twenty-three percent reported that no other adults lived in the household who were helping to care for their child, 59% reported one other adult, and 19% 2 or more other adults.

Caregivers' Dental Knowledge and Behavior

Caregivers revealed a reasonably high level of knowledge on all but 1 of the 9 knowledge items included in the questionnaire (Table 2). Most (79%) knew that putting a child to bed with a bottle containing milk can cause cavities. An even greater percentage (85%) knew that putting a child to bed with a bottle containing juice can cause cavities. Seventy-five percent correctly reported that an infant should stop bottle use by 1 year of age. In addition, 76% knew that children should start making dental visits between the ages of 1 and 3 years. As a method of dental caries prevention, 89% knew that fluoride prevents decay. Most of the caregivers (83%) knew that teeth should be brushed with toothpaste containing fluoride, but a slightly smaller percentage (70%)

knew that fluoride can be used to coat the teeth of infants and children. Eighty-five percent agreed that plaque bacteria can contribute to cavities, while only 19% knew that adults can transmit cariogenic bacteria to their children.

Results of caregivers' reports of their behaviors that might contribute to the oral health of their children are displayed in Table 3. These reported behaviors show performance of both caries prevention and promotion activities. For example, most caregivers (93%) either wiped or brushed their child's teeth; with only a small percentage of children getting their teeth cleaned by either a sibling (2%) or another person (4%) and 49% performing this activity daily. When asked about how teeth were cleaned, 62% used a toothpaste containing fluoride.

Although oral hygiene seemed to be practiced at a reasonably good level, dietary exposures were not as favorable. Thirty-six percent of caregivers reported that they put their child to bed with a bottle, often containing a cariogenic substance (Table 3). For example, 70% of caregivers revealed supplying their children with bottles containing milk or some form of a sugary substance such as fruit juice. A number of children (31%) also used a cup or bottle for extended periods during the day, that is, for more than 2 hours.

Caregivers' Dental Value and Importance

Caregivers in this sample seemed to place a high level of importance on the dental health of their children and those factors that can contribute to good dental health (Table 4). More than 90% agreed that it was important to them that their children have good

dental health and that their teeth be brushed, that they get fluoride, eat a diet that promotes oral health, and make dental visits to have their teeth checked.

Overall, 64% of caregivers reported that it was very important that their child get all five of the preventive services included in the questionnaire, with 36% reporting some but not all. Nevertheless, a single question attempting to measure the value that parents place on primary teeth ("Do cavities in a three-year-olds teeth need to be filled?"), demonstrates that only about one-half of parents value baby teeth sufficiently to have them restored.

Bivariate Associations for Independent Variables and ECC in Children

Analysis of bivariate associations between caregivers' characteristics and physician-identified ECC in these children demonstrate marginally significant associations (p-value=.07) for caregiver education level and age (Table 5). No relationship was observed between ECC and the caregiver's education, ethnicity, marital status, or whether the caregiver themselves had ever had their teeth cleaned professionally.

Four percent of children aged 12-23 months and 10% of those aged 24-36 months had obvious dental caries identified by the physician during the screenings (Table 6). None of the children less than 11 months of age were reported to have any evidence of dental caries.

Only a few dental behaviors were associated with ECC at a statistically significant level (p-value$\leq$1) in the bivariate analyses (Table 6). Dental caries was observed by physicians in 5% of the children who almost always used a bottle or cup at nap or night,

11% of those who used them less than once a week and 4% among those who never used them. A significant association also was observed between bottle contents and ECC. Of children who napped or were put to bed with a bottle or cup with a sugary substance, water or no bottle at all, 3%, 13% and 4%, respectively, were observed to have dental caries. Neither caregivers' knowledge nor the importance that they place on oral health were associated with ECC in their children at a statistically significant level.

Bivariate Associations of Independent Variables and ECC in Children, Stratified by Age

Physicians did not identify any dental caries in those children less than 12 months of age. Of the seven risk factors examined for their associations with ECC in the stratified analysis, only one was found to reach a statistically significance level (Table 7). Significant correlations were found between bottle or cup use at nap or nighttime and ECC in children aged 12-24 months ($p = 0.0384$) and 25-36 months ($p = 0.0384$). The percentage of 12-24-month-old children with ECC who used a bottle or cup at nap or night time almost always, less than once a week or never was 6%, 12% and 3%, respectively. The percentage of children aged 24-36 months with ECC who used a bottle or cup at nap or nighttime almost always, less than once a week or never was 10%, 25% and 11%, respectively.

Because of the importance of feeding habits in ECC observed in this and other studies, bottle/cup use and hours of bottle/cup use per day were analyzed for their association with predictor variables. Results of this analysis, not presented in tabular form in the thesis, demonstrate a significant association between frequency of use and caregiver's age ($p = 0.028$), education ($p = 0.007$) and race (Hispanic/Latino and White,

African-American and Other). A significant association also was observed between bottle or cup use at nap/night and race ($p = 0.023$), child age ($p = 0.036$) and the hours per day the child uses the bottle/cup ($p < 0.001$).

Discussion

The sample of caregivers' had an average age of less than 25 years with the majority having an education level between the sixth and twelfth grades. With this in mind, the assumption could be made that children enrolled in this study would present with a greater prevalence of dental caries than was observed. However, the results of this study were opposite from what was expected. The caregivers' demonstrated both a high level of dental knowledge and placed a lot of importance on the oral health of their children.

Although, the caregivers were found to have good knowledge and felt that oral health of their children was important, child's age and night time/nap bottle use were stronger predictors of ECC. The primary finding of this study is that neither the caregivers' knowledge about oral health nor the value they place on oral health were associated with physician-detected ECC in children. In general, these findings are in agreement with the dental literature.

A number of reasons could explain why the original premise about the importance of these two oral health constructs was not supported by study findings. The number of children with ECC detected by physicians in their screenings was small, representing only 4% of the overall sample. This small number of ECC cases prevented more sophisticated analyses such as multivariable analysis to control for potential confounders. Because the presence of ECC was based on dental screenings by physicians, the number of cases may have been underestimated, further complicating sample size concerns, but

more importantly raising concerns about misclassification of children according to caries status. This misclassification would bias results toward the null.

A small variation was observed in caregivers' knowledge and the importance placed on oral health. Although they were parents of children enrolled in Medicaid and thus were low-income, they appeared to place great importance on the oral health of their children and were very knowledgeable about oral health. More than 90 percent of caregivers believed that tooth brushing, fluoride use, oral examinations and limits on sugar use were all-important activities for their children. They also placed a high value on their children being caries free. Moreover, caregivers' knowledge scores averaged about 70 percent correct overall.

Deficiencies in knowledge and value placed on oral health were observed in only two areas. Almost 50% of respondents felt that primary teeth did not need to filled, and only 19% knew that decay-causing bacteria could be transmitted from the mother to the child. Their lack of knowledge about this aspect of caries etiology suggests that new information is not disseminated rapidly to the Medicaid population or that they have difficulty in comprehending this information because of low literacy or interest.

A large percentage of caregivers reported some behaviors appropriate for preventing ECC in their children. The majority frequently practiced good oral hygiene with their child and used fluoridated toothpaste. However, dietary practices were much less favorable to their child's oral health. Close to 45% almost always put their child to bed for the night or a nap with a bottle or cup, many times with contents harmful to the teeth. Furthermore, this practice related to bottle use was consistently a strong predictor of ECC and needs to be targeted in health education programs.

Counseling of parents about oral health has been given a low priority in pediatrics and professional training of physicians and nurses. As suggested previously, knowledge among the public can be changed much more readily than behaviors. The most effective intervention for changing oral health behaviors is individualized instruction accompanied by demonstration and skill building.[3,17] Even if initially successful, a lack of reinforcement in the first stages of adopting a new behavior can lead to a decline in behaviors within 3-6 months.[17] The Medicaid program implemented in North Carolina provides non-dental healthcare workers the opportunity to counsel parents of young children up to six times before the third birthday, thus providing an ideal opportunity for frequent, one-on-one oral health counseling during the period of a child's life when they are undergoing rapid developmental change. Further studies are needed to determine the effectives of this program in changing behaviors of parents, particularly feeding habits of young children.

The strongest predictor of ECC in this study other than diet was age. The percentage of children with ECC increased from 4% in the second year of life to 10% in the third year. Based on statewide epidemiological surveillance data, it is likely that the prevalence pf ECC in this high-risk Medicaid population will double almost every year before they enter kindergarten. This steep increase in the prevalence of ECC as Medicaid children age emphasizes the importance of early intervention with effective and efficient preventive methods.

This study has several limitations. The sample is based on a systematic sample of the first 30 patients attending practices who were early adopters of IMB services. Thus the sample does not represent all children attending all physician offices in North

Carolina providing services for Medicaid children less than 36 months of age. The Medicaid population may have a higher caries rate than the 4% observed in this study because of biases inherent in the identification of the sample. Other studies of Medicaid children, those enrolled in the North Carolina Health Choice Program, and other disenfranchised working poor without public dental insurance suggest that countless numbers of young children need dental care.

Another limitation of the study is that only a small number of items could be included on the questionnaire because they were being administered in busy medical offices and the sample was expected to have low literacy. It is possible that the knowledge and importance domains are not reliable and valid. Although the questions were drawn mostly from other questionnaires that had been used for the study of pediatric oral health, the scales were limited in their number of items. A final limitation of this study is that the questionnaires and encounter forms may have been matched incorrectly or important encounter forms were missing because they were not completed by personnel in the medical office. This potential problem could bias results either because an important characteristic of the child or family was misclassified or because information was missing.

Conclusion

Nearly 4 million children in America suffer from the effects of neglected dental treatment. In an effort to prevent early onset of childhood caries and to provide timely access to dental care, the Into the Mouth of Babes Program was initiated in North Carolina. This program trains physicians to provide dental screenings, counseling and fluoride services for parents and children at high-risk for dental caries. The purpose of this study was to characterize oral health knowledge, values and behaviors among caregivers of Medicaid-eligible children receiving services through the IMB program, and to assess the association of these variables with early childhood caries.

Caregivers in this study had a high level of dental knowledge about most areas of oral health and also placed a high level of importance on the oral health of their children. Knowledge about recent advances in etiology, measured by their knowledge about the transmissibility of bacteria from adult to child, was not as good as for standard dental practices. Most parents also reported practicing good dental hygiene for their child, but dietary practices were less favorable. Inappropriate bottle use, the dietary risk factor most frequently reported, was associated with ECC.

An increase in the prevalence of ECC with age suggests that this sample of children is at high risk for ECC and should be the target of aggressive preventive efforts. Studies should continue on the effectiveness of the counseling component of the IMB program in changing caregiver knowledge, increasing the value that parents place on the oral health of their children, promoting health dental behaviors, and improving the oral health of children enrolled in Medicaid.

TABLE 1: PERCENTAGE DISTRIBUTION OF CAREGIVERS' BY DEMOGRAPHIC CHARACTERISTICS

QUESTIONS	N (561)	PERCENTAGE
Q 28. Caregiver's that had their teeth professionally cleaned		
Yes	424	88
No	58	12
Q 29. Caregivers' education:		
Between 0-6 years	7	1
Between 6-12 years	313	59
Between 13-17 years	189	35
Above 18 years	25	5
Q 30. Caregivers' Age		
16-24 years old	279	52
25-30+ years old	253	48
Q 31 & 32. Race and Ethnicity:		
Hispanic/Latino	29	6
American Indian/Alaskan	33	6
Asian	10	2
African-American	220	41
NH or other Pacific Islander	1	<1
White	293	55
Other	25	5
Q 34. Marital Status:		
Married	226	42
Divorced, widowed, or separated	57	11
Single/never married	187	34
Unmarried couple	73	13
Q 36. Caregiver's within household:		
No other adults caring for the child	123	23
One other adult	318	59
2 or more other adults	102	19

TABLE 2: PERCENTAGE DISTRIBUTION OF CAREGIVERS' FOR INDIVIDUAL AND OVERALL KNOWLEDGE

We would like to know your opinion about children's dental health.	**N (549)**	**PERCENTAGE**
Q 18. Putting a child to bed with a bottle containing milk can cause cavities in the teeth.		
Know	431	79
Do not know	80	15
Q 19. Putting a child to bed with a bottle containing juice can cause cavities in the teeth.		
Know	463	85
Do not know	59	11
Q 20. Children should stop using a bottle by their first birthday.		
Know	406	75
Do not know	51	9
Q 22.Fluoride helps prevent tooth decay.		
Know	484	89
Do not know	53	10
Q 23. Children's teeth should be cleaned regularly using toothpaste with fluoride by two years of age.		
Know	449	83
Do not know	79	15
Q 24. Fluoride can be used to coat the teeth of infants and children.		
Know	380	70
Do not know	143	26
Q 25. Bacteria and germs on the teeth help to produce cavities.		
Know	463	85
Do not know	43	8
Q 26. Adults who have cavities can pass tooth decay germs to their children.		
Know	101	19
Do not know	241	44
Q 27. At what age should kids start going to the dentist?		
Between the ages of 1-3 years	406	76
Between the ages of 4-5 years	122	23
Between the ages of 6-8 years	5	1
Older than 8 years	2	<1
Knowledge Score of questions answered correctly.		
>0-60%	139	28
>60-70%	112	22
>75-85%	117	23
>85%	133	27

TABLE 3: PERCENTAGE DISTRIBUTION OF CAREGIVER'S INDIVIDUAL AND OVERALL BEHAVIORAL RESPONSES

QUESTIONS	N (549)	PERCENTAGE
Q 2. Children teeth wiped by:		
Adult	448	93
Sibling	10	2
Another person	19	4
Q 3. Frequency of teeth wiped or brushed:		
2-3 times per week	97	20
Once per day	235	49
Two or more times per day	149	31
Q 4. Used toothpaste containing fluoride:		
Yes	191	62
No	35	11
Do not know	82	27
Q 7. Bottle Use:		
Do not use during the day	225	42
Less than two hours a day	143	27
3-5 hours a day	126	23
6-8 hours a day	38	7
Greater than 8 hours a day	8	1
Q 8. Bottle or cup use:		
Almost always at nap/night	236	44
1-2 times a week	104	19
Less than once a week	28	5
Never	173	32
Q 9. Put to bed with a bottle or cup		
Yes	192	36
No	344	64
Q 9. Bottle contents:		
Formula	74	16
Milk	141	31
Sweet milk	4	1
Soda	2	<1
Cereal	16	4
Water	79	18
Juice	81	18
No bottle	189	42

TABLE 4: PERCENTAGE DISTRIBUTION OF CAREGIVERS' INDIVIDUAL IMPORTANCE RESPONSES

How important is it to you…	N (561)	PERCENTAGE
Q 13. …that your child's teeth are brushed every day?		
Yes	524	97
Not sure	6	<1
Not important	15	3
Q 14. …that your child's baby teeth do not get cavities?		
Yes	541	99
Not sure	3	1
Not important	1	<1
Q 15. …that your child gets some form of fluoride (in tap water, drops, tablets, etc.)?		
Yes	496	91
Not sure	41	8
Not important	6	1
Q 16. …that your child's teeth are checked by a health care professional?		
Yes	543	92
Not sure	543	6
Not important	543	2
Q 17. …to limit food and drinks with sugar in your child's diet?		
Yes	526	97
Not sure	13	2
Not important	3	1
Importance Score (Q. 13-17)		
All Very Important	321	64
Some What Important	158	32
Not Sure/Not Important	22	4
Q 21. Do cavities in three year olds' teeth need to be filled?		
Know	273	50
Do not know/Not sure	211	39

TABLE 5- CAREGIVERS DEMOGRAPHICS (CHILDREN WITH CARIES)

QUESTIONS	N (21)	PERCENTAGE	P-Value*
Q 28. Caregivers' that had their teeth professionally cleaned	18	4	0.7192
Q 29. Caregivers' education:			
Between 0-12 years	13	4	**0.0758**
Between 13-17 years	5	3	
Above 18 years	3	14	
Q 30. Caregivers' Age			
16-24 years old	12	10	**0.0736**
25-30+years old	9	8	
Q 31 & 32. Race and Ethnicity:			
African-American	6	3	0.9102
White	12	5	
Other	3	8	
Q 34. Marital Status:			
Married	9	4	0.8889
Divorced, widowed, or separated	3	6	
Single/never married	6	3	
Unmarried couple	3	4	
Q 36. Caregivers within household:			
No other adults caring for the child	6	5	0.5372
One other adult	13	4	
2 or more other adults	2	2	

***Fishers Exact Test**

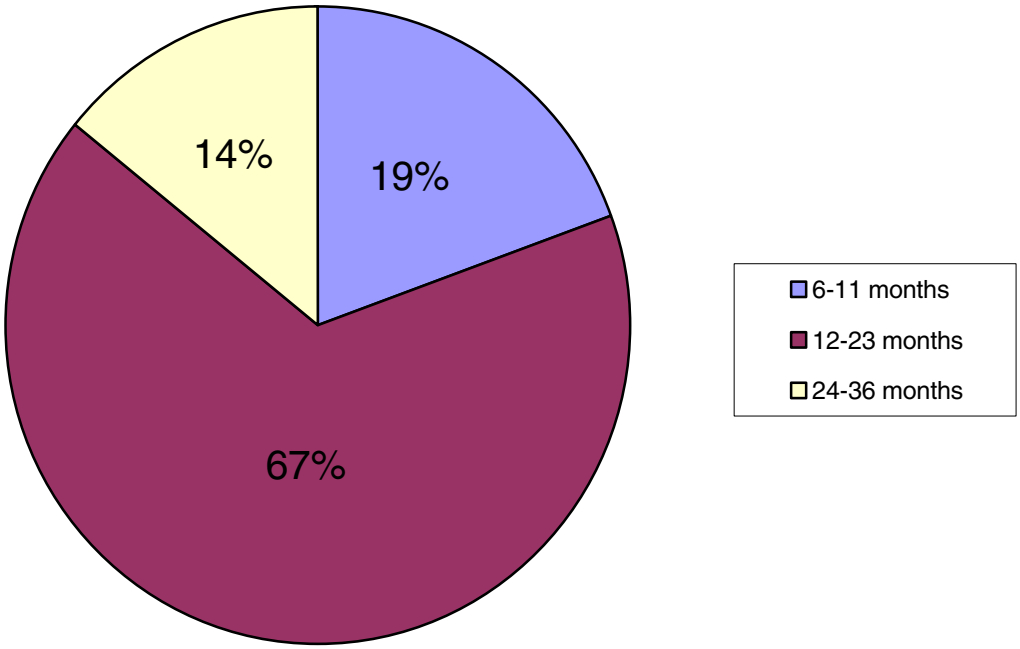
Table 6- Association of Child Characteristics with Dental Caries

QUESTIONS	Sample Size	N (21)	PERCENTAGE	P-Value
Population of children with caries:				
Aged 6-11 months	97	0	0	**0.0071**
Aged 12-23 months	33	14	4	
Aged 24-36 months	71	7	10	
Q 1. Children teeth cleaned:				
Never	61	2	3	0.5021
Adult	414	19	5	
Non-Adult	25	0	0	
Q 3. Frequency of teeth cleanings and dental caries:				
Never cleaned	61	2	3	0.8972
Cleaned 2-3 times per week	87	3	3	
Once a day	216	9	4	
More than two times per day	134	7	5	
Q 4. Children with dental caries and toothpaste use:				
Never cleaned with toothpaste	61	2	3	0.2552
Cleaned without toothpaste	151	3	2	
Cleaned with fluoridated toothpaste	100	7	4	
Cleaned with non-fluoridated toothpaste	167	7	7	
Q 8. Children put to bed with bottle at nap/night and dental caries:				
Almost always	215	11	5	**0.0510**
Less than once a week	122	3	11	
Never	160	7	4	
Q 9. Children with dental caries put to bed with a bottle:	218	6	3	**0.0629**
Sugary substance	24	3	13	
Water	222	9	4	
No bottle				

TABLE 7- ASSOCIATION OF CHILD CHARACTERISTICS WITH DENTAL CARIES, (CONTROLLING FOR AGE)

CHILD'S AGE	N (21)	PERCENTAGE	P VALUE
Children less than 12 months	0	0	0
Ages 12-23 months			
Never had their teeth cleaned by an adult	2	5	0.4848
Teeth cleaned by an adult	12	4	0.4848
Teeth cleaning frequencies with caries:			
2-3 times a week	1	2	0.9416
Once a day	6	4	
> 2 times a day	5	6	
Bottle or cup use at nap/night with caries:			
Almost always	9	6	**0.0384**
< Once a week	2	12	
Never	3	3	
Toothpaste use with caries:			
No toothpaste	3	3	0.6193
Fluoridated toothpaste	3	2	
Non-fluoridated toothpaste	5	9	
Importance scores of Caregivers			
All Important	10	4	0.6381
Somewhat	4	4	
Not Sure/Not Important	0	0	
Knowledge score of caregiver's correct responses with caries:			
0-60%	7	7	0.3863
60-75%	3	4	
75-85%	2	3	
> 85%	2	3	
Ages 24-36 months			
	0	0	0.4848
Never had their teeth cleaned by an adult	7	11	0.4848
Teeth cleaned by an adult			
Teeth cleaning frequencies with caries:			
2-3 times a week	2	14	0.9416
Once a day	3	11	
> 2 times a day	2	7	
Bottle or cup use at nap/night with caries:			
Almost always	2	10	**0.0384**
< Once a week	1	25	
Never	4	11	
Toothpaste use with caries:			
No toothpaste	0	0	0.6193
Fluoridated toothpaste	4	11	
Non-fluoridated toothpaste	2	7	
Importance scores of Caregivers			
All Important	4	9	0.6381
Somewhat	3	13	
Not Sure/Not Important	0	0	
Knowledge score of caregiver's correct responses with caries:			
0-60%	2	10	0.3863
60-75%	1	9	
75-85%	0	0	
> 85%	4	17	

FIGURE 1: AGE OF CHILDREN AT TIME OF DENTAL SCREENING BY PHYSICIAN



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