EARLY CHILDHOOD CARIES:
IMPLICATIONS FOR ADVANCED PRACTICE
NURSING AND COMMUNITY HEALTH

by
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ABSTRACT

Pediatric oral health is steadily declining due to cognitive and environmental factors that create poor oral health behaviors. The role of the nurse practitioner in preventing early childhood caries, however, is poorly defined and rarely studied. Early childhood caries prevention must be prioritized in all primary care settings that provide pediatric health care services. This project provides a review of literature to better define nurse practitioner prevention of early childhood caries and promotion of pediatric oral health. Oral health anticipatory guidance will be outlined along with practical advantages of a collaborative oral health environment. This will allow the nurse practitioner to address cognitive and environmental factors that contribute to poor oral health behaviors.
CHAPTER 1: INTRODUCTION

Problem

While the oral health of the nation as a whole is improving, tooth decay among children between the ages of 2 to 5 is increasing (Dye et al., 2007). Early Childhood Caries (ECC), formerly known as “Baby bottle tooth decay” or “nursing bottle rot,” is the most common chronic disease of childhood, five times more likely than asthma and seven times more likely than hay fever (U.S. Department of Health and Human Services [USDHHS], 2007).

Pediatric oral health is threatened daily by behavioral, cognitive and environmental factors that contribute to early childhood caries. Linardakis et al. (2008) indicate that more than half of children Kindergarten age and younger consume sugar-sweetened drinks on a regular basis. When combined with poor oral hygiene, such oral hygiene behaviors may lead to increased levels of cariogenic bacteria that result in dental decay.

Current problematic cognitive factors held by children and their parents may also distract from good oral hygiene behaviors and ECC prevention. Nurse practitioners may address these challenging cognitions by learning about ECC disease progression and providing anticipatory guidance that encourages positive pediatric oral behaviors.

Lastly, current pediatric environments lack collaboration between medical and dental providers. As a result, many children and their families are left unaware of oral health promotion and ECC disease prevention. American Academy of Family Physicians (AAFP), American Academy of Pediatrics (AAP), American College of Physicians (ACP), American Osteopathic Association (AOA) jointly recommend children establish a “medical home” in infancy (American Academy of Pediatrics, 2010). Within the Medical Home, children experience
accessible, continuous, comprehensive, family-centered, coordinated, compassionate, and culturally effective care (AAP, 2010). While 42% of children establish a “Medical home” in infancy (Child and Adolescent Health Measurement Initiative, 2007), only 5-11% of children establish a “dental home” by 24 months of age (Brickhouse et al., 2006). The failure to establish a “dental home” (Nowak & Casamassimo, 2002) until well after the recommended age of one provides some explanation for the current prevalence of ECC. Thus, NPs who see pediatric children, especially those at demographically higher ECC risk, must take measures to increase their oral health knowledge.

A search of PUBMED, a well known nursing research database, showed little if any guidance for nurse practitioners in the realm of pediatric oral health (N=2), therefore, nurse practitioners who treat pediatric patients may not be adequately assessing and managing ECC risk. Again, owing to the multidimensional nature of ECC, this disparity must address dental environment, hygiene cognitions and behaviors to promote pediatric oral health and prevent ECC disease.

Purpose

The purpose of this project is to provide a review of current literature that examines environmental, cognitive, and behavioral factors contributing to ECC. This will prepare the nurse practitioner (NP) to better manage dental health and decrease ECC risk in their pediatric patients. Social Cognitive Theory (Bandura et al, 1961) has been widely used in health promotion research and provides the theoretical framework for the project. Some behaviors are affected directly while others are more indirectly affected. For example, studies have shown that the utilization of SCT concepts in creating anticipatory
guidance has helped change parents’ behaviors that promote obesity in their children (McGarvey et al., 2004) and helped school nurses promote positive health practices in minority adolescents (Mahat et al., 2002). Thus, some behavioral change is directed towards those who affect behavior (parents and teachers) as well as those performing the behavior (children or students). Only after parents and caregivers adopt behaviors that support good oral hygiene can the NP direct change towards the child. As the NP promotes mastery of oral hygiene knowledge through SCT concepts of skills training and observational learning (brushing, flossing), the child’s behavioral capability to mimic that task is increased. To increase probability of repeat behaviors, good oral hygiene behaviors and self-control should be positively reinforced by the NP and caregiver.
BACKGROUND

Anatomy and Pathophysiology

Most humans have 20 primary, or deciduous, teeth that erupt around 6 months of age, and 36 adult teeth that become permanent between the ages of 9-14 (Ash & Nelson, 2002). Constant chemical and physical contact with foreign substance requires the teeth to have adequate protection to avoid injury.

Dental Structure

Enamel is the outermost layer and is the first to contact starches and sugar-sweetened drinks that enter the body. Deeper tissues include dentin, cementum, and dental pulp. Enamel is vastly susceptible to demineralization which occurs in the presence of an acidic environment (Cate, 1998, p.1), like that produced when fermentable carbohydrates are digested by bacteria in the mouth. When a tooth first erupts, enamel formation, or amylogenesis, is complete. Sometimes amyloblasts are disturbed during tooth development, due to genetics, illness or injury. As a result, the enamel develops incompletely and enamel hypoplasia occurs, which will be discussed later in a later chapter. Enamel is not metabolically active and cannot be regenerated after eruption, although minerals in saliva can help to slightly remineralize enamel when damage has occurred. Differing from enamel, both dentin and cementum are metabolically active and can recover after injury (Stewart, 2005, p. 117). The innermost part of the tooth is the dental pulp that contains a neurovascular bundle. Damage to this bundle will deny the tooth crucial nutrients and growth factors, and will cause the tooth to become ischemic and eventually necrotic. Finally, the periodontal ligament serves to anchor the tooth to the mandible.
Saliva

Saliva contains calcium and phosphorous molecules that help remineralize worn enamel and buffer acids produced by plaque. Saliva also retains fluoride molecules from toothpaste or mouth rinse that contribute to the strength of the enamel. Antibodies found in saliva help defend against foreign organisms introduced into the oral cavity. Despite all of its defenses, the longer and more frequently acids are introduced into the mouth, the less saliva is able to maintain adequate remineralization and buffer against acid erosion (American Dental Health Association, 2002). Additionally, the normal decrease in salivary flow during sleep may increase the risk of tooth decay when constant contact with fermentable carbohydrates occurs, as in frequent nighttime breast or bottle feedings without dental care (Thie, 2002).

Demineralization

Four factors are involved in caries development (see Figure 3). When all four are present, the tooth decays. Demineralization occurs when fermentable carbohydrates, usually sucrose, are digested on the tooth surface by bacteria, most commonly streptococcus mutans. These bacteria produce potent lactic acids that lower the normal salivary oral pH between 6.0 and 7.4 (Guyton & Hall, 2005) to a level below 5.5 (Samour & Helm, 2005, p.118). At this acidic level, the rate of enamel decalcification exceeds...
that of remineralization and enamel erosion occurs (Brown, 2003, p.688). Dentin’s network of
tubules is used to deliver nutrients and remove waste, but also creates an ideal passageway for
bacteria to infect deeper dental tissues. If an acidic environment persists, as in frequent
prolonged periods of milk or juice in the oral cavity, damage to the dental pulp may cause
ischemic death of the pediatric tooth.

*Streptococcus Mutans*

The human mouth contains hundreds of bacteria. Lactobacilli and *Streptococcus Mutans*
(S. mutans) are specific to plaque formation (Simon, 2007). S. mutans is especially cariogenic
because of special bacterial receptors that allow it to adhere to dental surfaces (Madigan &
Martinko, 2009). S. mutans is both infectious and transmissible (American Academy of
microbes are most commonly transmitted from the caregivers’s saliva to the infant’s mouth
(Berkowitz et al., 2006). Parents who kiss their infant on the lips, share eating utensils with their
infant, self-clean bottle nipples or pacifiers, or who play with the infant by “biting” its hand,
place the child at risk for acquiring S. Mutans (Berkowitz et al., 2006).

*Plaque Production*

S. mutans metabolizes fermentable carbohydrates into simple sugars like sucrose,
glucose, lactose, and fructose. The simple sugars are further metabolized by S. mutans into
lactic acid which plays a vital role in enamel decalcification. The metabolism of sucrose
produces not only lactic acid but also a sticky polysaccharide that acts as glue, cohering the S.
mutans together and forming a plaque (Ryan, 2004). The plaque continues to metabolize various
fermentable carbohydrates into simple sugars while adhering to the dental surface, again
contributing to increased lactic acid production and increased opportunity for enamel damage. If the plaque is not removed it begins to absorb the same minerals in saliva normally absorbed by the enamel for remineralization and strength. The persisting plaque calcifies and forms a tartar or calculus which then provides a new surface for yet another plaque formation.

**Complications**

Inattention to cognitive, environmental, and behavioral factors of ECC development may lead to further, more significant complications. Damages from ECC can be both physical and psychological and may create harmful pediatric habits in that span well into adulthood.

**Pediatric**

*Impaired growth and speech.* Infants and children who experience pain from ECC infection have difficulty feeding and often fail to gain critical pounds needed for optimal growth (Sheiham, 2007). This failure to thrive is a learned response from the negative reinforcement of painful food ingestion. Because the child with failure to thrive due to ECC does not receive adequate nutrition necessary for physical and cognitive growth, the child may digress to the 10th percentile for weight by age group and may fail to reach certain developmental milestones (Clarke et al., 2006). However, with regular dental visits, it has been shown that a child with failure to thrive may regain the necessary weight with restoration of dentition, even when the cause of the failure to thrive seems organic (Sheiham, 2007).

Speech is also affected in children with severe ECC whose teeth become ischemic and are expelled. Without the proper dental structures necessary for speech, children will be unable to develop spoken communication (AAP, 2008). Delayed speech will affect all aspects of
development, especially disturbing social development as the child has difficulty participating in meaningful conversation with peers.

*Cognitive disruptions.* Children with poor dentition are more likely to miss two or more weeks of school than children with good dentition (USDHHS, 2005). Dental-related illnesses account for 50 million missed school hours each year (USDHHS, 2001). Missing school may delay a child’s physical, social and cognitive development as the child misses the opportunity to interact in a stimulating environment (Clarke et al., 2006). For children with ECC whose pain is not considered severe enough to miss school or who do not have the option of staying home, paying attention in school becomes difficult (Ramage, 2000). The chronic ache of untreated caries distracts from cognitive learning, and delays psychosocial growth (Clarke et al., 2006).

*Psychosocial/psychological disruptions.* Children with dental abnormalities are also more likely to be bullied in school (DiBiase & Sandler, 2001). Children with visible yellow or black carious lesions on their teeth, with missing teeth, or who have developed malocclusions or improper alignment of their permanent teeth due to ECC may be more hesitant to smile or communicate than others with good dentition or straight teeth. Further, poor speech development along with poor cosmetic dentition associated with ECC may cause a child to be less active in pursing relationships out of embarrassment (Moore et al., 2004).

Malocclusions and improper dental alignments can be the direct result of deciduous teeth that are lost too early. Normally, deciduous teeth last five to ten years after eruption. When the permanent tooth is developmentally ready to erupt, the deciduous tooth’s root dissolves and the erupting permanent tooth pushes it outward. When a deciduous tooth is lost too early, as in cases of ischemic teeth with ECC, its underlying permanent tooth has no path to follow and may erupt
in an unintended area. Further, the lost tooth leaves an empty space for surrounding teeth to naturally drift into. The permanent teeth that underlie these deciduous teeth follow the drifted path of their deciduous predecessor and may cause malocclusion, crooked teeth, and embarrassment from smiling. To decrease the risk severe speech or mastication disability, the NP should be able to recognize and decrease risk for preventable causes of malocclusion like ECC.

*Disease promotion.* Twenty seven percent of children have untreated tooth decay (CDC, 2004). Bacteria in untreated caries may cause more severe effects on the body, including death (Otto, 2007). Poor nutritional intake related to ECC pain may decrease proper nourishment, the body’s immune system weakens and becomes more prone to infection and less responsive to any intrinsic or extrinsic insult. When introduced into the blood stream from extensive dental disease, S. mutans may travel to vital organs in the body, including the brain, lungs and heart and may cause infection, life-threatening inflammation and may also cause systemic sepsis. One such case resulted in death, with S. mutans infecting the brain of a young 12-year-old who suffered meningoencephalitis and subdural empyema from an untreated tooth abscess (Otto, 2007). In addition, surrounding tissues are also affected by poor dentition. Acute infections of surrounding dental tissue occur when S. mutans spreads which may result in gingivitis, which is found almost universally in children, or peridontitis depending on the severity of infection (Califano, 2003). Dental abscesses from chronic untreated dental decay may progress from gingivitis to mandibular cellulitis, an acute infection that requires IV antibiotic treatment, is highly costly, and possibly life-threatening as the infection can spread systemically (Douglass, D. & Douglass, 2003).
Children with pre-existing disease, such as diabetes or congenital heart disease are at increased risk for developing complications from ECC. Children with diabetes and ECC may be unable to regulate their diets correctly due to dental pain. Also, children with congenital heart defects and ECC who undergo dental procedures are at risk for developing infective endocarditis (Cheuk et al., 2004). In addition, females with histories of ECC who become expectant mothers are at increased risk for developing gum disease, which increases the risk of pre-term delivery (Jeffcoat et al., 2003).

*Surgical intervention and cost.* Treating effects of ECC are far more costly than initial preventive expenses. Dental caries that are discovered before most of the tooth is infected may be capped or filled under local anesthesia or conscious sedation in a dentist’s office. If multiple caries are present, more than one visit may be necessary to decrease the amount of time the infant or child will need to be locally anesthetized or sedated. If multiple severe caries are present, the teeth will likely need to be crowned which requires general anesthesia (Eidelman, 2000). When compared to conscious sedation done in a dental office, general anesthesia in a hospital is more efficient for the dentist, but more costly to the patient, averaging around $1,500-$6,000 for a basic dental restoration (Griffin et al., 2000). This cost can cause financial hardship for children from low income families. Although general anesthesia provides an optimal working environment for the dentist, general anesthesia is not optimal for the child. A dental restoration requires the child to be anesthetized for one to two hours and the child often awakes groggy and disoriented for the remainder of the day, based on their inability to metabolize and excrete the potent drugs. If school-age, the child will require general anesthesia, will be required to fast pre-operatively, and may miss at least one day of school, all of which add to the potential for a
traumatic experience. Although aggressive surgical intervention may be effective in the short run, it is not a long-term solution. If behavioral causes of ECC like diet and hygiene are not addressed, poor dentition is likely to persist. More than half of children with current or previous caries develop a recurrence within two years (Foster et al., 2006).

**Adult**

Cariogenic behaviors in childhood tend to become habit in adulthood (Marja-Leena et al., 2008), increasing the likelihood of adult periodontal disease, a serious and painful inflammation of the periodontal ligaments. The effects of ECC in childhood increases the risk of dental complication is adulthood. For example, peridontitis causes pain with mastication, complicating diseases regulated by nutrition and diet, like cardiovascular disease and diabetes. In addition, severe peridontitis may become systemic, infecting and damaging vital organs (Lee et al., 2006). Perodontitis-initiated systemic inflammatory response causes vessel inflammation and has been linked to stroke, atherosclerosis, and carotid artery calcifications (Dorfer et al., 2004, Ravon et al., 2003). Periodontitis also complicates diabetes, due to lack of nutritious intake and increased blood sugar from systemic inflammation (American Dietetics Association, 2007). Though periodontal disease in expectant mothers has been thought to increase the risk of delivering low-birth weight neonates, research has failed to identify a significant relationship (Davenport, 2002). Gestational gingivitis, however, has been linked to pre-term labor, possibly precipitated by poor dentition from ECC (Jeffcoat et al., 2003). ECC may also increase the number of dental procedures undergone as an adult, putting adults with pre-existing valve conditions at greater risk for surgical complications like infective endocarditis (Cheuk et al., 2004). Moreover, chronic pain and poor self-esteem from ECC may contribute to poor character development and a
abnormal social perspective in adulthood. Adults with poor self-esteem may also have difficulty finding or retaining work and are less successful in academic environments (Trzniewski et al., 2006).
CHAPTER 2: CONCEPTUAL MODEL AND METHODS

Theoretical Framework

Social Cognitive Theory

Bandura et al. (1961) created Social Cognitive Theory (SCT) from observations that children’s perceptions of an environment produce a learned behavior. SCT is a strong theoretical guide to nurse practitioner ECC prevention by identifying environmental and cognitive factors that influence oral hygiene perceptions and create oral hygiene behaviors. By verbally influencing cognitions and perspectives through anticipatory guidance, socially promoting healthy behavior and environment, and modeling behavior that is rewarded positively, SCT-based practice can guide the nurse practitioner to successful reduction of ECC risk in pediatric patients (Bandura, 1977; Bandura, 1986).

Bandura (1998) has applied concepts of SCT (environment, cognitions/perceptions and behavior), directly to health promotion. Bandura (1998) states that a person’s level of self-efficacy collaborates with cognized goals, outcome expectations, and environmental hindrances or aids to actuate behavioral change. Eleven SCT concepts help explain the relationships between environmental, cognitive, and behavioral factors that lead to lasting oral health behavior. These concepts are discussed in the following paragraphs.

Environmental factors. It is suggested that a child’s “medical neighborhood” is all tangible areas where support for pediatric oral health is received. Within the ideal “medical neighborhood,” community water is fluoridated, school sealant programs are available, medical and dental care are readily accessible, and social marketing that promotes pediatric oral health is pervasive. The NP’s role within the “medical neighborhood” involves SCT concepts. The NP
can provide opportunities in the “medical neighborhood” for observational learning by identifying and promoting respected role models of proper oral hygiene (parents, siblings, picture cartoons). The “medical neighborhood” also accounts for home environments, promoting home brushing charts and timed brushing supplies that help regulate oral hygiene goals. Self-control of pediatric hygiene behaviors occurs when supplies are available, goals are regulated and behaviors are rewarded.

**Cognitive factors.** Oral health perceptions and cognitions may also be positively affected by SCT-based intervention. NP-provided anticipatory guidance may correct oral health misperceptions held by the patient’s/caregiver’s, improving the child’s perceived oral health environment or situation. Anticipatory guidance also may help improve the child’s external environment, emphasizing parental social support and opportunity for good oral health behaviors. Oral health anticipatory guidance is tailored to each child in an individual blend of environmental, cognitive, and behavioral change factors (Glanz et al., 2002). This emphasizes the SCT concept of reciprocal determinism, where change occurs from environment, cognitions and behaviors all affecting each other mutually. To promote self-efficacy, the NP sets small goals for the child (i.e. first brushing, then flossing). Smaller goals may seem less daunting and increase the child’s confidence in performing tasks and establishing lasting behavioral change. As the child is provided positive examples of healthful oral hygiene behaviors, positive expectations will begin to be associated with those behaviors and change will seem appealing. The caregiver will come to value and be motivated by the outcome indicators of lower future dental costs and less missed school days. Additionally, these positive expectancies will act as incentive for continuation of the new behavior and lasting change. Emotional coping responses
must also be addressed by the NP to provide help response for parents or caregivers of non-compliant infants/children. Because emotions largely influence behavior, stress management techniques for parents or caregivers of less willing children should be made available.

Behavioral factors The SCT has been used in many health promoting studies to improve unhealthy behaviors. Studies have shown that anticipatory guidance created using SCT concepts helps change parents’ unhealthy behaviors and cognitions that promote obesity in their children (McGarvey et al., 2004). SCT concepts have also helped school nurses promote positive health practices in minority adolescents (Mahat et al., 2002). Behavioral change is directed towards those who affect behavior (parents and teachers) and those performing the behavior (children or students). Once parents and caregivers adopt behaviors that support good oral hygiene, the NP can focus on change in the child. As the NP promotes mastery of oral hygiene knowledge through SCT concepts of skills training and observational learning (brushing, flossing), the child’s behavioral capability to mimic that task is increased. Good oral hygiene behaviors and self-control should be positively reinforced by the NP and caregiver to increase the probability of regular practice.

Summary

Establishing a Medical Neighborhood improves the pediatric oral health environment while oral health anticipatory guidance improves perceptions and cognitions of oral hygiene behavior. NPs who establish trust, emphasize the importance of oral hygiene, model correct behaviors for the parent and child to observe, and reinforce positive behaviors may positively affect pediatric oral health. Figure 1 represents an SCT (1981) triadic relationship using the oral health concepts presented in this project.
Search Terms

It is recognized that ECC risk is influenced by three factors: environment, cognition, and behavior. The Social Cognitive Theory (SCT), as presented by Bandura et al. (1961), explains the relationship between environment, cognition, and behavior as modifiable and was used to conduct a review of literature related to ECC prevention concerning nurse practitioners. Environmental and cognitive factors were each reviewed with current literature and applied to specific nurse practitioner intervention that may be used to define their role in promoting good pediatric oral health behaviors and preventing ECC. First, to define the current problem, a search of the current literature was conducted using SCT factors, including “environment and early childhood caries” (N=461), “cognitions and early childhood caries” (N=0), “thought and early childhood caries” (N=4) and “behavior and childhood caries” (N=107). Initially, the term “nurse practitioner and childhood caries” was searched, but was later excluded due to literature identified (N=2). Citations were then excluded based on English-only, available full-text, and abstract content that related to ECC and primary care (N=78). To identify effective preventive
practices and recommendations, a search was next conducted using the term “early childhood caries prevention” (N=6), “family practice and early childhood caries” (N=7), “fluoride and early childhood caries” (N=4), “diet and early childhood caries” (N=3), and “anticipatory guidance and early childhood caries” (N=5). Citations were excluded based on English-only, available full-text, relevant abstract content, publication within the past five years, controlled randomized trials, and practice guidelines (N=25) and were grouped and reviewed into three SCT categories: Personal/cognitive, environmental, and behavioral. Search results for preventive practices and recommendations were grouped similarly.
CHAPTER 3: RESULTS OF REVIEW

Environmental Factors

Environment is a modifiable factor of ECC development. For the purposes of this project, environment is defined as the pediatric patient’s home environment, medical environment, and social environment that influence ECC risk.

Socioeconomic Status

Children who live in homes with higher socioeconomic status [SES] develop less caries than those from lower income homes (Gerdin et al., 2008) (see Figure 4). Failure to thrive and ECC are more prevalent in areas of poverty, and negatively influence each other (Crocetti & Barone, 2004). In addition, four out five children from low-income families do not see a dentist yearly (Manski & Brown, 2007). Also, those same four out of five children account for 85% of all pediatric dental decay (Jones & Tomar, 2005). This disparity may be explained by decreased income to purchase dental items that improve dental health care and help decrease risk of ECC. Also Lack of dental insurance is associated with increased ECC risk. Children with no dental insurance are more than two times as likely to develop ECC than those with dental insurance (Ramoz-Gomez et al., 2002).

Feeding practices that vary among different income levels may contribute to increased caries risk. While mothers of low socioeconomic status have traditionally breast-fed their infants, studies have shown that rigorous formula marketing as well as an increase in mothers needing to provide working income have led to an increase in bottle-fed infants enrolled in day care (Beasley et al., 2007). Additionally, U.S. spends $50 billion annually for sweetened beverages that often offer a cheaper alternative to purchasing milk or formula (AAP, 2001).
Though decayed primary teeth may be replaced with crowns, the cost is large and many children from low income families who suffer from ECC would find difficulty affording treatment even if it were offered (Barbaro & Matear, 2008). Further, low SES is related to premature births and malnutrition, both of which may cause poor development of primary teeth and increase ECC risk (Hood et al., 2007).

**Dental Health Coverage**

Children who have no dental coverage are at higher risk for developing dental decay and ECC (USDHHS, 2000). For every one child in America without health insurance, 2.6 children lack dental insurance (USDHHS, 2003). Further, 35% of children 21 and younger have no dental health coverage (Agency for Healthcare Research and Quality, 2003), yet 78% of this group have experienced dental decay (Children’s Defense Fund, 2004). Low income families, families with parents who have low education degrees, and families of color are more likely to lack dental insurance (Agency for Healthcare Research and Quality, 2003).

Without dental insurance, or plans with high premiums have historically out of pocket costs for dental services are expensive, decreasing the number of uninsured who decide to participate in health insurance (The Kaiser Commission of Medicaid and the Uninsured, 2006), professional dental service utilization. For example, Black and Hispanic children from low-income families have greater incidence of ECC yet also have fewer dental sealants than children of other ethnicities (Beltrán-Aguilar et al., 2005).

**Lack of Referral**

Many children do not see a dentist regularly. Lack of dental insurance and dental misconceptions may place the NP as the sole health care provider for a child. As such, the NP
needs to be aware of referral need and be willing to refer to appropriate care. In addition to teaching preventive oral hygiene, proper dental referral by the NP is vitally important in promoting pediatric oral health.

Poor dental practice incentives, have led to a shortage of dentists catering to the needs of rural and low income communities where ECC risk is highest. The NP who cares for these vulnerable populations should be vitally aware of their important role in managing the oral health care of their patients which may include recruiting dentists to provide care in these areas or, when possible, referral to urban care.

Primary prevention is the key to decreasing dental treatment costs, and the NP is well-positioned to provide preventive oral health care interventions within their scope of practice and to make appropriate referrals. Delayed professional treatment may inevitably lead to decay and disease progression, and may require more expensive care (Lee et al., 2006). Therefore, the NP must be educated to recognize the beginning stages of ECC, understand barriers to dental insurance access and be willing to support and refer as necessary.

Dental Health Provider Shortage

Many general dentists are reluctant to regularly see pediatric patients because of low reimbursement rates and insufficient pediatric training (Griffin et al., 2007). Some dentists view pediatric patients as “difficult” and relay discomfort in pediatric dental practice (Iowa Department of Human Services, 2006). Poor reimbursement rates and insufficient pediatric training have also caused a shortage of pediatric dentists (pedodontists). Two years of additional schooling may detract general dentists from pursuing pediatric speciality training. For children living in rural areas, the shortage is more pronounced. Which often requires hours of
travel to receive age-appropriate treatment. Many rural residents do not make the travel at all, relying on local services alone, which are often insufficient (Chan et al., 2006). Further complicating matters, only a fraction of pedodontists participate in Medicaid and SCHIP programs related to reimbursement issues (Pierce et al., 2002). Advocating the improvement of pediatric dental provider availability and reimbursement will facilitate the NP in providing an environment that reduces the prevalence and effects of ECC.

Lack of Community Involvement

Communities with fluoridated water experience less pediatric caries than communities without fluoridated water (ADA, 2008). The Surgeon General has proclaimed that “Fluoridation is the single most effective public health measure to prevent tooth decay and improve oral health over a lifetime, for both children and adults” (ADA, 2008). Poor and rural communities may view water fluoridation too costly, however, without understanding its positive economic effects. Other communities may believe the benefit of healthier teeth not worth the risk of fluorosis. Additionally, some communities do not utilize school-room settings for dental learning or provide new mothers with dental resources for their newborns. Communities must become more involved in promoting the dental healthcare of their children to decrease ECC risk.

Cognitive and Personal Factors

Cultural Differences

Though race and gender are essentially non-modifiable, cognitions and cultural practices indigenous to certain races and cultures are learned but also flexible to change. Some of the ECC risk differences may be attributed to feeding practices that vary by culture. For example, Mexican-Americans feed their children from bottles for a longer duration of the child’s life than
do White or African Americans (Brotanek et al., 2005). Perhaps resulting from this difference, Mexican-American children have greater numbers of cavities than White or African American populations (Beltrán-Aguilar et al., 2005). It is also estimated that 31% of Mexican-American children aged 6-11 have decay in their permanent teeth (US Department of Health and Human Services 2007), and are less likely to have dental insurance as compared to other races (The Dental Health Foundation, 2005). Socioeconomic differences may explain this racial difference and will be discussed later in the chapter.

**Genetic Differences**

Some children inherit a greater propensity for ECC. Every child inherits a salivary sugar protein chain sequence that attaches to the surface of the tooth and repels harmful ingested sugars, like sucrose, from attaching to the tooth surface. Some chains are weaker than others and are not as successful in repelling harmful sugars. For this reason, children with weak salivary sugar chains may be at greater risk for enamel demineralization and dental decay (Denny et al., 2006). Enamel hypoplasia, an autosomal dominant genetic disorder that causes the development of teeth with weak enamel, may also cause ECC. Another genetic risk of ECC is immune related. Infants passively acquire certain antibodies as part of their immune system that fight bacteria in the mouth. The ability and nature of these acquired antibodies will determine a child’s ability to combat ECC disease. Lastly, gender differences may also increase caries risk. Studies show that females may be more likely to develop cavities than males, although the mechanism is not clearly understood (Lulic-Dukic et al., 2001).
Behavioral Factors

Diet

High-risk dietary habits seem to be established at the early age of 12 months and are continued throughout childhood and into adulthood (Kranz et al., 2006). Fermentable carbohydrates (see Table 1) are metabolized by S. mutans on the surface of the tooth to form lactic acid which then contributes to plaque formation. When sugar-sweetened liquids are frequently consumed, ECC risk increases (Samour & Helm, 2005, p.120; Usatine, 2001). Many fermentable carbohydrates are found in liquids given to children in bottles. Milk and many formulas contain lactose, many fruit juice concentrates and soft drinks contain high-fructose corn syrup, and table sugar is often added to powdered drink mixes as part of the recipe. The American Academy of Pediatrics [AAP] (2001) estimates that 90% of children drink juice by age one. Also, only 12% of parents believe restrictions of starchy snacks and sugar-sweetened soft drinks from children are optimal for a healthier lifestyle (National Association for Sports & Physical Education, 2003). When combined with poor dental hygiene, sugar-sweetened drinks given to children in bottles increases risk of dental decay ECC (AAP, 2001). It should be noted, however, that abstinence from sugar does not decrease the risk for caries, as other behavioral factors have been proven equally causative (Burt & Pai, 2001).
Table 1. *Common Fermentable Carbohydrates*

<table>
<thead>
<tr>
<th>COMMON FERMENTABLE CARBOHYDRATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown sugar</td>
</tr>
<tr>
<td>Corn sweetener</td>
</tr>
<tr>
<td>Corn syrup</td>
</tr>
<tr>
<td>Dextrose</td>
</tr>
<tr>
<td>Fructose</td>
</tr>
<tr>
<td>Fruit juice concentrates</td>
</tr>
<tr>
<td>Glucose</td>
</tr>
<tr>
<td>High-fructose corn syrup</td>
</tr>
<tr>
<td>Honey</td>
</tr>
<tr>
<td>Invert sugar</td>
</tr>
<tr>
<td>Lactose</td>
</tr>
<tr>
<td>Maltose</td>
</tr>
<tr>
<td>Malt Syrup</td>
</tr>
<tr>
<td>Molasses</td>
</tr>
<tr>
<td>Raw sugar</td>
</tr>
<tr>
<td>Sucrose (table sugar)</td>
</tr>
<tr>
<td>Sugar</td>
</tr>
<tr>
<td>Syrup</td>
</tr>
</tbody>
</table>

Adapted from USDHHS, 2008.

Though research has been unable to directly link obesity to increased caries risk, the increase in frequency of non-nutritive, cariogenic substances among children in the United States, as evidenced by the obesity epidemic, does threaten the integrity of their overall health (Hong et al., 2008). In merely 20 years, the percentage of obese children between the ages of 6 and 11 in the United States has increased from 6.5% in 1980 to 17% in 2006 (Ogden et al., 2008). While decreased physical activity is an obvious contributor to the increase in childhood obesity, the epidemic is largely due to changes in dietary habits that are also cariogenic. Many children, for example, are increasing their energy intake in the form of increased starch and sweetened beverage consumption (Malik et al., 2006), a practice that may also contribute to caries formation.

The primary teeth of infants are especially vulnerable to dental erosion, containing weaker dental defenses than adult teeth. However, it is not the amount of sugar consumed that contributes to dental injury, but the frequency at which sugar is consumed. In the absence of oral hygiene, the more often a child is given a bottle for feeding during the day and night, the more likely that child is to develop ECC (Mazhari et al., 2007).
Frequency of Exposure

It is impossible to determine the exact time it takes for a cavity to form owing to the multifactorial etiology. However, more frequent exposures to fermentable carbohydrates do increase a child’s risk for ECC (Samour & Helm, 2005, p.120; Usatine, 2001). To meet the specific caloric requirements of a growing child, parents are often instructed to feed their child frequently throughout the day. For a much of a child’s first year, its caloric needs are met through breast milk and formula. By one to three years of age, 6 to 12 primary teeth have erupted. If the infant at this age is frequently breast or bottle fed with poor hygiene practices, its teeth will be continually immersed in fermentable carbohydrates and lead to lactic-acid induced dental decay (AAP, 2001; Mazhari et al., 2007; Samour & Helm, 2005; Usatine, 2001). No difference in increased risk for ECC has been established between breast and bottle feeding (Iida et al., 2007).
CHAPTER 4: DISCUSSION AND RECOMMENDATIONS

By intervening at the perceptual/cognitive and environmental levels, primary care NP’s will begin to improve pediatric oral health behaviors. At the cognitive level, anticipatory guidance will be provided [see Appendix A], while at the environmental level, a “medical neighborhood” will be defined [see Appendix B]. Healthy pediatric oral hygiene behaviors will be the outcome of living in a medical neighborhood that provides role models and anticipatory guidance for oral health. These factors represent the triadic relationship modeled in Bandura’s SCT (1981).

Environmental Factors

The primary care NP should be able to identify a child’s caries risk, provide oral health anticipatory guidance, refer according to assessed ECC risk, and encourage community involvement in oral health promotion within a supportive medical environment. For the purposes of this paper, such an environment is termed the “medical neighborhood”. The medical neighborhood (see Appendix B), includes all environmental aspects that contribute to a child’s overall health, including the dentist, the PCP, the parents or primary caregivers, and the child’s home and the community.

In the first 24 months of life, dentists are seen less regularly than primary care providers (Dela Cruz et al., 2004), so collaboration within a medical neighborhood is necessary for optimal growth and accomplishment of developmental milestones. In such a neighborhood, NPs are manifestly involved in the oral health of their pediatric patients through competent dental assessment, referral to professional dental care, and advocacy for community involvement in ECC prevention.
Identify Caries Risk

Most primary care providers, including NPs, do not have enough education and training in pediatric oral health risk assessment (Cruz et al., 2004), which ultimately affects referral utilization. Rozier et al. (2003) state that medical professionals must “step up to the plate” by providing three basic services for pediatric patients: caries risk assessment, fluoride varnish application, and oral health anticipatory guidance according to the child’s developmental needs and the practitioner’s scope of practice.

The oral assessment begins with a visualization of tooth surfaces, for cavitated lesions (dark yellow, brown spots) and non-cavitated lesions (white spots). White spots are the earliest signs of enamel hypoplasia and may be visible as early as 10 months of age (Douglass, J. et al., 2004). White spots are visible in 25% of children (Habibian, 2003), though this represents only a small portion of decay that may be present. Next, caries risk should be assessed with the Caries Risk Assessment Tool or CAT (2006) (see Appendix C). Created by the American Association of Pediatric Dentistry to assist PCPs in pediatric caries risk assessment, the CAT accurately identifies and minimizes causative ECC factors while optimizing protective factors (Nainar et al., 2006). It is recommended that NPs include the CAT in all pediatric charts. If the CAT is unavailable, risk may be assessed by reviewing family history, socioeconomic status, diet, and other important indicators, such as children who are medically compromised, of low birth-weight status, have special health care needs, or who take sugar-based medicines or other medications that decrease salivary flow (Sanchez et al., 2000). Oral health follow-up should assess caries risk as well as behavioral changes that have been made since the last visit to
determine the oral health care plan’s effectiveness and how consistently preventive activities are being performed.

In addition to caries risk assessment, some NPs scope of practice includes fluoride varnish application for preventive mineralization. To help buffer the effects of the current shortage, NPs in these states should become trained in applying fluoride varnish. Fluoride varnish can reverse non-caries lesions such as white spot demineralization of enamel (USDHHS, 2001). Training lasts a couple of hours and is provided by any trained health professional, including dentists, dental hygienists, physicians, nurse practitioners, or registered nurses and is also offered in a variety of web-based courses. Fluoride varnish supplies can be purchased at most local dental supply stores for a low cost. NPs who provide oral health promotion services may bill using the following Medicaid reimbursement codes: performing an oral assessment and counseling parents (CDT D0145), applying fluoride varnish (CDT D1203 or CDT D1206), and referring to dental care (AAPD, 2004; Bawden et al., 2007; Lee et al., 2006). Medicaid reimbursement for oral assessment and parental counseling prior to fluoride varnish application is $38.07, and $15.44 for varnish application (Bawden et al., 2007). Fluoride varnish application should be limited to one per 180 days from the first to the third birthday (Bawden et al., 2007).

Refer

Ideally, a “dental home” within the Medical Neighborhood is established when the first tooth erupts or by at least 12 months of age, and regular check-ups occur every 6 months or more frequently if ECC risk is high (AAPD, 2004). Even when infant ECC risk is low, dental referral should be considered mandatory around 6 months of age and no later than one year of age.
(AAPD, 2006). The dental home should be accessible, family-centered, continuous, comprehensive, coordinated, compassionate, and culturally competent (Nowak & Casamassimo, 2002), and provide preventive and corrective dental services (AAPD, “Policy on Early”, 2004). Pediatric dentition problems should initially be referred to a pedodontist who then refers to an endodontist when gingivitis or periodontitis from extensive ECC exists. Failure to refer when damage exists may lead to injury exacerbation and more expensive treatment (Lee et al., 2006).

Dental sealants are plastic coatings placed by a dentist on the chewing surface of primary or permanent teeth vulnerable to decay (usually the molars). Dental sealants are effective in preventing dental decay and may last as long as 10 years (Locker et al., 2003). Healthy People 2010, recommends that half of all 8-year-old children have at least one dental sealant by the year 2010 (USDHHS, 2000). To be cost-effective, however, dental sealants should only be placed on children with current or previous caries or who are at severe risk for ECC (Locker, et al., 2003). Currently only 30% of children have dental sealants (National institute of dental and craniofacial research, 2004). NPs should advocate for increased Medicaid reimbursement of dentists who perform sealant procedures. One study, showed a 102% increase in sealant placement when reimbursement rates were temporarily increased (Griffin et al., 2007).

Because of time constrictions, PCPs generally provide the family member with a phone number for dental referral. When time permits, however, the PCP should call the dentist to set up an appointment. After referral, follow-up should not rest with the dentist or endodontist. The NP should follow up at every subsequent well or sick child visit on their dental referrals as a continuum of care.
**Improve Access**

*Provider shortage.* The shortage of dentists catering to the needs of rural and low income communities makes referral within these areas especially challenging. Dental referral in poor and rural populations is also complicated by lack of dental insurance. The pediatric dental care provider shortage may be improved by increasing reimbursement, offering financial aid to dentists specializing in pediatric dentistry and by providing incentives for low-income and rural pediatric dental practice rural settings. Examples of incentives include subsidized tuition for pediatric specialty or lower business activation fees for low-income or rural pediatric practice. The NP who cares for vulnerable populations should also make efforts to correct this disparity by recruiting dentists to rural and low income areas and by improving access.

*No Insurance.* Though 85% of low-income children aged 1 to 4 years have had an office-based primary care visit in the past year, only 20% have visited a dental care provider (AAPD, “Policy on Early”, 2008; Jones & Tomar, 2005; McCormick et al., 2000). Because the underinsured are more likely to develop ECC (Ramoz-Gomez et al., 2002), many government-sponsored programs have been provided to increase coverage for this population. Medicaid and SCHIP (States Children’s Health Insurance Plan) are two dental insurance plans for low-income families. SCHIP is a newer program offered to families whose income is too high to qualify for Medicaid. Coverage between the two differs, though each improves the overall oral health environment. The NP should be aware of these differences when helping parents choose the best dental plan for their child’s needs. It has been suggested that the least expensive pediatric dental coverage is gained through Medicaid due to high cost-sharing and premiums enacted by SCHIP (The Kaiser Commission of Medicaid and the Uninsured, 2006). However, children with SCHIP
are 26% less likely to have untreated dental decay than children with Medicaid (Brickhouse et al., 2008).

Each insurance program offers services that will improve a child’s dental environment and Medical Neighborhood if utilized. The NP needs to be aware of these services and should advocate legislation that increases pediatric access to dental insurance. Similar legislation was recently passed after lack of dental insurance turned fatal. The Deamonte Driver case, where poor access to dental care resulted in death, inspired the “Deamonte Driver Dental Care Access Improvement Act of 2008” that expands the number of dental providers, increases the poor’s dental access, and improves caries prevention and dental data reporting (H.R.5549). NPs who educate and provide patients with dental insurance resources, and who advocate awareness of insurance disparities and action on those disparities, will be most successful in establishing a Medical Neighborhood that decreases ECC risk.

Many insurances cover sealant placement for policy holders, while the uninsured, who have the highest risk of decay (Agency for Healthcare Research and Quality, 2003; Children’s Defense Fund, 2004; USDHHS, 2000; USDHHS, 2003), pay around $20 to $50 per tooth. Perhaps high dental costs are why the poor and underinsured seek the least amount of dental preventive and corrective services of any SES (Dye, 2007). To ease costs, low-income parents should be encouraged to utilize Medicaid services, as Medicaid actually saves about $15 dollars for every tooth sealed instead of filled (Griffin et al., 2007).

Implement Guidelines

The effects of poor oral health are so prevalent yet so preventable that professional and governmental guidelines have been established to standardize dental and oral care and minimize
ECC risk. Appendix D outlines the most recent AAPD (“Policy on ECC,” 2008) pediatric dental health guidelines, adapted for application in advanced nursing practice.

_Encourage Community Involvement_

Every community should fluoridate its water. NPs should encourage their city leaders to implement or continue water fluoridation and should encourage their patients to drink less bottled water and more fluoridated water, always being sure to educate about proper fluoride ingestion levels for age by weight. Elementary schools should begin dental education and sealant programs that provide sealant services using mobile dental centers. Mobile offices gain permission to travel to schools and provide preventive services like basic dental examinations or screenings, dental cleanings, fluoride treatments, sealants and occasionally x-rays for the uninsured and children with Medicaid or SCHIP coverage (The Dental Home Initiative, 2008). Community hospitals should include a soft-bristled or rubber gum brush in diaper bags given to new mothers. Nurses caring for new mothers should provide instruction on how to properly clean the infant’s gums.

_Cognitive Factors_

Primary care NPs base practice on Florence Nightengale’s “Health promotion and Disease prevention” assertion (McDonald, 1987). To promote health and prevent disease, NPs need to teach healthy dental habits and provide services and referral that help evade illness. Healthy dental habits may be taught at any age, but will have greater impact physiologically and are more cost-effective if taught within the first six months of life (Lee et al., 2006).

NPs should initially direct thorough oral hygiene teaching towards the caregiver, as many parents view books and magazines as more informative about oral hygiene than their primary
care provider (AAPD, 2002). Parents’ dental habits are directly related to their children’s dental habits and will impact the child’s experience of ECC (Mohebbi et al., 2006). The optimal time to begin teaching healthy dental habits is before the infant is born. Practice of those habits on the infant should occur before the first tooth erupts. Once cognitively ready, the child should be included in dental teaching. Ultimately the child needs to understand and feel in control of both benefits and consequences of poor dental hygiene. The NP and parent should respect their independence while strongly encouraging and providing good example of oral hygiene.

**Provide Anticipatory Guidance**

Anticipatory guidance is defined as:

“A proactive developmentally based counseling technique that focuses on the needs of a child at each stage of life. By providing practical and contemporary health information to parents before significant physical emotional and psychological milestones, parents will anticipate impending changes, maximize their child’s developmental potential and identify their child’s special needs” (Titley, 2006).

Oral health anticipatory guidance predicts oral health needs and promotes change in pediatric oral hygiene environment and behaviors through age-appropriate learning. The oral health anticipatory guidance (summarized in Appendix A) is organized according to age and the four risk factors of ECC: diet/drink, bacterial transmission, and oral hygiene (combines the tooth and oral hygiene risk factors).

*Infant diet.* No difference in ECC risk exists between bottle-fed infants and breast-fed infants (Yonezu et al., 2006). Prolonged and frequent breast or bottle feedings, however, are
considered ECC risk indicators (Hallett et al., 2002). Both breast milk and milk-based formula contain the fermentable sugar lactose, and in the presence of S. mutans and poor oral hygiene, ECC risk is high. Soy-based formulas contain sucrose are the most cariogenic of all infant formulas and place the infant at greater risk for ECC in the absence of good oral hygiene (Al-Ahmari et al., 2003). NPs should teach mothers who breast and bottle-feed to limit the frequency of feedings, placing special emphasis on decreasing frequent night feedings. Mothers and caregivers must also be taught to clean the infant or child’s teeth or gums immediately after every feeding. If a child is sent to bed with a bottle, only water should be allowed to avoid cariogenic liquids from pooling around the teeth. Bottles should never be propped on pillows for feedings, again to prevent pooling of liquid and prolonged exposure to the harmful acids of sugar metabolism in the infant’s mouth. Infants should be weaned from the bottle around 12 months of age (AAPD, “Policy on Early,” 2008).

When the infant begins solid foods, parents should be encouraged to feed the infant or child well-balanced meals based on the U.S. Department of Agriculture’s Food Pyramid (2007). Diet should focus on whole grains, lean meats, calcium products, and fruits and vegetables with sparing use of added sugars. Snacking between meals should be limited to nutritive snacks like fresh fruits and vegetables that are naturally abrasive and help scrape plaque from teeth. Fruit juices should not be consumed until after 6 months of age and should be limited to 4-6 oz. per day (Shetty et al., 2006). Consumption of all substances should always be followed by good oral hygiene practice.

Sugar substitutes. Little is mentioned on the use of artificial sweeteners in caries prevention. Xylitol is the only sugar substitute acknowledged to be effective in preventing caries
Xylitol is easily accessible and relatively inexpensive, currently found in many chewing gums (Milgrom et al., 2006). Xylitol has been found safe for consumption in moderation (Federal Drug Administration, 2006).

**Bacterial transmission.** Transmission from the mother’s saliva to the child’s mouth is the most common form of S. Mutans spread (Berkowitz et al., 2006). Some common modes of mother-infant transmission are food, eating utensils, toys, pacifiers, bottle nipples, food, and the infant’s hands. In the child, transmission is likely to occur while sharing eating utensils or drinking cups. The earlier children acquire S. mutans, the more likely they are to develop caries (Berkowitz, 2006). Nothing that has entered the mother’s mouth should be introduced into the infant or child’s mouth unless properly cleaned. New mothers can help decrease transfer and colonization in their infants’ mouths by chewing xylitol gum four times a day (Hale, 2003).

**Expectant mothers.** Periodontal disease has been associated with preterm labor (Jeffcoat et al., 2003). Female with histories of ECC are more likely to have dental problems in adulthood and should practice good oral hygiene during pregnancy to decrease the potential of premature birth or a low birthweight infant (Jeffcoat et al., 2003). Teaching expectant mothers to brush twice daily, floss daily, and to use a non-alcoholic fluoride rinse regularly may reduce the risk of pre-term labor (Jeffcoat et al., 2003).

**Brushing.** Tooth-brushing should begin before the first tooth erupts (AAPD, “Policy on Early,” 2008). Q-tips, clean, damp washcloths or rubber-bristled finger-brushes work well for brushing the gums of an infant younger than 6-months of age. Around 6 months of age, the first tooth will erupt and a soft-bristled pediatric toothbrush may be used for dental care. Around one year of age, the child will be able to hold a toothbrush and should be encouraged to do so. The
parent or caregiver should help the child with tooth-brushing movements, particularly targeting the gum-tooth interface and back molars, and should supervise brushing until techniques are mastered. The toothbrush should be replaced every 3-4 months (ADA, 2005). Interactive toothbrushes are commercially available and provide positive reinforcement for establishing healthy dental behaviors in children. Once weaned from the bottle, the teeth should be brushed twice a day for two minutes during each brushing. To help the child understand this length of time, a two-minute sand timer, stopwatch, or toothbrush with a built-in timer may be used. For children younger than two years of age who are not exposed to fluoridated water and who are not taking fluoride supplements, a small, smear-sized amount of fluoride-based toothpaste is appropriate and spitting is not necessary (Adair, 2006).

_Dentifrice._ Dentifrice, or toothpaste, is not indicated until teeth have erupted to minimize the risk of fluorosis (AAPD, “Policy on early,” 2008; AAPD, “Guideline on fluoride,” 2008; ADA, 2006; Adair, 2006). Children less than two years of age who have erupted teeth may be given fluoridated dentifrice in small smear quantities (American Dental Association [ADA], 2008). A pea-sized amount of fluoridated dentifrice may used for children greater than two years of age or when the child is able to spit on command (Adair, 2006). To maximize the beneficial topical effects of fluoride in dentifrice, rinsing after spitting should be kept at a minimum (Scottish Intercollegiate Guideline Network, 2005). Many flavored dentrifices are available and though effective in increasing brushing frequency, may encourage the child to overuse or swallow (Franzman et al., 2004). Close supervision of tooth-brushing is always necessary until the child demonstrates proper technique.
Fluoride. Ingested fluoride ions decrease risk of ECC by inhibiting S. mutans reproduction and by fortifying enamel (ADA, 2005). Fluoride may enter the body systemically (fluoridated water) or topically (i.e. dentrifice, rinses, varnish, gels, foams). A recommended amount of fluoride should be ingested each day to prevent dental caries, the dosage varying by age and level of fluoride in local drinking water (see Table 2). Prescription fluoride supplementation is only necessary for preschool children greater than 6 months of age whose primary water source lacks fluoride (U.S. Agency for Healthcare Research and Quality 2004 Recommendations, 2004; AAPD, 2007).

Table 2. AAPD Fluoride Supplementation Guidelines

<table>
<thead>
<tr>
<th>Age</th>
<th>*Fluoride ion level in drinking water in ppm #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn-6 months</td>
<td>&lt;0.3 ppm</td>
</tr>
<tr>
<td>6 months to 3 years</td>
<td>0.25 mg/day*</td>
</tr>
<tr>
<td>3 years-6 years</td>
<td>0.50 mg/day</td>
</tr>
<tr>
<td>6 -16 years</td>
<td>1.0 mg/day</td>
</tr>
</tbody>
</table>

# 1.0 ppm=1mg/L
*2.2 mg of sodium fluoride contains 1.0 mg fluoride ion


*The fluoride level in any U.S. city may be obtained at http://apps.nccd.gov/MWF/Index.asp.

Children given fluoride supplements may experience fluorosis if fluoridated water is ingested regularly or if fluoridated toothpaste is frequently swallowed (AAPD, “Enamel Fluorosis,” 2008). Though pea-sized amounts of fluoride toothpaste may be used beginning at age two, fluoride rinse should not be used before six years of age, because children at this age and younger are more likely to swallow before spitting (ADA, 2006). Enamel fluorosis is a discoloration of permanent teeth, and is becoming more prevalent in American children (ADA,
Fluorosis does not affect teeth that have already erupted but affects those in development, placing infants with developing primary teeth and school-age children with developing permanent teeth at especially high risk (AAPD, 2008). To prevent the probability of fluorosis, caregivers of formula-fed infants should mix formula with purified, demineralized, deionized, distilled or reverse osmosis filtered water (ADA, 2008). Fluorosis may be treated cosmetically by a dentist with bleaching or microabrasion.

Other topical forms of fluoride are available in both dental and physician or NP offices. Fluoride varnish, for example, is available in some primary care settings and may be topically painted on the tooth by trained NPs when a tooth becomes highly sensitive or develops weakened enamel. Fluoride varnish comes in a variety of flavors, convenient when treating a pediatric patient (Association of State and Territorial Dental Directors, 2007). The varnish continues to soak into the tooth’s enamel for 24 hours and provides fortifying effects for several months. In order to effectively prevent decay, the varnish should be applied at least twice a year (USDHHS, 2001).

Water fluoridation in communities protects against ECC, particularly in children of low income (ADA, “Fluoride Facts,” 2005). On average, water fluoridation costs $0.50 per person per year, though every $1 used for water fluoridation saves $38 in dental costs (Griffin et al., 2001). Bottled water lacks important fluoride molecules, and when consumed exclusively, places the child at risk for underdeveloped enamel (ADA, 2005, “Fluoride Facts”). Consumption of bottled water should be kept at a minimum in a child whose fluoride exposure is low to decrease ECC risk.
**Flossing.** Regular flossing is a preventive measure that should begin when brushing no longer reaches all tooth surfaces or when two erupted teeth touch (AAPD, “Policy On Early,” 2008). Lack of coordination prohibits the infant or child from performing proper flossing action, so the parent should be taught correct flossing techniques for improved home hygienic practice.

**Address Preconceptions**

The NP should educate and reassure every family and child about the appropriateness of regular dental hygiene and the establishment of a dental home. Frequent exposure to dental care may allay the child’s fear and anxiety related to dental procedures (AAPD, 2007). Pictures of ECC are especially effective in changing behavior and when shown to the parent may increase understanding of poor dental care effects (Young, 2004). The NP should remind the parent that follow-up on dental care will occur at every primary care visit, inducing parental awareness and accountability for the infant or child’s dental hygiene.
CHAPTER 5: STRENGTHS AND LIMITATIONS

Strengths of the project include the use of Bandura’s Social Cognitive Theory (1986) to identify factors that affect behavior for specific application to promoting pediatric oral health and preventing ECC. All recommendations specific to nurse practitioners [Appendix A] the were then reviewed by a pediatric dentist.

The project was limited to studies included in the Pub Med database only. The author recognizes that other databases may have more insight to offer. The project was also limited by the small amount of research studies related to nurse practitioners and oral health. Though nurse practitioners promote all aspects of pediatric health, research has traditionally excluded oral health when defining the nurse practitioner and clinical improvement.

Significance to Nurse Practitioners

While the NP is not meant to replace the dentist, assessing oral health properly, teaching effectively, and referring, advocating, and collaborating appropriately are all important in improving ECC incidence and pediatric quality of life. Primary care NPs are often the first and sometimes the only to assess the behaviors, cognitions, and environment that affect a child’s dentition and oral health. Yet the NP’s dental health scope of practice is poorly defined. As primary care providers, NPs are critical in recognizing caries risk, assessing the oral cavity, providing ECC prevention and guidance to correct cognitions and behaviors, and referring to professional care within a healthy and supportive dental environment.

Future Study

Findings from this literature review may be used to used to develop a teaching module for pediatric and primary care nurse practitioners. The module would address dysfunctional
cognitive and environmental factors that promote poor oral hygiene behaviors and ECC. The module would also outline oral health anticipatory guidance and emphasize the medical neighborhood for use in practice. Future research may include how NPs with fluoride varnish training statistically reduce the number of caries experienced by pediatric patients. Study may also be conducted on dental referral rate within primary care and the subsequent ECC rate.

Conclusion

Unlike asthma, hay fever, and most chronic diseases, ECC is completely preventable by straightforward and relatively simple behavioral changes that are influenced by cognitive and environmental factors (Bandura et al., 1961). The nurse practitioner provides primary care that certainly encompasses dental care and is important in providing oral anticipatory guidance that influences cognitive factors for the prevention and treatment of ECC. The NP must also encourage and participate in a Medical neighborhood that promotes health dental behaviors and that recognizes dentists as partners in ECC prevention. The result will be a supportive environment that encourages ECC prevention behaviors and provides practical advantages for the pediatric patient, NP, dentist, and community.
### APPENDIX A

**ECC ANTICIPATORY GUIDANCE**

<table>
<thead>
<tr>
<th align="left">Anticipatory Guidance to Share with Pregnant Women, New Mothers, or Other Intimate Caregivers</th>
<th align="left">FOOD/NUTRITION</th>
</tr>
</thead>
<tbody>
<tr>
<td align="left">- Eat healthy foods during planned meals and snacks, and limit eating (grazing) in between.</td>
<td align="left">- Eat fruit, vegetables, grain products (especially whole grain), and dairy products (milk, cheese, cottage cheese, and unsweetened yogurt).</td>
</tr>
<tr>
<td align="left">- Eat foods containing sugar at mealtimes only, and limit the amount. Frequent consumption of foods high in sugar, such as candy, cookies, cake, and sweetened beverages (e.g., fruit drinks, soda), and fruit juice increases the risk for tooth decay. In addition, frequent consumption of foods that easily adhere to the tooth surface, such as dried fruit, fruit roll-ups, and candy, increases the risk for tooth decay. When checking for sugar, look beyond the sugar bowl and candy dish. A variety of foods contain one or more types of sugar, and all types of sugars can promote tooth decay.</td>
<td align="left"></td>
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<tr>
<td align="left">- Choose fruit rather than fruit juice to meet the recommended daily fruit intake. Drink fruit juice at mealtimes only, if at all.</td>
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<tr>
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<td align="left">DRINK</td>
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<tr>
<td align="left">- Avoid carbonated beverages during pregnancy and for the first 30 months of the infant's life.</td>
<td align="left">- Drink fluoridated water (via a community fluoridated water source) to prevent tooth decay; for families that prefer bottled water, drink a brand in which fluoride is added at a concentration of approximately 0.7 to 1.2 mg/L (ppm).</td>
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<tr>
<td align="left"></td>
<td align="left">TRANSMISSION</td>
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<tr>
<td align="left">- Once the infant is born, to prevent transmission of bacteria that cause tooth decay from the parent (especially the mother) via saliva to the infant, avoid testing the temperature of the bottle with the mouth, sharing utensils (e.g., spoons), or cleaning a pacifier or bottle nipple with saliva.</td>
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<td align="left">ORAL HYGIENE</td>
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<tr>
<td align="left">- Brush teeth twice a day with fluoridated toothpaste and floss daily.</td>
<td align="left">- Spit excess toothpaste after brushing and do not brush.</td>
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<tr>
<td align="left">- Rinse every night with alcohol-free OTC fluoride mouth rinse.</td>
<td align="left">- Have a dental visit for an exam and restoration of all active decay ASAP.</td>
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<tr>
<td align="left">- Educate mother about hormonal changes during pregnancy that can increase a woman's risk for gingivitis.</td>
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<table>
<thead>
<tr>
<th align="left">Anticipatory Guidance to Share with Parents of Infants</th>
<th align="left">FEEDING</th>
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</thead>
<tbody>
<tr>
<td align="left">- Breastfeed the infant exclusively for approximately the first 6 months of life. Breastfeeding can be continued until age 12 months, or as long as the mother and infant wish to continue. For mothers who cannot breastfeed or choose not to breastfeed, feed the infant a prepared infant formula. No additional nutrients are needed.</td>
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<tr>
<td align="left">- Do not put the infant to sleep with a bottle or sippy cup or allow frequent and prolonged bottle feedings or use of sippy cups containing beverages high in sugar (e.g., fruit drinks, soda, fruit juice), milk, or formula during the day or at night to prevent sugary fluids from pooling around the teeth, which can increase the infant's risk for tooth decay.</td>
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<tr>
<td align="left">- Hold the infant while feeding. Make sure to never prop a bottle (that is, use pillows or any other objects to hold a bottle in the infant's mouth).</td>
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<tr>
<td align="left">- Never add cereal to a bottle. This causes sugary fluids to pool around the teeth.</td>
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</table>
Anticipatory Guidance to Share with Parents of Infants…Cont.

**FEEDING**
- Feed the infant solid foods with a spoon or fork, or, once the infant is able, encouraging self-feeding.
- Introduce a small cup when the infant can sit up without support.
- Wean the infant from the bottle as the infant begins to eat more solid foods and drink from a cup. Begin to wean the infant gradually, at about age 9-10 months. By age 12-14 months, most infants can drink from a cup.

**Diet/Nutrition**
- Do not introduce juice into infants' diets before age 6 months. Serve the infant juice in a cup, and limit juice to 4 to 6 oz per day. Serve 100 percent fruit juice or reconstituted juice.
- For infants ages 6 months and older, serve age-appropriate healthy foods during planned meals and snacks, and limit eating (grazing) in between.
- Serve foods containing sugar at mealtimes only (not between meals), and limit the amount. Frequent consumption of foods high in sugar, such as candy, cookies, cake, sweetened beverages (e.g., fruit drinks, soda), and fruit juice increases the risk for tooth decay. In addition, frequent consumption of foods that easily adhere to the tooth surface, such as fruit-roll-ups and candy, increase the risk for tooth decay. A variety of foods contain one or more types of sugar, and all types of sugars can promote tooth decay.

**Transmission**
- To prevent the transmission of bacteria that cause tooth decay from the parent (especially the mother) via saliva to the infant, avoid testing the temperature of the bottle with the mouth, sharing utensils (e.g., spoons), or cleaning a pacifier or a bottle nipple with saliva.

**Oral Hygiene**
- Make an appointment for the infant’s first dental visit within 6 months of eruption of the first tooth and no later than 12 months of age.
- After initial dental visit make future appointments based on the schedule suggested by the dentist, based on the infant’s individual needs.
- Clean infant’s gums with a clean damp cloth or an infant toothbrush with a small head using plain water after each feeding.
- Brush infant’s teeth as soon as the first tooth erupts usually at the age of 6-10 months twice a day using a soft bristled toothbrush designed for infants.
- Give infant nothing to eat or drink after brushing, except water.
- For infants with increased risk for tooth decay, consult a dentist, physician, or nurse practitioner about brushing with fluoridated toothpaste.
- Become familiar with the normal appearance of the infant’s teeth and gums so problems can be identified if they occur (check once a month).
- Give the infant 6 months or older fluoride supplements but only as recommended by a dentist, physician or nurse practitioner (based on water fluoride level).
- In case infant has sore gums caused by tooth eruption, give infant a clean teething ring, cool spoon, or cold, wet washcloth, or even rub his gums with a clean finger.

Anticipatory Guidance to Share with Parents of Young Children

**Feeding**
- Continue to encourage the child to drink from a cup. Wean the child from the bottle by age 12-14 months.
- Do not put the child to sleep with a bottle or sippy cup or allow frequent and prolonged bottle feedings or use of sippy cups containing beverages high in sugar (e.g., fruit drinks, soda, fruit juice), milk, or formula during the day or at night to prevent sugary fluids from pooling around the teeth, which can increase the child's risk for tooth decay.
### DIET/NUTRITION
- Serve age-appropriate healthy foods during planned meals and snacks, and limit eating (grazing) in between.
- Serve fruit, vegetables, grain products (especially whole grain), and dairy products (milk, cheese, cottage cheese, and unsweetened yogurt).
- Serve foods containing sugar at mealtimes only (not between meals), and limit the amount. Frequent consumption of foods high in sugar, such as candy, cookies, cake, sweetened beverages (e.g., fruit drinks, soda), and fruit juice increases the risk for tooth decay. In addition, frequent consumption of foods that easily adhere to the tooth surface, such as fruit-roll-ups and candy, increase the risk for tooth decay.
- When checking for sugar, look beyond the sugar bowl and candy dish. A variety of foods contain one or more types of sugar, and all types of sugars can promote tooth decay.
- Encourage the child to eat fruit rather than drink fruit juice to meet the recommended daily fruit intake.

### DRINK
- Serve the child juice in a cup, and limit the child's consumption of juice to 4 to 6 oz per day. Serve 100 percent fruit juice or reconstituted juice.
- If the child drinks beverages between meals, encourage the child to drink water or milk rather than fruit juice or sweetened beverages (e.g., fruit drinks, soda).
- Drink fluoridated water (via a community fluoridated water source) to prevent tooth decay; for families that prefer bottled water, drink a brand in which fluoride is added at a concentration of approximately 0.7 to 1.2 mg/L (ppm).

### TRANSMISSION
- To prevent the transmission of bacteria that cause tooth decay from the parent (especially the mother) via saliva to the child, avoid sharing utensils (e.g., spoons) or cleaning a pacifier or a bottle with a nipple with saliva.

### ORAL HYGIENE
- If the child has not yet been for a dental visit make an appointment for the first dental visit.
- After initial dental visit make future appointments based on the schedule suggested by the dentist, based on the child’s individual needs
- For children under the age of two brush the teeth twice a day with plain water.
- For children with increased risk for tooth decay, consult a dentist, physician, or nurse practitioner about brushing with fluoridated toothpaste.
- For children ages 2 and above brush teeth twice a day with no more than a pea-sized amount of fluoridated toothpaste and make him spit but not rinse.
- Young children cannot clean teeth without parental help, so they need to be helped as brushing requires fine motor skills (around 7-8 years).
- Become familiar with the normal appearance of the child’s teeth and gums so problems can be identified if they occur (check once a month).
- Give the child fluoride supplements but only as recommended by a dentist, physician or nurse practitioner based on the level of risk and that of fluoride in the drinking water.
- Discuss with a dentist or other qualified health professional the need to apply fluoride topically.
- Discuss with a dentist or other qualified health professional the need to apply dental sealants.
- In case child has sore gums from tooth eruption, give cooled teething ring, cool spoon, cold or wet washcloth, or even rub his gums with a clean finger.
APPENDIX B
THE MEDICAL NEIGHBORHOOD

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<tr>
<th>ACCESSIBLE</th>
<th>FAMILY CENTERED</th>
<th>CONTINUOUS</th>
<th>COMPREHENSIVE</th>
<th>COORDINATED</th>
<th>COMPASSIONATE</th>
<th>CULTURALLY COMPETENT</th>
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<tbody>
<tr>
<td>Primary and dental healthcare provided in child’s community</td>
<td>Recognition of centeredness of family</td>
<td>Same primary care and dental care provider form infancy through adolescence.</td>
<td>Primary and dental healthcare available 24 hours/day 7 days/week</td>
<td>Families linked to support education and community services</td>
<td>Families linked to support education and community services</td>
<td>Express and demonstrated concern for child</td>
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<td>All insurance accepted and changes in coverage or lack of insurance accommodated</td>
<td>Unbiased complete information is shared continuously</td>
<td>Assistance provided with transitions (i.e. to school)</td>
<td>Preventive primary and tertiary care referred or provided</td>
<td>Information centralized</td>
<td>Information centralized</td>
<td>Cultural background recognized, valued and respected</td>
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<tr>
<td>Source of care is close to home and accessible to family</td>
<td>Low parent child anxiety improves care</td>
<td>Appropriate referral/recall intervals are based on child’s needs</td>
<td>Emergency access is ensured</td>
<td>Records centralized</td>
<td>NP and dentist-child relationships are established</td>
<td>Cultural background recognized, valued and respected</td>
</tr>
<tr>
<td>Minimal hassle encountered with payment</td>
<td>Anticipatory guidance and care protocols are comfortable to family</td>
<td>Continuity of care is better owing to the referral/recall system</td>
<td>Care manager and primary NP or dentist are in local area</td>
<td>School, workshop, therapy linkages established and known (fluoride services, sealant programs)</td>
<td>Family relationship is established with NP and dentist</td>
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<tr>
<td>Office ready for referral/treatment in emergency situations</td>
<td>Appropriate role of parents in home care is established</td>
<td>Coordination of complex dental treatment is possible (traumatic injury)</td>
<td>Intervention based on environmental, cognitive, and behavioral factors</td>
<td>Environment, cognitions, and behavior assessed and NP efforts made to find healthy balance</td>
<td>Children less anxious owing to familiarity of NP and dentist</td>
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<tr>
<td>Office non biased in dealing with children with special health care needs</td>
<td>Positive behavior rewarded in home and office for reinforcement and probability of long-term change</td>
<td>Liaison with medical providers for CSHCN is improved (congenital heart disease)</td>
<td>Positive behavior reinforced</td>
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<tr>
<td>NP and dentist know community needs and resources (fluoridation, sealant programs)</td>
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PRACTICAL ADVANTAGES

- Source of care is close to home and accessible to family
- Minimal hassle encountered with payment
- Office ready for referral/treatment in emergency situations
- Office non-biased in dealing with children with special health care needs
- NP and dentist know community needs and resources (fluoridation, sealant programs)
- Low parent child anxiety improves care
- Anticipatory guidance and care protocols are comfortable to family
- Appropriate role of parents in home care is established
- Positive behavior rewarded in home and office for reinforcement and probability of long-term change
- Appropriate referral/recall intervals are based on child’s needs
- Continuity of care is better owing to the referral/recall system
- Coordination of complex dental treatment is possible (traumatic injury)
- Liaison with medical providers for CSHCN is improved (congenital heart disease)
- Positive behavior reinforced
- Emergency access is ensured
- Care manager and primary NP or dentist are in local area
- Intervention based on environmental, cognitive, and behavioral factors
- Records centralized
- School, workshop, therapy linkages established and known (fluoride services, sealant programs)
- Environment, cognitions, and behavior assessed and NP efforts made to find healthy balance
- NP and dentist-child relationships are established
- Family relationship is established with NP and dentist
- Children less anxious owing to familiarity of NP and dentist
- Mechanism is established for ongoing care
- Specialized are known and established if needed
- Staff may speak different languages and know health/dental terminology

- Cultural background recognized, valued and respected

### APPENDIX C

**Caries Risk Assessment Tool**


#### Risk Indicators

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<thead>
<tr>
<th>Level of Means</th>
<th>High</th>
<th>Moderate</th>
<th>Low</th>
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</table>
| **Radiographic Exam**
| Absent | Present |
| **Enamel Defects**
| Absent | Present |
| **Hypomineralization (White Spots Lesions)**
| Absent | Present |
| **Visible plaque on anterior teeth**
| Absent | Present |

#### Part 1 - History (determined by reviewed the medical record/caregiver)

- **Fluoride exposure:** No, yes
- **Tartar control:** Daily brushing, No or irregular brushing
- **Smoking:** Yes, No
- **Note:** One or more systemic illness, Yes, No
- **Medications:** Yes, No
- **Socio-economic status:** Middle class, Low, High
- **Child’s mother:** Yes, No
- **Child’s father:** Yes, No
- **Child’s age:** <2 years, 2-4 years
- **Child’s home**
  - **Teeth cleansed:** Yes, No
  - **Home oral hygiene program:** Yes, No
  - **Teeth brushed:** Yes, No
  - **Supervised brushing:** Yes, No
  - **Use of fluoride toothpaste:** Yes, No
  - **Use of fluoride mouth wash:** Yes, No

#### Part 2 - Clinical Evaluation (determined by examining the child’s mouth)

<table>
<thead>
<tr>
<th>Component</th>
<th>Yes</th>
<th>No</th>
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APPENDIX D

PRIMARY CARE DENTAL HEALTH GUIDELINES

1. All nurse practitioners who serve mothers and infants should provide parent/caregiver education on the etiology and prevention of early childhood caries (ECC). Oral health counseling during pregnancy is especially important for the mother.

2. The infectious and transmissible nature of bacteria that cause early childhood caries and methods of oral health risk assessment (the Caries-risk Assessment Tool [CAT]), anticipatory guidance, and early intervention should be included in the curriculum of all advanced practice nursing, health professional programs.

3. Every infant should receive an oral health risk assessment from his/her primary health care provider or qualified health care professional by 6 months of age. This initial visit should consist of the following:
   - Assessing the patient’s risk of developing oral disease using CAT
   - Providing education on infant oral health
   - Evaluating and optimizing fluoride exposure

4. Parents or caregivers should establish a dental home for infants by 12 months of age. The following should be accomplished at that visit:
   a. Recording thorough medical (infant) and dental (mother or primary caregiver and infant) histories
   b. Completing a thorough oral examination
   c. Assessing the infant’s risk of developing dental disease using CAT and determining an appropriate prevention plan and interval for periodic reevaluation based upon that assessment
   d. Providing anticipatory guidance regarding dental and oral development, fluoride status, nonnutritive sucking habits, teething, injury prevention, oral hygiene instruction, and the effects of diet on the dentition
   e. Planning for comprehensive care in accordance with accepted guidelines and periodicity schedules for pediatric oral health (“Clinical guideline on periodicity,” 2004)
   f. Referring patients to the appropriate health professional if intervention is necessary

Health care professionals and all stakeholders in children’s health should support the identification of a dental home for all infants at 12 months of age.

REFERENCES


