oral health

During Pregnancy & Early Childhood:

Evidence-Based **Guidelines** for Health Professionals

February

2010

Acknowledgments:

The CDA Foundation would like to thank the project's co-chairs, Advisory Committee and expert panel for their dedication to this project. Also, special thanks to the numerous practitioners who participated in the development process by providing careful and thoughtful review of draft documents prior to publication.

Oral Health During Pregnancy and Early Childhood: Evidence-Based Guidelines for Health Professionals was supported through a generous grant from the California HealthCare Foundation and support from First 5 California, Sierra Health Foundation and Anthem Blue Cross Foundation.

These Perinatal* Oral Health Practice Guidelines are intended to assist health care professionals in private, public and community-based practices in delivering oral health services to pregnant women and their children, and are based on a review of the current science-based literature. Their development was guided by a group of state and national medical, dental and public health experts and organizational representatives brought together through a collaborative process by the California Dental Association Foundation and the American College of Obstetricians and Gynecologists, District IX. This document first presents the Guidelines in a quick-to-read bullet format, and then follows with the supporting evidence and references for readers interested in the rationale behind the Guidelines. Several useful forms, such as a client referral form for pregnant women, are included in the Appendices as is a glossary of terms. Recommendations for systems improvement and public policy changes are addressed in a document accompanying these Guidelines.

Background

Good oral health and control of oral disease protects a woman's health and quality of life before and during pregnancy, and has the potential to reduce the transmission of pathogenic bacteria from mothers to their children. Yet many women do not seek—and are not advised to seek—dental care as part of their prenatal care, although pregnancy provides a "teachable moment" as well as being the only time some women are eligible for dental benefits. Barriers and limits to improving oral health and utilizing oral health services for pregnant women and their children are multifaceted and complex, and the factors relate both to the health care system and to the client herself.

Prenatal and oral health providers are limited in providing oral health care during pregnancy by their lack of understanding about its impact and safety. Many dentists needlessly withhold or delay treatment of pregnant patients because of fear about injuring either the woman or the fetus—or because of fear of litigation. Because they have not been trained to understand the relationship between oral health and overall health, many prenatal providers fail to refer their patients regularly to dental providers. A coordinated effort between the oral health and prenatal communities can benefit maternal and child oral health outcomes.

* While the term "perinatal" generally refers to the period around childbirth (i.e., three months prior to and a month following), it is used in this document to more broadly include the entire prenatal and postpartum periods. In its *broadest* sense of maternal and child health, "perinatal" could include time after and between pregnancies.

Key Findings

Current understanding of maternal and fetal physiology indicates that the benefits of providing dental care during pregnancy far outweigh potential risks. Prevention, diagnosis and treatment of oral diseases, including needed dental radiographs and use of local anesthesia, are highly beneficial and can be undertaken during pregnancy with no additional fetal or maternal risk when compared to the risk of not providing care. The American Academy of Periodontology, for example, urges oral health professionals to provide preventive services as early in pregnancy as possible and to provide treatment for acute infection or sources of sepsis irrespective of the stage of pregnancy. The timing of such care is vital given that the oral health of pregnant women has the potential to impact the oral health status of their children. Further, assessment of oral health risks in infants and young children with appropriate intervention, along with anticipatory guidance for parents and other caregivers, has the potential to prevent the transmissibility and development of early childhood caries (ECC).

The most common complications of pregnancy include spontaneous abortion (miscarriage), preterm birth, preeclampsia and gestational diabetes. The current scientific studies, referenced in this document, regarding these conditions related to dental care indicate:

- Control of oral diseases in pregnant women has the potential to reduce the transmission of oral bacteria from mothers to their children.
- There is no evidence relating early spontaneous abortion to first trimester oral health care or dental procedures.
- Preeclampsia is a challenging condition in the management of the pregnant patient, but preeclampsia is not a contraindication to dental care.
- While research is ongoing, the best available evidence to date shows that periodontal treatment has no effect on birth outcomes of preterm labor and low preterm birthweight and is safe for the mother and fetus.
- Best practice suggests that because it has been shown to be safe and effective in reducing periodontal disease and periodontal pathogens, periodontal care should be provided during pregnancy.

Consequently, the following consensus statement was developed by the expert panel convened to create these Guidelines:

Perinatal Oral Health Consensus Statement

Prevention, diagnosis and treatment of oral diseases, including needed dental radiographs and use of local anesthesia, are highly beneficial and can be undertaken during pregnancy with no additional fetal or maternal risk when compared to the risk of not providing care. Good oral health and control of oral disease protects a woman's health and quality of life and has the potential to reduce the transmission of pathogenic bacteria from mothers to their children.

These Perinatal Oral Health Practice Guidelines are based on the clinical evidence for the importance of oral health care for women and their children before and during pregnancy and early childhood. They apply to health care providers and other professionals in public, private and community-based practices. The Guidelines are organized by provider type (with some unavoidable duplication). Where possible, the material was adapted from the 2006 New York State Department of Health "Oral Health Care During Pregnancy and Early Childhood Practice Guidelines," and supplemented, updated and rewritten based on current evidence.

Prenatal Care Professionals

Oral health care services should be routinely integrated with prenatal care services for all pregnant women.

Prenatal care professionals are encouraged to take the following actions for pregnant women:

- Educate the pregnant woman about the importance of her oral health, not only for her overall health, but also for the oral health of her children.
- Provide education and dental referrals for oral health care, understanding that such care may have relatively low priority for some women, particularly those challenged by financial worries, unemployment, housing, intimate partner violence, substance abuse or other life-stressors.
- Ask the woman if she has any concerns/fears about getting dental care while pregnant. Based on her response, be ready to inform her that dental care is safe during pregnancy and address specific concerns.
- Advise the pregnant woman that:
  - Prevention, diagnosis and treatment of oral diseases (including needed dental X-rays and use of local anesthesia) are highly beneficial and can be undertaken any time during pregnancy with no additional fetal or maternal risk as compared to not providing care.
  - Dental care can improve her overall health and the health of her developing fetus and her children.

- Determine and document in the prenatal record whether the patient is already under the care of an oral health professional; if a referral is needed, make a referral and document this in the prenatal record.
- Encourage all women at the first prenatal visit to schedule a dental examination if one has not been performed in the past six months, or if a new condition has developed or is suspected.
- Facilitate dental care by providing written consultation or an oral health referral form (see sample in Appendix A). While many medical providers understand there is no need for dentists to consult with an MD for routine dental care on a healthy patient, such a form from the obstetrical provider reassures the patient as well as the dentist that dental care is acceptable/permissible during pregnancy. Include this form as part of routine new-prenatal patient paperwork.
- Obtain or develop and maintain a list of community dental referral sources that will provide services for pregnant women, particularly for women enrolled in publicly funded programs (e.g., Medicaid).
- As a routine part of the initial prenatal examination, conduct and document an oral health assessment of the teeth, gums, tongue, palate and mucosa.
- Share appropriate clinical information with the oral health professional and answer questions that the oral health professional may ask about a patient or condition.
- Encourage and support all women to adhere to the oral health professional's recommendations for appropriate treatment and follow-up care for oral disease.
- Encourage and support a woman's decision to breastfeed, providing appropriate oral hygiene instructions for after feeding, and have ready access to resources.
- Educate women and encourage behaviors that support good oral health:
  - Brushing teeth twice daily with fluoridated toothpaste, especially before bedtime, and flossing daily.
  - Taking prenatal vitamins, including folic acid to reduce the risk of birth defects such as cleft lip and palate, and eating foods high in protein, calcium, phosphorus and vitamins A, C and D.
  - Chewing xylitol-containing gum or other xylitol-containing products, four to five times a day, after eating.

- Not delaying necessary dental treatment.
- Limiting foods containing fermentable carbohydrates—sugars (including fruit sugars), cookies, crackers, chips—to mealtimes only. Frequent between-meal consumption of these foods increases caries risk.
- Limiting drinking juice, soda, sports drinks or carbonated drinks (including diet soda) between meals. These drinks contain sugar that can cause caries. Even diet sodas contain acids that can weaken the enamel of teeth, especially those containing caffeine and citric acid.

- Advise pregnant women experiencing frequent nausea and vomiting to reduce erosion of tooth surfaces by:

  - Eating small amounts of nutritious yet noncariogenic foods—snacks rich in protein, such as cheese—throughout the day.
  - Using a teaspoon of baking soda (sodium bicarbonate) in a cup of water to rinse and spit after vomiting, avoiding tooth brushing directly after vomiting as the effect of erosion can be exacerbated by brushing an already demineralized tooth surface.
  - Using gentle tooth brushing and fluoride toothpaste twice daily to prevent damage to demineralized tooth surfaces.
  - Using a fluoride-containing mouth rinse immediately before bedtime to help remineralize teeth.

- Advise women that the following actions may reduce the risk of caries in their children:

  - Wiping an infant's gums or teeth, especially along the gum line, with a soft cloth after breast or bottle feeding.
  - Brushing the child's teeth using a pea-sized (the size of a child's pinky nail) amount of toothpaste, especially before bedtime. Children older than 2 should use fluoride toothpaste; children younger than 2 should use a smear of fluoride toothpaste on the brush only if they are at moderate to high risk of developing caries.
  - Helping a child brush their teeth until they are about 7 years old.
  - Avoiding putting the infant to bed with a bottle or sippy cup containing anything other than water.
  - Avoiding saliva-sharing behaviors, such as kissing the baby on the mouth, sharing a spoon when tasting baby food, cleaning a dropped pacifier by mouth or wiping the baby's mouth with a cloth moistened with saliva. For older children, avoiding the sharing of straws, cups or utensils.

- Using a bottle or sippy cup between meals containing only water.
- Begin weaning children from at-will bottle and sippy cup use (such as in an effort to pacify a child's behavior) by about 12 months of age.
- Choosing fresh fruit rather than fruit juice to meet the recommended daily fruit intake.
- Regularly lifting the lip and looking in their child's mouth for white or brown spots on the teeth.

- Encourage women to learn more about oral health during pregnancy and early childhood by accessing available consumer information including reputable Web sites.

- Advise and encourage the woman to obtain necessary follow-up dental care and oral health maintenance during the postpartum period and thereafter.

Oral Health Care Professionals

The role of oral health professionals includes providing preventive services and restorative treatment along with anticipatory guidance for pregnant women and their children. Oral health professionals should render all needed dental services to pregnant women.

> Pregnancy is not a reason to defer routine dental care or treatment of oral health problems.

It is not necessary to have approval from the prenatal care provider for routine dental care of a healthy patient.

Oral health professionals are encouraged to take the following actions for pregnant women:

- Provide education and dental referrals for oral health care, understanding that such care may have relatively low priority for some women, particularly those challenged by financial worries, unemployment, housing, intimate partner violence, substance abuse or other life-stressors.
- Ask the woman if she has any concerns/fears about getting dental care while pregnant. Based on her response, be ready to assure her that dental care is safe during pregnancy and address specific concerns.
- Advise the pregnant woman that prevention, diagnosis and treatment of oral diseases, including needed dental X-rays and use of local anesthesia, are highly beneficial and can be undertaken with no additional fetal or maternal risk when compared to not providing care.
- Plan definitive treatment based on customary oral health considerations, including:
  - Chief complaint and health history
  - History of tobacco, alcohol or other substance use
  - Clinical evaluation
  - Radiographs and other diagnostics when indicated

- Develop and discuss a comprehensive treatment plan that includes preventive, treatment and maintenance care throughout pregnancy. Discuss the benefits, risks and alternatives to treatments.
- Provide emergency/acute care at any time during pregnancy as indicated by oral condition.
- Perform a comprehensive periodontal examination, which includes a periodontal probing depth record.
- Consider the following as strategies to decrease maternal cariogenic bacterial load:
  - Recommend brushing teeth twice daily with fluoridated toothpaste along with fluoride mouth rinses, especially before bedtime, and flossing daily.
  - Restore untreated caries.
  - Recommend chlorhexidene mouth rinses and fluoride varnish as appropriate.
  - Recommend the use four to five times a day of xylitol-containing chewing gum or other xylitol products.
  - Encourage drinking optimally fluoridated tap or bottled water.
- Use the following when clinically indicated (See Table 2 for acceptable and unacceptable drugs.):
  - Radiographs with thyroid collar and abdominal apron.
  - Local anesthetic with epinephrine.
  - Analgesics, preferably acetaminophen, not to exceed daily dosages.
  - Antibiotics including penicillin, cephalosporins and erythromycins.
- Do not use the following medications (See Table 2 for acceptable and unacceptable drugs.):
  - Nonsteroidal anti-inflammatory drugs (NSAIDs) are not routinely a part of prenatal care, however in rare clinical situations they can be use for 48 to 72 hours; avoid use in the first and third trimesters.
  - Avoid erythromycin estolate and tetracycline.
- Ask all women of childbearing age if they take a multivitamin supplement containing folic acid, and recommend initiation if they do not.

- Support a woman's decision to breastfeed and have ready access to patient education resources. Address the topic by integrating it into regular patient education, such as saying "After breast or bottle feeding, be sure to wipe your baby's gums."

- Reinforce medical recommendations at oral health office visits, including tobacco and alcohol cessation.

- During treatment of a pregnant patient:
  - Place pregnant women in a semi-reclining position as tolerated, encourage frequent position changes, and/or place a small pillow under her hip to prevent postural hypotensive syndrome.
  - Utilize a rubber dam during restorative procedures and endodontic procedures.
  - Use safe amalgam and safe composite practices when placing restorative materials intraorally.

- Consult with the perinatal care provider when considering:
  - Deferring treatment because of pregnancy. (Note: there is no need to consult with the prenatal care provider for routine dental care of a healthy patient.)
  - Co-morbid conditions that may affect management of dental problems such as diabetes, pulmonary issues, heart or valvular disease, hypertension, bleeding disorders, or heparin-treated thrombophilia.
  - The use of nitrous oxide as an adjunctive analgesic to local anesthetics.
  - Anesthesia other than a local anesthesia such as intravenous sedation, nitrous oxide or general anesthesia needed to perform the dental procedure.

- Provide any necessary follow-up evaluation to determine if the oral health care interventions have been effective.

- Provide health education or anticipatory guidance about oral health practices for her children to prevent early childhood caries.

- Encourage women to learn more about oral health during pregnancy and early childhood by accessing available consumer information including reputable Web sites. (See list in Appendices.)

- Advise and encourage the woman to obtain necessary follow-up dental care and oral health maintenance during the postpartum period and thereafter.

- Provide dental care for other family members to prevent transmission of cariogenic bacteria to her infant or other children.

Oral health professionals are encouraged to take the following actions for infants and young children:

- Assess the risk for oral diseases in children starting by age 1 by identifying risk indicators including:
  - Inadequate or inappropriate fluoride exposure.
  - Past or current caries experience of child, siblings, parents and other caregivers.
  - Restorations placed in children within past two years.
  - Insufficient or lack of age-appropriate oral hygiene efforts by parents/caregivers.
  - Frequent or prolonged exposure to fermentable carbohydrates especially between meals.
  - Use of night-time bottle or sippy cup containing anything other than water.
  - Frequent use of medications that contain sugar or that inhibit salivary flow (e.g., anticholinergics, asthma, seizure and attention-deficit hyperactivity medications or antibiotics with added sugary syrup).
  - Clinical findings of heavy accumulation of plaque or any signs of decalcification (white spot lesions).
  - Low socioeconomic status.
  - Special health care needs (developmental delays or disabilities).

- Provide necessary treatment for children assessed to be at increased risk for oral disease or in whom carious lesions or white spot lesions are identified.

- Engage caregivers, whenever possible, in providing anticipatory guidance to increase the potential for changing oral health behaviors.

- Impress upon the parents or caregiver the importance of the child's primary dentition (e.g., avoid pain and suffering, for proper nutrition, avoidance of caries in permanent dentition, loss of school attendance, to save space for permanent teeth, for proper speech development).

- Apply fluoride varnish two to three times per year for children at moderate to high caries risk starting at 1 year of age.

- Advise parents about the most appropriate type of water to use to reconstitute infant formula. While occasional use of water containing optimal levels of fluoride should not appreciably increase a child's risk for fluorosis, mixing powdered or liquid infant formula concentrate with fluoridated water on a regular basis for infants primarily fed in this way may increase the chance of a child's developing enamel fluorosis.

- Advise parents and other caregivers about the following interventions to disrupt the chain of events that is implicated in the development of early childhood caries:

  - Reduce the bacterial reservoir in mothers and caretakers by using therapeutic agents such as chlorhexidene solutions and xylitol and restoring untreated dental caries.
  - Avoid saliva-sharing behaviors of mothers and other caregivers, such as kissing the baby on the mouth, tasting food before feeding, cleaning a dropped pacifier by mouth or wiping the baby's mouth with a cloth moistened with saliva. For older children, avoiding the sharing of straws, cups or utensils.
  - Avoid saliva-sharing behaviors between children via their toys, pacifiers, utensils, etc.
  - Encourage drinking optimally fluoridated tap or bottled water. If not possible, prescribe fluoride drops or tablet supplements (see Fluoride Supplementation, Table 3, p. 48).
  - Limit exposure to fermentable carbohydrates (e.g., crackers, chips, cookies, dry cereals) to mealtimes only—and limit the amount—and to caries-promoting sugars such as fruit juices, infant formula preparations, and sugary snacks.
  - Never allow at-will and night-time use of bottles and sippy cups unless they contain only water. The last thing to touch the child's teeth before bedtime should be a toothbrush or water.
  - Wipe an infant's teeth after breast or bottle feeding, especially along the gum line, with a soft cloth or soft-bristled toothbrush.

- Brush the child's teeth using a pea-sized (the size of a child's pinky nail) amount of toothpaste, especially before bedtime. Children older than 2 should use fluoride toothpaste; children younger than 2 should use a smear of fluoride toothpaste on the brush only if they are at moderate to high risk of caries.
- Help the child with brushing their teeth until they are about 7 years old.
- Visit an oral health professional beginning when the child is 12 months of age, or when the first tooth erupts.
- Encourage parents to lift the lip and look in their child's mouth for white or brown spots on the teeth, showing them how to do this if necessary.

- Explain the importance of each family member having their own toothbrush.

- Regularly clean toys in the dental office waiting room, using an antibacterial solution.

Child Health Care Professionals

Child health care professionals should develop the knowledge to perform oral risk assessments on children beginning at 6 months of age (American Academy of Pediatrics). In addition, children at moderate to high risk for caries should receive an aggressive anticipatory guidance and intervention program.

Child health care professionals are encouraged to:

- Assist parents/caregivers in establishing a regular source of dental care (a "dental home") for the child and for themselves. The first visit should occur when the child is 12 months of age or when the first tooth erupts.
- Provide counseling and anticipatory guidance to parents and other caregivers concerning oral health and protective behaviors during well-child visits.
- Impress upon the parents/caregivers the importance of the child's primary dentition.
- Assess the risk for oral diseases in the child beginning at 6 months of age by identifying risk indicators such as:
  - Inadequate or inappropriate fluoride exposure.
  - Past or current caries experience in child, siblings, parents and other caregivers.
  - Restorations placed in a child within the past two years.
  - Insufficient or lack of age-appropriate oral hygiene efforts by parents/caregivers.
  - Frequent and prolonged exposure to sugary substances especially between meals including bottle or sippy cup use.
  - Use of at-will and night-time bottle or sippy cup containing anything other than water.
  - Frequent use of medications that contain sugar or cause xerostomia (inhibit saliva flow) (e.g., anticholinergics, asthma, seizure and attention-deficit hyperactivity medications or antibiotics with added sugary syrup)
  - Clinical findings of heavy accumulation of plaque or any signs of decalcification (white spot lesions).
  - Low socioeconomic status.
  - Special health care needs (developmental delays or disabilities).
- Facilitate appropriate referral for management of children assessed to be at increased risk for oral disease or in whom carious lesions or white spot lesions are identified.

- Obtain or develop and maintain a list of community oral health referral sources that will provide services to young children and children with special health care needs.

- Encourage drinking optimally fluoridated tap or bottled water. If not possible, prescribe fluoride drops or tablet supplements. (See Fluoride Supplementation Table 3, p. 48.)

- Advise parents about the most appropriate type of water to use to reconstitute infant formula. While occasional use of water containing optimal levels of fluoride should not appreciably increase a child's risk for fluorosis, mixing powdered or liquid infant formula concentrate with fluoridated water on a regular basis for infants primarily fed in this way may increase the chance of a child's developing enamel fluorosis.

- Advise parents (and demonstrate as needed) that the following actions may reduce the risk of caries in children:

  - Wipe an infant's teeth, especially along the gum line, with a soft cloth after feeding from the breast or bottle.
  - Brush the child's teeth using a pea-sized (the size of a child's pinky nail) amount of toothpaste, especially before bedtime. Children older than 2 should use fluoride toothpaste; children younger than 2 should use a smear of fluoride toothpaste on the brush only if they are at moderate to high risk of caries.
  - Help children with brushing until they are about 7 years old.
  - Give each family member their own toothbrush.
  - Never put the child to bed with a bottle or sippy cup containing anything other than water. The last thing to touch the child's teeth before bedtime should be a toothbrush or water.
  - Begin weaning children from at-will bottle and sippy cup use (such as in an effort to pacify a child's behavior) by about 12 months of age.
  - Feed the child foods containing fermentable carbohydrates (e.g, crackers, cookies, dry cereals) at mealtimes only and limit the amount.
  - Avoid saliva-sharing behaviors, such as kissing the baby on the mouth, sharing a spoon when tasting baby food, cleaning a dropped pacifier by mouth, or wiping the baby's mouth with a cloth moistened with saliva. For older children, avoiding the sharing of straws, cups or utensils.
  - Avoid saliva-sharing behaviors between children via their toys, pacifiers, utensils, etc.

- Lift the lip and look in the child's mouth for white or brown spots on the teeth.
- Visit an oral health professional beginning when the child is 12 months of age, or when the first tooth erupts.
- Apply fluoride varnish applications two to three times a year for children at moderate to high risk of caries.

- Educate pregnant women and new parents about care that will improve their own oral health:

  - Brush teeth twice daily with a fluoride toothpaste and floss daily, especially before bedtime.
  - Eat foods containing fermentable carbohydrates at mealtimes only and in limited amounts.
  - Avoid sodas and other sugary beverages of any type, especially between meals.
  - Choose fresh fruit rather than fruit juice to meet the recommended daily fruit intake.
  - Obtain necessary dental exam and treatment before delivery when possible.
  - Chew sugarless or xylitol-containing gum or other xylitol-containing products, four to five times a day, after eating.
  - Do not smoke or use tobacco products.

Community-Based Programs

Successful intervention to improve oral health during pregnancy and early childhood is benefited by comprehensive community-based efforts. A "health commons approach"[1] to oral health—where community-based, primary care safety net practices include medical, behavioral, social, public and oral health services—can enhance dental service capacity and increase access for low-income populations. Professionals working in these settings, including agencies such as Women, Infants and Children and Head Start, should provide anticipatory and other guidance to parents and integrate parent oral health curriculum into their client education services.

Public health and community-based organization professionals are encouraged to:

- Assist parents/caregivers in establishing a regular source of dental care (a "dental home") for the child and for themselves. The first visit should occur when the child is 12 months of age or when the first tooth erupts.
- Provide counseling and anticipatory guidance to parents and other caregivers concerning oral health during well-child visits.
- Impress upon the parents the importance of the child's primary dentition (e.g. avoid pain and suffering, for proper nutrition, avoidance of caries in permanent dentition, loss of school attendance, to save space for permanent teeth, for proper speech development).
- Facilitate appropriate referral for management of children assessed to be at increased risk for oral disease or in whom carious lesions or white spot lesions are identified.
- Follow up on referrals to ensure that timely dental care has been provided.
- Obtain or develop and maintain a list of oral health referral sources that will provide services to young children and children with special health care needs.
- Encourage parents with children at moderate to high risk of caries to receive fluoride varnish applications two to three times per year.
- Encourage drinking optimally fluoridated tap or bottled water. If not possible, prescribe fluoride drops or tablet supplements. (See Fluoride Supplementation Table 3, p. 48.)

- Advise parents about the most appropriate type of water to use to reconstitute infant formula. While occasional use of water containing optimal levels of fluoride should not appreciably increase a child's risk for fluorosis, mixing powdered or liquid infant formula concentrate with fluoridated water on a regular basis for infants primarily fed in this way may increase the chance of a child's developing enamel fluorosis.

- If making home visits, conduct an in-home assessment of oral health practices. For example:
  - Inquire whether each family member has his or her own toothbrush.
  - Ask if an adult helps children younger than 8 with tooth brushing.

- Advise parents (and demonstrate where necessary) that the following actions may reduce the risk of caries in children:
  - Wipe an infant's teeth after bottle or breastfeeding, especially along the gum line, with a soft cloth.
  - Brush the child's teeth using a pea-sized (the size of a child's pinky nail) amount of toothpaste, especially before bedtime. Children older than 2 should use fluoride toothpaste; children younger than 2 should use a smear of fluoride toothpaste on the brush only if they are at moderate to high risk of caries.
  - Help children with brushing until they are about 7 years old.
  - Give each family member their own toothbrush.
  - Never put the child to bed with a bottle or sippy cup containing anything other than water. The last thing to touch a child's mouth at bedtime should be a toothbrush or water.
  - Begin weaning children from at-will bottle and sippy cup use (such as in an effort to pacify a child's behavior) by about 12 months of age.
  - Limit foods containing fermentable carbohydrates—cookies, crackers, chips, dry cereals, candy (including fruit sugars)—to mealtimes only.
  - Avoid saliva-sharing behaviors, such as kissing the baby on the mouth, sharing a spoon when tasting baby food, cleaning a dropped pacifier by mouth, or wiping the baby's mouth with a cloth moistened with saliva. For older children, avoiding the sharing of straws, cups or utensils.
  - Avoid saliva-sharing behaviors between children via their toys, pacifiers, utensils, etc.
  - Lift the lip and look in the child's mouth for white or brown spots on the teeth.
  - Visit an oral health professional the with child by 12 months of age or when the first tooth erupts.

- Educate pregnant women and new parents about care that will improve their own oral health:
    - Brush teeth twice daily with a fluoride toothpaste and floss daily, especially before bedtime.
    - Eat foods containing fermentable carbohydrates at mealtimes only and in limited amounts.
    - Avoid sodas and sugary beverages (including juices and sports drinks), especially between meals.
    - Choose fresh fruit rather than fruit juice to meet the recommended daily fruit intake.
    - Obtain necessary dental treatment before delivery when possible.
    - Chew sugarless or xylitol-containing gum or other xylitol-containing products, four to five times a day, after eating.
    - Do not smoke or use tobacco products.

Introduction

Oral health care is particularly important for the health of infants, young children, new mothers, and women who are pregnant or may become pregnant. There is sufficient, strong evidence to recommend appropriate oral health care for these groups of patients. These Perinatal* Oral Health Practice Guidelines are intended to assist health care practitioners in private, public and community-based settings in understanding the importance of providing oral health services to pregnant women and their children and making appropriate decisions regarding their care.

The Guidelines are based on a review of current medical and dental literature related to perinatal oral health, and their development was guided by a group of national experts. Because these Guidelines do not represent a static standard of community practice and are established based on current scientific evidence, the recommendations in this document should be reviewed regularly by medical and dental experts in the light of scientific advances and improvement in available technology, approaches or products.

Good oral health has the potential to improve the health and well-being of women during pregnancy,[2] and contributes to improving the oral health of their children. Pregnancy and early childhood are particularly important times to access oral health care since the consequences of poor oral health can have a lifelong effect[3]—and because pregnancy is a "teachable moment" when women are receptive to changing behaviors that can benefit themselves and their children.

However, oral health care in pregnancy is often avoided and misunderstood by dentists, physicians and pregnant women because of the lack of information or perceptions about the safety and importance of dental treatment during pregnancy.[4] Dental and obstetrical professionals who care for women during pregnancy need evidence-based and practical information concerning the risks and benefits of dental treatment to oral and overall health, and an understanding of the factors that affect a woman's dental care used to support more effective practice behaviors. While evidence-based practice guidelines, such as those developed by the New York State Department of Health[5] and other professional advisories, are evolving to support practitioners, many dentists withhold or delay treatment of pregnant patients because of a fear of injuring either the woman or the fetus.[6] And, because they have not been trained to understand the relationship between oral health and overall health, many prenatal providers fail to refer their patients regularly for dental care.[7,8] A coordinated effort between the oral health and prenatal care communities can benefit maternal and child oral health outcomes. In addition to obstetricians, family physicians and other primary care providers play a pivotal role in preventing oral disease, especially among minority and underserved populations who

* While the term "perinatal" generally refers to the period around childbirth (i.e., three months prior to and a month following), it is used in this document to more broadly include the entire prenatal and postpartum periods. In its broadest sense of maternal and child health, "perinatal" could include time after and between pregnancies.

have limited access to dental services and poorer oral health status; and they in a unique position to fill gaps in access to care.[9] Emerging data on important oral-systemic linkages suggest an increasing need for dental-medical collaboration and cross-training.[10]

Although pregnancy places women at higher risk for some oral conditions, such as tooth erosion and periodontal disease,[11,12] various studies suggest that only about one-quarter to one-half of women in the United States receive any dental care, including prophylaxis, during their pregnancies.[13,14] The likelihood of low-income and uninsured women receiving such care is even lower. In California, for example, one study found that in 2004 fewer than one in five pregnant women enrolled in Medicaid received any dental services.[15]

Dental caries is well documented as the most prevalent chronic disease of children—especially among low-income families—despite the fact that tooth decay is largely preventable.[16] Nationally, 28% of 2 to 5-year-olds show visual evidence of dental caries;[17] and in California, more than half (53%) of all children have experienced dental caries by the time they reach kindergarten, with 28% having untreated caries.[18] Poor oral health also impacts academic achievement as dental problems result in millions of lost school days each year.[19,20]

Guidelines Development Process

In addition to the 2006 New York State Practice Guidelines—which have served as an early model—a number of organizations have recently undertaken efforts to address oral health care during pregnancy and early childhood. To reinforce these recommendations and to add to the growing repository of evidence, the California Dental Association Foundation (CDA Foundation) and the American College of Obstetricians and Gynecologists, District IX (ACOG District IX) collaborated on an effort to substantiate the relationship between health and oral health status, treatment of oral disease and pregnancy outcomes. An expert panel of medical and dental professionals was engaged to review the scientific literature and, on the basis of evidence and professional consensus, derive practice guidelines.

An Advisory Committee of professionals representing statewide organizations in public and private clinical practice, research, health education, and policy was formed to work with the CDA Foundation, ACOG District IX, and the project co-chairs to guide the process. The committee was composed of professionals representing organizations such as the American Academy of Pediatrics, California Primary Care Association, California Nurse-Midwives Association, American Dental Association, American Association

of Public Health Dentistry, National Network for Oral Health Access, and American Academy of Pediatric Dentistry. Its role included helping to identify the expert panel, developing the agenda for the consensus conference and reviewing, and giving feedback on the Guidelines during their development.

The interdisciplinary expert panel was selected for their subject matter expertise in oral health and perinatal medicine and represented medical and dental specialties such as maternal-fetal medicine and periodontology. Panel members were charged with performing a literature search on the available science and presenting a summary of evidence-based studies that provided the framework for developing the Guidelines according to the following definition of evidence-based decision making: practices and policies guided by documented scientific evidence of effectiveness, particular to and accepted by the specific field of practice. The experts were charged with identifying existing interventions, practices and policies; assessing issues of concern; and developing recommendations.

Consensus Conference

The expert panel made their presentations at a two-day consensus conference held in Sacramento, Calif., on Feb. 20-21, 2009. In addition to the Advisory Committee members, the conference was also attended on the first day by representatives of about 50 multidisciplinary stakeholder groups involved in maternal and child health. Many of these representatives—from such organizations as the California Department of Public Health's Maternal, Child and Adolescent Health program; Kaiser Permanente; and the California Primary Care Association Dental Director's Network—have direct involvement in the care of pregnant women and young children. The engagement of stakeholders early in the process encouraged buy-in and gave these groups the opportunity to provide feedback about the practicality of implementing the Guidelines as they were being developed.

Following the research presentations on the first day, the panelists and Advisory Committee on the second day reviewed numerous comments submitted from the audience the previous day and identified common themes, unanswered questions, key messages and recommendations. Major findings pertaining to each topical area were then re-reviewed relative to specific clinical Guidelines for prenatal, oral health and child care professionals to identify areas of agreement as well as ambiguity. The group relied on expert consensus when controlled studies were not available or conclusive to address specific issues and concerns.

The documentation and proceedings from this conference were summarized and supplementary material added to create these Guidelines, and several drafts were reviewed by the expert panel and Advisory Committee. Prior to dissemination, the final draft was revised to reflect additional feedback from "reality testing" focus groups with local dentists and physicians from private, public and community-based practices that provided valuable feedback about their content, utility and prospective acceptance, as well as suggestions for dissemination.

The Guidelines are organized around key issues addressed during the consensus conference to reflect a patient-centered model of care—a model that takes into account the various factors that influence a woman's individual needs, personal circumstances, and ability to access services, in addition to advice and counsel from health professionals.

Perinatal Oral Health Consensus Statement

The key consensus statement developed by the expert panel and Advisory Committee conference participants is as follows:

Perinatal Oral Health Consensus Statement

Prevention, diagnosis and treatment of oral diseases, including needed dental radiographs and use of local anesthesia, are highly beneficial and can be undertaken during pregnancy with no additional fetal or maternal risk when compared to the risk of not providing care. Good oral health and control of oral disease protects a woman's health and quality of life and has the potential to reduce the transmission of pathogenic bacteria from mothers to their children.

Oral Health Care as an Integral Part of Perinatal Health

Control of oral disease is important because it protects a woman's health and quality of life and has the potential to reduce the transmission of pathogenic bacteria from mothers to their children. A woman's preconception as well as pregnancy experience not only influences her own oral health status but also may increase her risk of other diseases. Health care professionals providing preconception care, including primary and general women's health care, between pregnancies should be educated to recognize the relationship between oral health and pregnancy, and maternal oral health status and future caries risk during early childhood.

Maintaining good oral health during pregnancy can be critical to the overall health of both pregnant women and their infants. As part of routine prenatal care, pregnant women should be referred to oral health professionals for examinations and any needed preventive care or dental treatment. Despite clear links between oral and overall general health, oral health is not accorded the same importance in health care policy as is general health.[21] Reimbursement models and clinical practice typically view the oral cavity as separate from the rest of the body. While oral health should be an integral part of comprehensive care for pregnant women, variations in oral health practice patterns reflect the fact that oral health screening and referral are not routinely included in prenatal care.[22] Moreover, some oral health professionals are hesitant to treat pregnant women because of misconceptions, fear of lawsuits or lack of evidence-based information.[23]

Preconception

Maintaining a healthy lifestyle, including optimal oral health, is essential for women who are currently pregnant or who may become pregnant. The most critical periods of fetal development occur in the earliest weeks following conception, before many women even know they are pregnant. Because at least one-third of pregnancies are estimated to be unplanned,[24] women frequently conceive while experiencing less than optimal health.[25] While oral health should be a goal in its own right, preconception prevention and treatment of oral health conditions as a mechanism to improve both women's oral and general health and their children's dental health must be considered.[26] Improving preconception health by providing health promotion, screening and interventions can result in improved reproductive health outcomes, with potential for reducing societal costs as well.[27,28] Ensuring that evidence-based interventions are implemented to further improve infant and maternal pregnancy outcomes among women living with chronic conditions, which includes poor oral health, should also be a priority preconception care activity.[29]

During Pregnancy and Early Childhood

Pregnancy and early childhood are particularly important times to access oral health care because the consequences of poor oral health can have a lifelong impact.[30] Improving the oral health of pregnant women prevents complications of dental diseases during pregnancy (e.g., abscessed teeth, toothache), and has the potential to subsequently decrease early childhood caries (ECC)* in their children.

Poor periodontal health is associated with chronic conditions such as diabetes, cardiovascular disease and some respiratory diseases. For women with diabetes diagnosed prior to pregnancy, for example, oral health is essential because acute and chronic infections make control of diabetes more difficult.[31] Diabetes control is particularly important during the first trimester. Rates of congenital anomalies increase as the degree of uncontrolled diabetes increases. Ongoing control of diabetes during pregnancy further decreases the risk of adverse pregnancy outcomes such as preeclampsia and large-for-gestational-age newborns.[32]

It is well-documented that the use of folic acid before and during pregnancy reduces the risk of neural tube defects. Some studies suggest it may also reduce the risk of oral congenital defects such as cleft lip, cleft palate and cleft lip with cleft palate.[33] Oral clefts are among the most common congenital malformations, with an estimated prevalence of 1.5 per 1,000 births.[34] Primary prevention of birth defects by adequate preconception and prenatal maternal folic acid supplementation is "a major public health opportunity"[35] with implications for oral health. As part of routine care for pregnant patients and all women of childbearing age, dental professionals should remember to ask women if they take folic acid (most commonly in multivitamin supplements) and recommend it if they do not.

Some oral health professionals have postponed treatment during pregnancy because of uncertainty about the risk of radiographs and bacteremia that can occur with dental prophylaxis and restoration.[36,37] However, deferring appropriate treatment may cause harm to the woman and possibly to the fetus for several reasons. First, women may self-medicate with potentially unsafe over-the-counter medications such as aspirin to control pain. (See later section on Pharmacology Issues.)

Second, untreated dental caries in mothers increases the risk of her children developing caries. Finally, untreated oral infection may become a systemic problem during pregnancy.

* Also known as "baby bottle caries" or "baby bottle tooth decay," Early Childhood Caries (ECC) is a common bacterial infection characterized by decay in the teeth of infants or young children. According to the American Academy of Pediatric Dentistry, ECC is defined (2003) as: one or more decayed, missing (due to caries), or filled tooth surfaces in any primary tooth in a child <71 months (i.e., age 6). In children <age 3, any sign of smooth-surface caries is indicative of severe ECC.

The American Academy of Periodontology urges oral health professionals to provide preventive services as early in pregnancy as possible and to provide treatment for acute infection or sources of sepsis irrespective of the stage of pregnancy.[38] For many women, completing treatment of oral diseases during pregnancy assumes greater importance because health and dental insurance may be available only during pregnancy. Consequently, the prenatal period is a unique opportunity for obtaining oral health services that would otherwise be unavailable. Moreover, assessment of oral health risks in infants and young children, along with anticipatory guidance for parents and other caregivers, has the potential to prevent ECC.

Utilization of Oral Health Services During Pregnancy

While for some women pregnancy is the only time they have medical and dental insurance[39]—thus providing a unique opportunity to access care—reports indicate that dental care use by women during pregnancy is less than optimal. In four states where oral health data are collected as part of the Pregnancy Risk Assessment Monitoring System (PRAMS, an ongoing, population-based survey that obtains information from mothers who recently delivered live-born infants), reports of dental care use during pregnancy ranged from 22.7% to 34.7%. In three states, 12.2% to 25.4% of respondents reported having a dental problem and, of these, 44.7% to 54.9% went for care. Among mothers reporting a dental problem, insurance through public funding and late prenatal care entry were significantly associated with their not getting dental care.[40]

Among women surveyed in another PRAMS study about the likelihood of women using dental services during pregnancy, 58% reported no dental care during their pregnancy. Among women with no dental problems, those at increased risk of not receiving dental care during pregnancy included women who received no counseling on oral health care, were overweight or obese, or reported smoking.[41]

Maternal and Infant Health Assessment (MIHA) data for California—where nearly 1 in 7 births occurs in the United States—found that 65% of all women delivering in California during 2002-2007 received no dental care during pregnancy, and about half (52%) reported having a dental problem prenatally; 62% of those reporting a dental problem received no dental care. The percentage of women with nonreceipt of dental care was higher among women who were lower income, had a lower education level, did not have private prenatal insurance or prenatal coverage during the first trimester of pregnancy, had no usual source of medical care prior to becoming pregnant, were non-English speaking or of nonwhite ethnicity, than among their counterparts.

Seventy-nine percent of women with Medi-Cal (California's Medicaid program) did not receive any dental care during pregnancy. This is particularly significant as Medi-Cal is the payer for nearly half (46%) of all births in California hospitals,[42] and women with Medi-Cal coverage during pregnancy have also been eligible for a limited range of Medi-Cal dental program (Denti-Cal) benefits since the end of 2005.[43] The primary reasons women reported not receiving dental care were lack of perceived need for that care, followed by financial barriers (including cost and lack of dental insurance). More than 8% of women reported that the main reason they did not get dental services was that their providers advised against care.[44] The implications of these and the above findings are that there is a need for education of providers and women on the importance of dental care during pregnancy, and that the financial and other barriers to care must be addressed and reduced.

Because of the two-fold (mother and fetus) responsibility that dental professionals face in treating the pregnant patient, it is essential that they understand the physiology of pregnancy, fetal development, normal changes during pregnancy, potential oral complications of pregnancy, and the effects that dental intervention may have on the woman, her fetus or her neonate.[45]

Normal Changes

Maternal cardiovascular response to pregnancy involves enormous changes. During gestation, plasma volume and cardiac output increase, peripheral vascular resistance decreases, and there is a modest decline in mean blood pressure during mid-gestation. Myocardial contractility increases during all trimesters of pregnancy resulting in the development of a mild ventricular hypertrophy. The increased load, which develops in tandem with additional blood volume, leads to an increase in left atrial diameter.[46] Due to the enlarging uterus from about mid-pregnancy, women in the supine position are at risk for aortic and venal caval compression by the gravid uterus. Thus, avoiding the flat supine position, particularly in a dental chair, by displacing the uterus laterally is important. [47] Although influenced primarily by the size of the uterus and the exact maternal and fetal position, "frank hypotensive syndrome"—characterized by hypotension, pallor, and nausea—occurs in about 15-20% of term pregnant women when supine unless a pillow under the hip is used for displacement.[48]

As pregnancy progresses, the enlarging uterus assumes a more important role in the alteration of respiratory functions. Conformational changes in the chest (e.g., rise in the diaphragm) may affect sleep patterns. Shortness of breath reflects increased respiratory drive and airway edema.[49] Total lung volume and lung capacities are not greatly changed by pregnancy; changes are primarily limited to the functional residual capacity (FRC), which is decreased 15-20% in the woman at term, and tidal volume, which is increased 30-40%. While vital capacity, taken in the upright position, remains essentially unchanged during normal pregnancy, obesity or cardiovascular or pulmonary dysfunction can cause a decrease in vital capacity.[50] Respiratory changes that occur during pregnancy are of special significance concerning anesthesia. The supine position impairs respiratory function late in pregnancy, worsening hypoxemia by aorto-caval compression. Reduced FRC, especially when compromised by the supine position, commonly falls below the closing capacity of the lungs (lung volume during expiration) in late pregnancy.

Pregnancy is also associated with pressure on the stomach caused by the enlarged uterus. Heartburn, nausea and vomiting and rapid satiety (feeling of fullness) are common. Heartburn is primarily a result of decreased gastroesophageal junction tone and increased gastric reflux.[51]

Stomach acid refluxed up through the esophagus and into the oral cavity is a concern because excessive vomiting can result in enamel erosion.[52]

Common hematologic changes during pregnancy include a mild decrease in mean platelet count (gestational thrombocytopenia), mild increases in mean white blood cell counts, and increased iron demands secondary to increased erythropoiesis which requires iron supplementation to maintain hemoglobin level and avoid depletion.[53] Other vascular changes include "spider angiomata" and palmar erythema. Pregnancy also increases procoagulants and reduces anticoagulants although neither clotting nor bleeding times are abnormal. All women are at increased risk for venous thromboembolism during pregnancy.[54]

There are substantial changes in the maternal innate and adaptive immunity systems that affect the maternal-fetal relationship. The immune system can respond through numerous pathways depending on a multitude of factors, including the nature and concentration of the offending agent, the conditions that prevail in the immediate microenvironment of the responsive cells, and the host's functional capacity to respond. In view of these varying conditions, the system must constantly be adaptive, mobilizing and functionally integrating its numerous cell types for rapid response.[55] Reduced resistance of the oral tissues to disease from a reduction in blood levels of immunoglobulins (IgG) in the second half of pregnancy often leads to increased colonization by oral pathogens with increased potential for severe, sustained oral infections such as periodontal disease, for example.[56]

Common Complications of Pregnancy

The most common complications of pregnancy include spontaneous abortion (miscarriage), preterm birth, preeclampsia and gestational diabetes. Pregnancy loss of less than 20 weeks' gestation occurs in approximately 15 to 25% of pregnancies.[57,58] Most are not preventable. The etiologies of spontaneous abortion include endocrine factors, uterine malformations, and chromosomal abnormalities, which account for the greatest majority (60-80%) of losses.

There is no evidence relating early spontaneous miscarriage to first trimester oral health care or dental procedures.

Preterm birth is the delivery of an infant before 37 completed weeks' gestation,[59] and accounts for about 11% of all deliveries in the United States.[60] Factors that contribute to the etiology of preterm labor are infection, increased uterine volume, indicated iatrogenic causes and idiopathic factors. There are no proven primary prevention interventions for all women for preterm labor or birth. Secondary prevention includes tocolytics (medications used to arrest or slow down premature labor) in an attempt to obtain additional gestational time, and the use of antibiotics to prolong the latency period in the setting of preterm rupture of the membranes. Preterm premature rupture of membranes occurs in 3% of pregnancies and is responsible for approximately one-third of all preterm births; the etiology may be subclinical infection.[61] Three recent large, well-designed randomized clinical trials,[62,63,64] all of which involved nonsurgical periodontal therapy during the second trimester, have failed to demonstrate that treatment of periodontal disease decreases the incidence of preterm labor and low preterm birthweight. Other periodontal intervention strategies involving different timing and/or treatment intensity have not been rigorously tested.

While research is ongoing, the best available evidence to date shows that periodontal treatment during pregnancy does not alter the rates of preterm birth or low birth weight and is safe for the mother and fetus.

Preeclampsia—pregnancy-induced hypertension (>140/90) plus proteinuria usually presenting after 20 weeks of gestation—affects 3-7% of pregnant women, usually primigravidas and women with pre-existing hypertension or vascular disorders (e.g., renal disorders, diabetic vasculopathy).[65] While the causes and pathophysiology of preeclampsia are unknown, the greater the pre-pregnancy blood pressure or pre-pregnancy weight, the greater is the risk for preeclampsia.[66] Immunogenic risk factors include multiple gestations, change in paternity, paternal family history and differing parental ethnicity.[67] Severe preeclampsia is associated with blood pressure >160/110, pulmonary edema, >5 gram of proteinuria in 24 hours, HELLP syndrome (hemolysis, elevated liver enzymes, and low platelet count), and increased risk of fetal IUGR (intrauterine growth restriction).[68] Treatment considerations must balance the risks for the mother and those of the baby with that of preterm delivery. While the best treatment is delivery, primary prevention strategies for some subgroups include aspirin, antiplatelet

agents, calcium supplementation, and heparin. Secondary prevention includes careful monitoring of blood pressures,[69] laboratory tests, and symptoms of severe preeclampsia to prevent complications of the disease. Diabetic pregnancies complicated by preeclampsia are of concern because of poor perinatal outcome.

Periodontitis is associated with preeclampsia in pregnant women. Studies have shown that preeclamptic women present a high prevalence of periodontitis, suggesting that active periodontal disease may play a role in the pathogenesis of pre-eclampsia.[70] Oral pathogens have been found in placentas of women with preeclampsia, which imply a possible contribution of periopathogenic bacteria to the pathogenesis of this syndrome.[71]

Despite the complexity of symptoms and challenges of preeclampsia in patient management, preeclampsia is not a contraindication to dental care.

Common oral problems in the general population of people with diabetes include tooth decay, periodontal disease, salivary gland dysfunction, infection and delayed healing. Gestational diabetes mellitus (GDM)—diabetes with initial onset or recognition during pregnancy—occurs in 3-7% of all pregnancies and is increasing, paralleling the obesity epidemic. Longer term outcomes include increased risk of Type 2 diabetes for the mother.[72,73] According to a six-year prospective cohort study, GDM is associated with increased likelihood of macrosomia (newborns with excessive birthweight), increased cord-blood serum C-peptide, higher primary caesarean delivery rate, and neonatal hypoglycemia.[74] Pregnant women who develop GDM are also at greater risk for periodontal disease than women who do not develop GDM. Once periodontal disease occurs, it makes control of diabetes more difficult. Appropriate detection and active management and treatment of periodontal disease can improve glycemic control of the diabetic patient.[75]

Common Oral Conditions

The physiologic changes in the mouth that occur during pregnancy are well-documented. Combined with lack of routine exams and delays in treatment for oral disease, these changes place pregnant women at higher risk for dental infections. Clinically important alterations in the woman's immune system during pregnancy have important implications for oral health. Pregnancy-associated immunologic changes, particularly suppression of some neutrophil functions, are the probable explanation for the exacerbation of plaque-induced gingival inflammation during pregnancy, for example. Inhibition of neutrophils is particularly important in pregnancy-periodontal disease associations.[76,77]

Nausea and vomiting during pregnancy (NVP) are very common; 70-85% of women experience these symptoms, which tend to be self-limiting after the first trimester. Although NVP is predominantly associated with early pregnancy, some women continue to experience it past the first trimester. Hyperemesis gravidarum is a severe form of NVP that occurs in about 0.3-2.0% of pregnancies,[78] and may lead to surface enamel loss primarily through acid-induced erosion.[79]

Changes in salivary composition in late pregnancy and during lactation may temporarily predispose to erosion as well as dental caries,[80] however there are no convincing data to show that dental caries incidence increases during pregnancy or during the immediate postpartum period, though existing, untreated caries will likely progress.

Gingivitis due to accumulation of plaque is the most common clinical periodontal condition of women during pregnancy, occurring in 60-75% of women,[81] which speaks to the importance of establishing periodontal preventive and treatment measures during pregnancy. Gingival changes generally occur between three and eight months of pregnancy and gradually decline after delivery. While gingival changes usually occur in association with poor oral hygiene and local irritants, especially bacterial flora of plaque, the hormonal and vascular changes that accompany pregnancy often exaggerate the inflammatory response to these local irritants.[82] The most marked changes are seen in gingival vasculature. This type of gingivitis, known as pregnancy gingivitis, is characterized by gingiva that is dark red, swollen, smooth and bleeds easily.[83] Generalized supra- and/or sub-gingival periodontal therapies should be initiated to eliminate plaque buildup along with intensive, effective oral hygiene education.

In addition to generalized gingival changes, pregnancy may also cause single, tumor-like growths of gingival enlargement referred to as a "pregnancy tumor," "epulis gravidarum," or "pregnancy granuloma." This lesion occurs most frequently in an area

of inflammatory gingivitis or other areas of recurrent irritation, or from trauma or any source of irritation.[84] It often grows rapidly, although it seldom becomes larger than 2 cm in diameter. Poor oral hygiene invariably is present, and often there are deposits of plaque or calculus on the teeth adjacent to the lesion. Scaling and root planing, as well as intensive oral hygiene instruction, should be initiated before delivery to reduce the plaque retention.[85] Generally, the pregnancy granuloma will regress somewhat postpartum. There are situations, however, when the lesion needs to be excised during pregnancy, such as when it is uncomfortable for the patient, disturbs the alignment of the teeth, or bleeds easily on mastication. However, the patient should be advised that the pregnancy granuloma excised before term may recur.[86]

Generalized tooth mobility in the pregnant patient is probably related to the degree of gingival diseases disturbing the attachment apparatus, as well as to mineral changes in the lamina dura.[87] Longitudinal studies demonstrate that as the gingival inflammation increases so do the probing depths, attributable to the swelling of the gingiva.[88] While most research concludes that generally no permanent loss of clinical attachment occurs during pregnancy,[89,90] in some individuals the progression of periodontitis can and does occur[91] and can be permanent.

Physiologic xerostomia (abnormal dryness of the mouth) is a common oral complaint. The most frequently reported cause of xerostomia is the use of medications that produce dryness as a side effect,[92] including antispasmodics, antidepressants, antihistamines, anticonvulsants and others. Adults or children using these medications long term may benefit from increased oral hygiene efforts and more frequent fluoride exposure to reduce the increased risk of caries.[93] Physiologic xerostomia also occurs during sleep, when salivary glands do not secrete spontaneously. With little or no saliva to buffer pH and clear away fermented bacterial products from teeth during sleep, the most important time for plaque removal is just before bedtime for both mothers and children.

Periodontal Disease and Adverse Pregnancy Outcome

Destructive periodontal disease affects about 15% of women of childbearing age and up to 40% of pregnant women, with a disproportionate burden among low-income women.[94,95] Advancing age, smoking and diabetes are risk factors for the development of periodontal disease.[96] These same risk factors present for adverse pregnancy outcomes. The destructive process involves both direct tissue damage resulting from plaque bacterial products and indirect damage through bacterial induction of the host inflammatory and immune responses.

Earlier studies showed conflicting evidence of maternal periodontal disease association with adverse pregnancy outcomes such as preterm birth and low birthweight, but recent random controlled studies have not. Two large cross-sectional studies reported positive associations of periodontal disease and adverse pregnancy outcome(s),[97,98] while three cross-sectional studies reported no associations.[99,100,101] Similarly, a number of case control studies have reported a positive association,[102,103,104] while other case-control studies have not shown a relationship.[105,106,107] In the case-control studies, those with positive associations tended to have relatively small sample sizes.

Prospective studies also demonstrate conflicting results. Several studies conducted in the United States, including the OCAP (Oral Conditions and Pregnancy) Cohort Study and additional studies around the world between 2001-2008, have shown an increased risk of adverse pregnancy outcome(s) with periodontal disease.[108,109,110,111] The OCAP studies also showed increased odds of the adverse pregnancy outcomes of preeclampsia,[112] fetal immune response,[113] and very early preterm birth,[114] among other conditions. Conversely, several other prospective cohort studies, such as the Mobeen et al. investigation of 1,152 Pakistani women enrolled at 20-26 weeks gestation[115] reported no risk of adverse preterm birth/low birthweight with periodontal disease.[116,117,118] Two large prospective cohort studies from the United Kingdom reported no association of preterm birth or low birthweight, but they did report a correlation between late miscarriage and periodontal disease.[119,120] In the United States, a multicenter prospective cohort study of pregnant women enrolled between six and 20 weeks' gestation (311 with periodontal disease compared with 475 without) found no association between periodontal disease and adverse pregnancy outcomes (preterm birth, preeclampsia, fetal growth restriction or perinatal death).[121]

Intervention trials for treatment of periodontal disease during pregnancy have demonstrated consistently improved maternal oral health, although findings regarding a positive association of treatment for preterm birth reduction are conflicting.[122] Early preliminary studies outside of the United States and preliminary U.S. clinical trials reported that periodontal therapy reduces adverse pregnancy outcomes. However three large multicenter U.S. trials, conducted with women during 13-23 weeks of pregnancy, concluded that there is no effect of routine periodontal therapy on reducing adverse pregnancy outcomes.[123,124,125] Importantly, however, evidence from these randomized clinical trials—which are a stronger research design than the earlier work of observational studies (cross-sectional, cohort, and case-control)—also showed that routine, essential dental care, nonsurgical periodontal care, and the use of topical or local anesthesia for dental procedures were not associated with any adverse serious medical events or adverse pregnancy outcomes.[126] Additionally, periodontal therapy can be effective in reducing signs of periodontal disease and reducing periodontal pathogens,[127,128] providing evidence to support the provision of periodontal care during pregnancy.

Because it has been shown to be safe and effective in reducing signs of periodontal disease and reducing periodontal pathogens, best practice suggests that periodontal care should be provided during pregnancy.

Transmission of Cariogenic Bacteria

It is well-established that dental caries is a bacterial infection,[129] and studies during the past 25 years clearly indicate that the bacteria involved are transmissible.[130] Dental caries involves multiple acidogenic species of bacteria that consume fermentable carbohydrates—sugars (including fruit sugars) and cooked starch (bread, cereal, crackers, chips)—and produce acid byproducts that diffuse into the tooth and dissolve minerals; the two principal groups of bacteria that have been implicated are the mutans streptococci and the *Lactobacilli* species. The principal species in the mutans streptococci group are *Streptococcus mutans* and *Streptococcus sobrinus*. Early colonization in an infant's mouth by *S. mutans* is a major risk factor for early childhood caries as well as future dental caries.[131]

It is helpful for health care providers to view caries as an ongoing and often changing balance between pathological factors and protective factors: If the pathological factors outweigh the protective factors, then caries progresses. In the reverse situation, caries may be arrested or an incipient lesion reversed. The pathological factors include the acidogenic bacteria, reduced salivary function, and the frequency of ingestion of fermentable carbohydrates. The protective factors include saliva and its numerous caries-protective components; the saliva flow; antibacterials, both intrinsic from saliva and extrinsic from other sources; fluoride in multiple forms and other factors that can enhance enamel remineralization; good oral hygiene to remove plaque; and dental sealants for susceptible pits and fissures. In most individuals, there are numerous acid challenges daily as fermentable carbohydrates are ingested and the battle between the pathological factors and the protective factors takes place.[132]

Control of oral diseases in pregnant women has the potential to reduce the transmission of oral bacteria from mothers to their children.[133] While the restoration of carious lesions is an essential first step to control the caries disease process and restore function, restorative treatment for the mother does not sufficiently affect the bacterial load nor

the transmissibility of bacteria to the infant if high levels of cariogenic bacteria remain in her mouth. A mother with tooth decay, or recent tooth decay, can still transmit the caries-causing bacteria to the child. Antibacterial therapy as well as fluoride treatment for the mother is essential to control caries and reduce the severity of bacterial transmission to the infant.

The mother is the most common cariogenic bacterial donor as noted in DNA fingerprinting studies that show genotype matches between mothers and infants in more than 70% of cases[134] In a study of caesarean deliveries, 100% of infants harbored a single genotype of *S. mutans* that was identical to their mothers, and acquired that bacterium nearly 12 months earlier than did vaginally delivered infants.[135] This observation suggests that additional care should be taken to reduce the transmission of cariogenic bacteria to infants of mothers with caesarean deliveries.

It is now well-established that mutans streptococci can be acquired and readily transferred through vertical transmission—from mother to child or caregiver to child[136,137,138]—or through horizontal transmission—from child to child, including unrelated children such as in preschool,[139,140,141] or adult to adult as between spouses.[142,143] Cariogenic or decay-causing bacteria are typically transferred from the mother or caregiver to child by behaviors that directly pass saliva, such as sharing a spoon when tasting baby food, cleaning a dropped pacifier by mouth, or wiping the baby's mouth with a cloth moistened with saliva. Early acquisition of *S. mutans* is a key event in the natural history of early childhood caries as children infected early have more caries later. Delaying or preventing primary infection by mutans streptococci reduces the risk for future dental caries.[144] Pregnant women who may not be concerned about their own oral health are generally very receptive to information about the consequences it can have on their children,[145,146] again marking pregnancy as a teachable opportunity for improving health behaviors.

Evidence on effective interventions to reduce mother-to-child transmission of cariogenic bacteria supports recommendations for the appropriate use of fluorides, antibacterials and dietary control to reduce maternal salivary reservoirs of cariogenic bacteria, particularly for women who have experienced high rates of dental caries.[147] Xylitol, a naturally occurring sugar alcohol approved for use in food by the U.S. Food and Drug Administration since 1963, has been shown to reduce *S. mutans* levels in plaque and saliva and to markedly reduce tooth decay.[148] Xylitol can inhibit bacterial transfer and is also antibacterial and nonfermentable. Maternal use of xylitol chewing gum or lozenges (four to five times a day) has been shown to be effective in reducing *S. mutans* colonization and caries in infants.[149] Studies involving schoolchildren have demonstrated

that habitual use of xylitol-containing products decreased dental caries. In a school-based randomized clinical trial, *S. mutans* and *S. sobrinus* were reported to be reduced among children when xylitol was consumed in specially formulated gummy bear candy, although there was no change in *Lactobacillus* levels.[150]

While the transmission of mutans streptococci and its link to caries has been shown to correlate with breastfeeding experience,[151] human milk by itself does not promote tooth decay. Poor oral hygiene and health practices such as lack of a consistent and early oral hygiene regimen, supplementation or replacement of breast milk feedings with sugary liquids or solids,[152] and falling asleep with the breast nipple in the mouth[153] are the underlying causes of caries among breastfed infants. Continued breastfeeding—e.g., for over one year and beyond eruption of teeth—may be positively associated with early childhood caries,[154,155] but there are conflicting findings to support a definitive link, and the research is often blurred by many uncontrolled factors. Pediatricians should work collaboratively with the dental community to ensure that women are encouraged to breastfeed and use good oral hygiene practices.

Preventive Care

The American Academy of Periodontology has urged oral health professionals to provide preventive services as early in pregnancy as possible and to provide treatment for acute infection or sources of sepsis irrespective of the stage of pregnancy.[156] Primary prevention is the prevention of dental caries and gingivitis in a completely healthy oral cavity. An important strategy in caries prevention includes measures to avoid infection and colonization of the oral cavity with primary cariogenic mutans streptococci, especially *S. mutans* and *S. sobrinus*.[157]

Establishing a healthy oral environment for the pregnant patient is the most important objective in planning dental care. This objective is achieved at home by the woman with adequate plaque control (brushing, flossing, toothpastes, and use of antimicrobial agents such as xylitol and chlorhexidine rinses) and with professional prophylaxis including coronal scaling, root planing and polishing.[158]

Although primarily used in caries prevention for children on unrestored permanent posterior teeth, dental sealants also benefit adults who have teeth with occlusal (biting) surfaces at risk for caries, and on the pits and fissures of susceptible primary teeth of children at risk for caries. In 2008 the American Dental Association released evidence-based sealant guidelines including a recommendation for sealant placement on both adult teeth and primary teeth at risk for caries. Evidence suggests that pregnant women similarly would benefit from pit-and-fissure sealants on teeth at risk of caries.[159]

Treatment Considerations

Informed Consent

The concept of informed consent is rooted in medical ethics and has been codified as legal principle. The dental patient must be provided with full information concerning risks, benefits and alternative procedures available to respond to her oral health condition. Specific consent should be obtained for any invasive/surgical procedures in compliance with the prevailing standard of care. No additional or special informed consent is necessary because of pregnancy.

Dental Treatment During Pregnancy

Dental treatment for a pregnant woman who has oral pain, an emergency oral condition or infection should not be delayed as the consequences of not treating an active infection during pregnancy outweigh the possible risks presented. The American Academy of Periodontology has urged oral health professionals to provide treatment for acute

periodontal infection or sources of sepsis irrespective of the stage of pregnancy.[160] Treatment for dental caries is recommended to reduce the level of caries-causing bacteria in the pregnant woman's mouth. If the woman does not receive treatment by the time of delivery, her infant could increase its own chance of early acquisition of cariogenic bacteria by transfer in saliva from the mother. There are practical considerations as well: After the baby is born, the mother may be too busy to attend to dental appointments or may lose pregnancy-related health insurance coverage.

While treatment of periodontal disease during pregnancy has not been shown to prevent preterm birth, fetal growth restriction or preeclampsia, the treatment itself is not hazardous to the woman or pregnancy;[161,162] and the benefits from treatment and risks from lack of treatment must be considered. The treatment approach tested so far consists of nonsurgical periodontal therapy in the second trimester. Evidence supporting the potential benefits of periodontal treatment on pregnancy outcomes shows that essential dental treatment, including the use of topical and local anesthetics, is safe and is not associated with an increased risk of experiencing serious medical adverse events or adverse pregnancy outcomes.[163] While the period covered in this study was 13 to 23 weeks' gestation, these findings do not imply that treatment earlier or later in pregnancy is not also safe.

Higher anxiety levels associated with pregnancy may intensify the stress of a dental appointment. Dental care during pregnancy should accommodate these changes with short appointments, judicious use of drugs and radiographs, and avoidance of flat supine positioning.[164]

Diagnostic Radiation

Radiographic imaging of oral tissues is not contraindicated in pregnancy and should be utilized as required to complete a full examination, diagnosis and treatment plan.

Diagnostic radiographs are an important tool in the diagnosis and treatment of dental problems and are considered safe during pregnancy.[165,166] Dental radiographic examinations require exposure to very low levels of radiation, which makes the risk of potentially harmful effects extremely small. Recommendations about radiographs developed by an expert panel from the dental profession under the auspices of the

Food and Drug Administration (FDA)[167] do not need to be altered because of pregnancy. The number and type of radiographs will depend upon the clinical conditions and the patient's health history. As standard practice, the oral health professional should provide protection from radiation exposure for the pregnant woman's abdomen and neck using an abdominal and neck shield.

One new dental technology involving dental radiographs, which is also safe during pregnancy, is digital radiographs. They offer the advantage of a reduction in radiation, no need for film or processing chemicals, and production of a nearly instantaneous image. The dental office also can print or copy digital radiographs. The main disadvantage is the cost, limiting their use in many dental practice settings.

Positioning the Pregnant Patient

When the pregnant woman lies flat on her back, the uterus in the third trimester can press on the inferior vena cava and impede venous return to the heart, which can lead to the supine hypotensive syndrome. This syndrome (which only occurs in 15-20% of pregnant women) can be avoided during dental treatment by placing the patient in a semi-reclining position, encouraging frequent position changes, and/or by placing a wedge underneath one of her hips to displace the uterus. A small pillow or folded blanket under either hip moves the uterus off the vena cava to prevent postural hypotensive syndrome.[168]

Pregnant women are at increased risk for gastric aspiration as a result of reduced gastroesophageal sphincter tone. Additionally, gastric emptying may be delayed by narcotics, onset of labor, pain and trauma. Maintaining a semi-seated position and avoiding excessive sedation are required to prevent aspiration.

Use of Nitrous Oxide

Nitrous oxide is used extensively to provide sedation and analgesia during labor and has been studied widely. Its widespread use in obstetrical analgesia is related to its ease of administration, minimal toxicity, minimal cardiovascular depression, lack of effect on uterine contractions, and the fact that it has not been implicated as one of the agents capable of causing malignant hyperthermia,[169] a severe biochemical reaction triggered by exposure to certain general anesthetics. In obstetrics, nitrous oxide has been used alone or in combination with other methods of pain control. In dentistry, nitrous oxide/oxygen is the most commonly used inhalation anesthetic. It is commonly used in ambulatory surgery centers and emergency centers as well.[170]

As a single agent, nitrous oxide has impressive safety and is excellent for providing minimal and moderate sedation for apprehensive dental patients.[171] Higher anxiety levels associated with pregnancy are not uncommon and may intensify the stress of a dental appointment for a pregnant woman.[172] Where a patient's anxiety may prevent cooperation with essential treatment, and behavioral management strategies are insufficient to manage her fear and anxiety, nitrous oxide may be regarded as the sedation agent of choice.[173] Because the issue under consideration here is the use of nitrous oxide sedation during a single appointment for non-elective dental treatment of a pregnant patient—and the treatment is not prolonged—apprehension for these patients should be allayed by using the safest agents available;[174] and the judicious use of nitrous oxide fulfills this requirement.[175,176]

To compare the relative potencies of anesthetic gases, anesthesiologists have accepted a measure known as MAC (minimum alveolar concentration)[177]—a measure of the potency of inhalational anesthetic agents. A lowered MAC for the pregnant patient will require less nitrous oxide to be administered as compared to the nonpregnant patient.

Because pregnancy is associated with decreased anesthetic requirements, lower concentrations of nitrous oxide may be adequate for sedation and patient comfort. Prolonged dental treatments and nitrous oxide exposure should be avoided if possible. Adequate precautions and monitoring must be taken to prevent hypoxia, hypotension and aspiration. Continuous monitoring of vital signs and adequate scavenging of exhaled gases are recommended. Proper use of scavenging devices while nitrous oxide is provided to patients in the dental setting eliminates any significant risk.[178]

Reduced fertility has been implicated with long-standing or chronic occupational exposure to nitrous oxide without proper scavenging apparatus, and prolonged exposure to even ambient concentrations of nitrous oxide has the potential to inhibit cell division. Short exposure during general anesthesia with such anesthetic agents as nitrous oxide and thiopental has not been shown to have deleterious effects or to be teratogenic.[179] Retrospective studies of nearly 6,000 general anesthetics in pregnant patients, which virtually all included nitrous oxide, failed to reveal any adverse outcomes for the patient or fetus.[180,181]

Important maternal anatomic and physiologic changes, with implications for anesthetic management, cause pregnant women to differ from nonpregnant women. During pregnancy, oxygen consumption increases and functional lung capacity decreases. Consequently, oxygen reserve decreases and pregnant women may develop hypoxia and hypercapnia more easily with decreased ventilation. Airway management can be difficult in pregnant women due to weight gain, increased chest wall diameter, breast enlargement, and laryngeal edema.[182] Plasma volume and cardiac output increase, and peripheral vascular resistance decreases. This explains why from mid-gestation

onward women in the supine position are at risk for compression of the great vessels by the uterus, which may result in significant hypotension, a common complication that can be easily avoided during dental treatment by proper positioning of the patient as described previously.

When used alone for mild to moderate sedation, nitrous oxide does not depress ventilation. However, when it is combined with sedatives or opioids that depress ventilation, a more pronounced and clinically important depression may result.[183] Therefore, administration of nitrous oxide in combination with opioids or central nervous system depressants should be performed by knowledgeable and appropriately trained personnel only. Prior to planned use of nitrous oxide/oxygen during dental treatment, consultation with an obstetrician or maternal-fetal medicine subspecialist is recommended to check for any pulmonary concerns, in addition to standard nitrous oxide protocols in dentistry.

Restorative Materials

Safety considerations for treating dental caries arise in relation to the presence, placement, and removal of dental restorative materials, including amalgam, composite resin and the associated adhesive materials. Best practices in using dental restorative materials are based on perinatal and child outcomes from studies on pregnant women as well as from relevant research conducted on dental professionals who may, during their pregnancies, receive higher exposures to these same materials through their workplace activities.

Amalgam, an alloy of silver, copper, tin and mercury,[184] is the most commonly used dental restorative material for repairing posterior teeth. The elemental mercury found in dental amalgam is inorganic, in contrast to organic forms such as methyl mercury, found largely in fish and seafood, and thimerosal, an ethyl mercury-based preservative found in pharmaceuticals. Current-day exposures to mercury are predominantly to methyl mercury from food intake, with inorganic mercury present at much lower concentrations. Oral habits such as bruxism and gum chewing can lead to higher concentrations of inorganic mercury in blood.[185,186] Similarly, use of teeth whitening products, which contain or generate hydrogen peroxide, results in release of inorganic mercury from dental amalgams,[187] and hence consideration should be given to avoiding these whitening products during pregnancy.

Placement and removal of amalgam restorations results in transiently higher blood mercury concentrations.[188] Mercury vapor is inhaled during placement and removal and carried to the lungs where it can enter the bloodstream and cross the placental barrier.[189] During both placement and removal, use of a rubber dam and high-speed suction can

markedly reduce vapor inhalation during procedures. It is advisable to delay removal until after pregnancy or weaning if a rubber dam and high-speed suction cannot be used. However, even during placement and removal, studies do not show any adverse reproductive effects if safe amalgam practices are used.[190]

Much of the research related to gestational mercury exposures has been conducted in women with occupational exposure;[191,192,193] these studies have examined fertility level, spontaneous abortion and low birthweight. For example, a study of dental assistants found fertility was not compromised among assistants who placed a large number of amalgams per week if their workplace practices were hygienic.[194] Two Scandinavian studies of women working in dental offices with low mercury levels found no association of self-reported exposures to mercury with risks for spontaneous abortion.[195,196] A Swedish study found a small elevation in risk for delivering a low birthweight baby in dental assistants but not in dentists or dental hygienists.[197] Studies in Washington state and the United Kingdom focused on non-occupationally exposed populations. In the former, births to enrollees in a dental insurance plan showed no increased risk for low birthweight if mercury-containing dental fillings were placed during pregnancy; but the analysis was flawed due to adjustment for a variable heavily influenced by intrauterine growth.[198] In a large birth cohort from the United Kingdom, no increased risk of low birthweight was observed in association with placement, removal or presence of amalgams.[199]

After review of about 200 scientific studies, the U.S. Food and Drug Administration on July 27, 2009, reaffirmed its view that dental amalgam is a safe, effective material for use in dental restorations. According to the FDA, the levels released by dental amalgam fillings "are not high enough to cause harm in patients," and "the best available scientific evidence supports the conclusion that patients with dental amalgam fillings are not at risk."[200] It further determined that "long-term clinical studies in adults and children aged 6 and older with dental amalgam fillings have not established a causal link between dental amalgam and adverse health effects." The FDA reversed an earlier caution against their use in certain patients, including pregnant women and children. It explored potential health effects of dental amalgam in developing fetuses, breast-fed infants and children younger than 6 and acknowledged that while research on these populations is more limited, "the scientific evidence that is available suggests that these populations also are not at risk."[201]

The FDA ruling classifies encapsulated amalgam as a class II medical device (moderate risk), which places it in the same class as gold and composite fillings. By classifying a device into class II, the FDA can impose special controls (in addition to general controls such as good manufacturing practices that apply to all medical devices regardless of risk) to provide reasonable assurance of the safety and effectiveness of the device. These special controls include recommended performance tests to ensure that essential information is provided to the FDA when devices are submitted for evaluation.

Composite resins, glass-ionomer, gold and porcelain restorations are alternative restorative dental materials. Composite resins are composed of a polymerized resin and inorganic filler. Recent research on methacrylate monomers, MMA, HEMA and TEGDMA, and on bisphenol-A (BPA), Bis-GMA, and Bis-DMA indicates that even after polymerization, monomers are released into the oral environment, diffuse through the dentin, and reach the pulp.[202] These compounds have estrogenic properties, but the clinical relevance of the amounts released is unknown.[203] While BPA may not be a direct ingredient in a dental sealant or resin material, it can be a byproduct of the degradation by salivary enzymes of other monomers used in these materials.[204] In a study by Joskow et al.[205] small amounts of BPA were found in saliva for about an hour after dental sealants were placed. Short-term exposures associated with the placement of dental sealants and composite restorations have not been shown to have any health risks; data is lacking on the effects of long-term exposures.[206]

Given the risks associated with untreated dental caries in pregnant women, oral health professionals should recommend prompt treatment of dental caries and, in consultation with the pregnant woman, determine the appropriate options for treatment and restorative materials.

Pharmacologic Considerations

Pharmacologic treatment during pregnancy is of concern as the maternal metabolism of drugs is altered by the normal physiologic changes of pregnancy, and certain medications can reach the fetus and cause harm. The physiologic changes of pregnancy influence absorption, plasma levels, drug distribution, half-lives and elimination of drugs (Table 1). Consequently, drug concentrations may be higher than, equal to or lower than those found in nonpregnant women. Physiologic changes in the pulmonary, gastrointestinal and peripheral blood flow can alter drug absorption. Alterations in the gastrointestinal system include decreased hydrochloric acid production that affects ionization and absorption of drugs, and delayed gastric emptying that increases bioavailability of slowly absorbed drugs. Hepatic changes can alter biotransformation of drugs by the liver and clearance of drugs from the maternal serum: While first-pass metabolism is generally unchanged, second-pass metabolism is variable and more

dependent on liver enzymes. Renal plasma flow and glomerular filtration rate increase by 75% and 50%, respectively, though typically changes in renal drug excretion are not clinically significant enough to require alterations in drug dosage.

Neurologic changes during pregnancy are important because anesthetics have differing effects on cerebral neuronal activity. The MAC value of volatile anesthetic agents, for example, is reduced from early in pregnancy by about 25-40% probably due to increased progesterone levels.[207]

Table 1. Influence of Pregnancy on Physiologic Aspects of Drug Disposition

Pharmacokinetic Parameter	Change in Pregnancy
Absorption	
Gastric emptying	Decreased
Intestinal motility	Decreased
Pulmonary function	Increased
Cardiac output	Increased
Blood flow to skin	Increased
Distribution	
Plasma volume	Increased
Total body water	Increased
Plasma proteins	Decreased
Body fat	Increased
Metabolism	
Hepatic metabolism	Increased or decreased
Extrahepatic metabolism	Increased or decreased
Plasma proteins	Decreased
Excretion	
Renal blood flow	Increased
Glomerular filtration rate	Increased
Pulmonary function	Increased
Plasma proteins	Decreased

Source: Blackburn ST. Maternal, Fetal and Neonatal Physiology: A Clinical Perspective, 3rd ed. 2007. Saunders Elsevier: St. Louis.

Teratogens are agents that act to irreversibly alter growth, structure or function of the developing embryo or fetus. These include viruses, environmental factors (hyperthermia, irradiation), chemicals (alcohol), and therapeutic drugs (ACE inhibitors, thalidomide, isotretinoin, warfarin, carbamazepine). Because many teratogens reach the fetus by the maternal bloodstream, exposure depends upon several critical factors such as gestational age, route of administration, absorption of the drug, dosage, maternal serum levels, and the maternal and placental clearance system. To cause a birth defect, a teratogen acts during critical periods of embryonic or fetal development and induces embryopathy or fetopathy. During organogenesis (five to 10 weeks after last menstrual period) fetal tissues begin to differentiate, and this interval is the period of greatest vulnerability for tetragenesis.

Research shows that drug-taking is common in women of childbearing age, and few women avoid drugs even when planning a pregnancy.[208] Epidemiological studies have also shown that pregnant women continue to take substantial quantities of drugs, particularly those readily available to them without prescription. A drug survey from 22 countries showed that the average woman took 2.9 medications (range: one to 15) during pregnancy.[209] According to a longitudinal study from the United States, pregnant women reported using an average 1.14 prescription drugs, excluding vitamins and iron; the U.S. women also took an average of 2.95 over-the-counter drugs and nearly half (45%) used herbal agents.[210] Health care professionals should become accustomed to querying each pregnant patient about her medications, her use of herbal and natural supplements, and her health. The best time to ask is during a brief medical update at the beginning of each appointment.[211]

Most of the common medications used in medical and dental settings have not been utilized in clinical trials with pregnant women. Very few drugs have been tested on pregnant women for obvious reasons. A number of resources describing drug effects during pregnancy are available, although not all answer the question of whether or not to treat, or which drug to use. A compilation of common drugs with FDA classifications and restrictions is displayed in Table 2. Tetracycline, for example, is a drug that should be avoided during pregnancy. If uncertain about drugs and medications during pregnancy, check with a pharmacist and the prenatal care provider to evaluate the benefits, risks and alternatives of using a particular drug. Additionally, neonatal withdrawal syndrome is a common side effect of prolonged use of certain analgesics (acetaminophen with codeine, codeine, hydrocodone, meperidine, morphine). Therefore, use of dental analgesics commonly used in dentistry should be considered a short-term option until definitive dental treatment can be performed.

Table 2. Pharmacological Considerations for Pregnant and Breastfeeding Women

Drug	FDA Classification	Teratogenic Risk**	Quality of the Evidence**	Restrictions/Special Considerations
ANALGESICS				
Aspirin	C	Minimal	Good	• Short duration of use • Avoid in 1st and 3rd trimester[a] • Avoid if breastfeeding
Acetaminophen	B	None to minimal	Good	• Analgesic and antipyretic of choice
Ibuprofen	B	Minimal	Fair to good	• Short duration of use • Avoid in 1st and 3rd trimester[a] • Do not use for >48-72 hours • Compatible with breastfeeding
Naproxen	B	Minimal	Fair	• Short duration of use • Avoid in 1st and 3rd trimester[a] • Do not use for >48-72 hours • Compatible with breastfeeding
Codeine	C	Unlikely	Fair to good	• Compatible with breastfeeding • At high maternal doses, may cause depression/drowsiness in breastfeeding infants
Morphine	B/D	Unlikely	Fair to good	• Withdrawal symptoms in neonate may occur with prolonged or chronic use • At high maternal doses, may cause depression/drowsiness in breastfeeding infants • Category D with prolonged use
Meperidine	B/D	Unlikely	Fair	• Category D with prolonged use • Compatible with breastfeeding
ANTIBIOTICS				
Penicillin	B	None	Good	• No restrictions
Amoxicillin	B	Unlikely	Good	• No restrictions
Cephalosporins	B	Unlikely	Fair to limited	• No restrictions
Clindamycin	B	Unlikely	Limited	
Erythromycin	B	Minimal	Fair	• Erythromycin estolate is avoided due to potential maternal hepatotoxicity
Tetracycline	D	Moderate for tooth staining	Good	• Avoid during pregnancy; use after 25 weeks may result in staining of teeth and possible effects on bone growth
Fluorquinolones	C	Unlikely	Fair	• Avoid during pregnancy and lactation due to toxicity to developing cartilage in animal studies
Clarithromycin	Undetermined		Limited	• Alternative antibiotics are recommended because number of cases of pregnancy exposure is too small to conclude no risk
ANESTHETICS				
Lidocaine (local)	B	None	Fair	• No restrictions
MISCELLANEOUS				
Chlorhexidine mouth rinse	C	Unlikely	Poor	• Has not been evaluated for possible adverse pregnancy effects
Xylitol	Undetermined	Unlikely	Not available	• No references available on possible adverse pregnancy effects

FDA Category Ratings: A = Controlled studies show no risk; adequate, well-controlled studies in pregnant women failed to demonstrate risk to fetus. B = No evidence of risk in humans; either animal studies show risk but human findings do not or, if no adequate human studies have been done, animal findings are negative. C = Human studies lacking and animal studies are either positive for fetal risk or lacking as well. However, potential benefits may justify the potential risk. D = Positive evidence of risk; investigational of post-marketing data show risk to fetus. Nevertheless, potential benefits may outweigh risks, such as some anticonvulsive medications.

[a] Recent studies have reported NSAIDs (nonsteroidal anti-inflammatory drugs) may be associated with gastroschisis if given in the first trimester. See for example: Kozer E, et al. Aspirin consumption during the first trimester of pregnancy and congenital anomalies: a meta-analysis. *Am J Obstet Gynecol.* 2002 Dec;187(6):1623-30. Sustained use in the third trimester may be associated with closure of the fetal ductus arteriosus.

**Teratogenic risk and quality of the evidence is based on adapted information from the Teratogen Information System (TERIS) and Reprotox® electronic databases.

Dental caries is the single most common chronic disease of childhood and a public health problem that continues to affect infants and preschool children worldwide. Any dental caries in the primary teeth occurring before age 6 is generally defined as early childhood caries (ECC). Dental caries impacts children's functioning including eating, sleeping, speaking, learning and growth. Because most children have visited a child health professional close to a dozen times by age 3—but may not have visited a dentist—medical providers as well as nurses, health educators and community health workers can play a significant role in reducing the burden of this disease if they have been properly trained. It has been estimated that primary care providers who provide care to children before age 2 have the opportunity of providing oral health screening seven times more frequently than dentists as a result of well-child visits.[212]

Infant oral health care begins ideally with prenatal oral health counseling for parents, a service that should be provided by all health professionals. This early involvement will form the foundation on which positive experiences can be built. While mothers usually are the primary decision-makers on matters affecting their children's health, it should be remembered that other family members, especially grandparents, can exercise a wide influence on children's accessing dental care.[213] Ideally a regular source of oral health care (a "dental home") should be established at a young age (i.e., not later than 12 months of age).[214]

Because dental caries is now recognized as a bacterial infection that can be transmitted from a parent or another intimate caregiver to an infant or child,[215,216] health professionals should identify women at high risk for dental caries as early as possible, preferably prior to pregnancy, to provide anticipatory guidance and early intervention. Parents should also be advised that caries is an infectious disease, and caries-causing bacteria, including *Streptococcus mutans*, can be spread from mother, intimate caregiver, siblings and other children by saliva-sharing behaviors. Because *Streptococcus mutans* may colonize the child's mouth even before the first tooth erupts, appropriate interventions can alter children's risk for developing caries.[217]

Evaluation of existing literature suggests a number of strategies for the prevention of ECC. The value of the therapeutic use of fluoride for children should be impressed upon parents, and at-home product use should focus on regimens that maximize topical content, preferably in lower-dose, higher-frequency approaches.[218] (See Table 3.) A small amount of fluoride toothpaste should be used twice daily as a primary preventive procedure.[219,220] While the appropriate amount of toothpaste and other fluoride products varies by a child's age and weight, an amount "the size of the child's pinky nail," "the size of a pea," or "a smear" are understandable descriptions to nearly all

parents and provides general guidance. (Note: parents who are avid brushers for their children—even those with "high dental IQ"—may use too much fluoride, resulting in fluorosis on permanent teeth.) Parents or caregivers of children younge than 8 should brush children's teeth or supervise brushing. Because children younger than 6 have not fully developed the swallowing reflex, using large quantities of toothpaste should be discouraged during the period of tooth development. Children younger than 2 should use fluoride toothpaste only after consultation with a dentist; however, children in this age group at moderate to high risk for caries may need to use a smear or pea-sized amount of fluoride toothpaste on a child-size toothbrush to help prevent ECC.[221]

Table 3. Daily Dietary Fluoride Supplementation Schedule

Age	Fluoride Ion Level in Drinking Water (ppm)*		
	<0.3 ppm F	0.3-0.6 ppm F	>0.6 ppm F
Birth – 6 months	None	None	None
6 months – 3 years	0.25 mg/day	0	0
3 – 6 years	0.50 mg/day	0.25 mg/day	0
6 years to at least 16 years	1.00 mg/day	0.50 mgday	0

* 1.0 ppm = 1 mg/liter
** 2.2 mg sodium fluoride contains 1 mg fluoride ion.
Note: For children not consuming optimally fluoridated water. Source: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. Date last reviewed: Oct. 8, 2008. Approved by the American Dental Association, the American Academy of Pediatrics, and the American Academy of Pediatric Dentistry.

Because feeding sugary liquids including milk and juice, especially at night, may increase the risk for caries, child health care professionals should focus on the message to reduce the exposure to fermentable carbohydrates (common sugars).[222] The teeth should be cleaned after feeding (breastfeeding, bottle use and sippy cup use) and before putting the child to sleep. The last thing to touch the child's teeth before bedtime should be a toothbrush or water.

Caregivers should be advised to begin weaning children from at-will bottle and sippy cup use (such as in an effort to modify or pacify a child's behavior) by about 12 months of age. Health care professionals should exercise cultural sensitivity when discussing this topic with parents in communities where extended bottle usage is normative.

While every child should be seen by a dentist before the first birthday, or when the first tooth erupts, it is particularly important to refer and follow up on children who have risk indicators[223] (e.g., low socioeconomic status, lack of age-appropriate oral hygiene efforts by parents). Two sample risk assessment forms are included in the Appendices (see Attachments 2 and 3). Child health professionals should utilize community resources, where available, such as caseworkers and community health workers for conducting follow-up and facilitating transportation to dental appointments.

Fluoride is a very effective caries preventive agent; but water fluoridation varies, and lack of fluoridation may disproportionately affect poor and minority children who do not have other sources of fluoride.[224] Health providers should be aware of community water fluoridation, or lack of it, in the region where their patients live and go to school, and depending on the child's age and risk for caries, prescribe fluoride drops or chewable fluoride tablets for children's teeth.

Although only a small factor in the risk for enamel fluorosis, the American Dental Association[225] and the Centers for Disease Control and Prevention[226] have issued guidance for parents and caregivers of infants younger than 12 months of age to consult with their medical or dental provider on the most appropriate type of water to use to reconstitute infant formula. Recent evidence suggests that mixing powdered or liquid infant formula concentrate with fluoridated water on a regular basis for infants primarily fed in this way may increase the chance of a child's developing the faint white markings of very mild or mild enamel fluorosis. Occasional use of water containing optimal levels of fluoride should not appreciably increase a child's risk for fluorosis. Studies have not shown that teeth are likely to develop more esthetically noticeable forms of fluorosis, even with regular mixing of formula with fluoridated water.[227]

One of the most important ways for health professionals to ensure that infants and young children enjoy optimal oral health is by performing risk assessments to identify those at risk for oral health problems, including dental caries, malocclusion and injury.[228] The American Academy of Pediatrics recommends that all child health care professionals develop the knowledge to perform oral health risk assessments on all patients beginning at 6 months of age. Risk assessment of infants and young children for oral health problems is based on the premise that all infants and children are not equally likely to develop such problems. Performing a risk assessment for infants and young children allows a plan to be developed to meet each infant's or young child's preventive and treatment needs and referral to a dentist. At each well-child visit, questions about oral health issues can be asked and anticipatory guidance provided while discussing other age-appropriate concerns. Children with chronic disease may require special assessment and treatment of oral diseases.

Barriers to Care

Despite the importance of dental care during pregnancy, many women, including those with private insurance, fail to receive care during this time due to personal challenges and barriers in accessing the delivery system

Access to oral health services for both pregnant women and young children is limited by a number of factors. On the health system side, these include lack of available resources, restrictive policies, provider attitudes and lack of cultural competency among dental providers. Common patient barriers are lack of perceived need and knowledge about the importance of oral health, financial (including lack of dental insurance), dental fear, lack of education, and limitations due to transportation, child care and work leave time issues. Public policies that reduce or eliminate barriers and support comprehensive dental services for vulnerable women of childbearing age need to be expanded, not only to safeguard their own oral and general health but also to reduce their children's risk of caries.[229]

System/Structural and Provider Barriers

Systems barriers to improving oral health and utilization of oral health services for pregnant women and their children are multifaceted. Low public-program reimbursement levels, lack of provider training, maldistribution of resources, capacity issues and provider attitudes limit access. Populations in which the greatest need/barriers exist include the uninsured and those covered by publicly funded programs. Women insured through medical and dental safety net programs often have difficulty finding participating providers. For instance, dentists may have concerns about treating low-income pregnant women because they may have a large burden of untreated dental disease and a short time period of eligibility for dental benefits.[230]

Fear of lawsuits may also be one of the factors for dentists' reluctance or refusal to see pregnant patients, although the incidence of lawsuits concerning pregnancy and dental care appears to be extremely low. Fear of medico-legal consequences related to radiographs and/or dental service tends to influence dentists, according to a U.K. study of general dentists.[231] However, The Dentists Insurance Company (TDIC)—which is endorsed by eight U.S. state dental associations and insures 17,000 dentists nationwide—reports only one incidence in the past 15 years or more. This case involved a pregnant patient who claimed her miscarriage was associated with radiographs, a claim not supported by scientific evidence.[232]

Oral health problems may also be exacerbated as a result of disparities such as an inadequate number of health care providers with cross-cultural training. Lack of provider diversity, particularly lack of multiple language capacity or interpreter services, may affect the ability to communicate oral health information in a sensitive and comprehensive manner.

Education and training on the specific oral health needs of infants and young children is inadequate in many dental education programs in the United States. Training has been shown to make a difference in increasing dentists' skills and comfort level in seeing children younger than five and in being willing to include more of this age group in their practices.[233] Attitudinal barriers about managing and treating young children can be reflected in medical and dental providers' practice behaviors. Believing that "parents aren't motivated and don't value baby teeth" or "it's a dentist's responsibility, not a physician's," for instance, have been cited as reasons for lack of involvement by dentists and primary care physicians, respectively.[234]

Prenatal care providers can play a crucial role in breaking down barriers to access and raising awareness about the importance of oral health. Health provider recommendations have been identified by patients as critical to the behaviors they incorporate into their daily activities.[235,236] Furthermore, as pregnancy is a "teachable moment" when women are motivated to change behaviors associated with poor pregnancy outcomes, providers can dispel misconceptions, such as the belief that bleeding in the mouth is "normal" during pregnancy, pain during dental procedures is unavoidable, radiographs during pregnancy are harmful to the fetus, and postponing treatment until after pregnancy is safer for the fetus and mother.

Patient Barriers

Many things occur during pregnancy that work against optimal oral health. Pregnancy is a life-changing event that can cause stress and uncertainty. Many factors can influence a woman's decision not to seek oral health services during pregnancy such as: financial pressures, the perception that oral health is not an important component of overall general health, dental care not being high on the list of life priorities, and fear of dental services and perceptions of potential danger of care during pregnancy.[237]

For low-income women, the cost of care can be prohibitive. Close to half of the 8,558 women surveyed in 2002-2007 in the California Maternal and Infant Health Assessment (MIHA) described earlier reported a dental problem of some sort during pregnancy. The main reasons for not receiving dental care during pregnancy among women with dental problems were financial barriers, cited by 28%; no perceived need, cited by 21%;

and attitudinal barriers, cited by 21%. Having insurance did not guarantee access, particularly for women with Medicaid; 79% of women with Medicaid (who should have had financial access to at least a minimal range of dental benefits at some point during pregnancy) did not receive dental care during pregnancy.

Employer-based health insurance does not always include dental benefits. Even when it does, not all private plans cover all dental services. Most employers of low-wage workers do not offer a dental insurance benefit; if offered, the employee portion of the premium is generally not affordable.[238] Lack of insurance leads many low-income pregnant women to avoid preventive dental visits for themselves and their children, and it puts added strain on emergency departments as patients resort to emergency services for serious dental problems.[239]

Children from low-income families are at higher risk of dental caries, and it may be hard for them to comply with recommendations that require the purchase of additional rinses, chewing gum and other products. Dental providers and early childhood professionals should be aware of this limitation.

Transportation and getting time off from work are practical barriers frequently cited by low-income parents that contribute to the factors that discourage providers from seeing these families: "No show" for appointments is a recognizable example. Acculturation and language barriers—difficulty speaking English to effectively communicate with health care providers—have also been shown to have some impact on determining use of dental care.[240]

Lack of education about the importance of dental care can result in parents' not understanding the connection between diet and tooth decay and failing to seek oral health services for young children. Many parents, including those who are well-educated, believe baby teeth are not important because they will be replaced by permanent teeth. The views of low-income and immigrant parents are especially important as these families have more limited access to resources and face greater challenges when seeking care. Results from the *First Smiles* evaluation (a $7 million oral health education and training program funded by First 5 California in 2004-2008), for instance, showed that while most parents attending WIC and Head Start sites reported an awareness of early childhood caries, 30% did not associate it with sugary contents.[241] Dental care and fear or anxiety have long been linked in popular culture,[242] and a number of *First Smiles* caregivers also disclosed this concern about themselves as a reason for not taking their child to a dentist. Personal experiences with dental care when encountering pain may also influence caregivers' attitudes about access and enthusiasm for dental care for young children.[243]

Beliefs and customs related to health also influence adoption of positive oral health practices. Use of nonfluoridated bottled and filtered water, besides being costly, may result in adverse dental health outcomes. For some families, drinking bottled water is a cultural norm. Latino immigrants for example, who have very high rates of caries, may be wary of drinking tap water and avoid it because they fear it causes illness.[244,245] Dental and other health care professionals should be aware of this belief and encourage the use of tap water in fluoridated areas, both for pregnant women and children, since community water fluoridation is a primary preventive intervention. Where the public water supply is not fluoridated, bottled water containing fluoride may be available.

Behavior change is a complex process. Understanding the process of change helps in ascertaining key influences that promote change and increase the likelihood of success in making positive changes. Various theories and belief models help to explain determinants such as the role of normative beliefs, although values, beliefs and practices vary across different social and cultural groups. Psychosocial factors such as oral health beliefs, norms of caregiver responsibility, and positive caregiver dental experiences have been shown to be associated with children's utilization of oral health services.[246] Motivation plays an important role in recognizing the need for change, being willing to overcome barriers to seek services, and achieving successful, sustained change. In general, motivation refers to the "personal considerations, commitments, reasons, and intentions that move individuals to perform certain behaviors."[247] For women who are pregnant, stage of pregnancy may be related to stage of readiness to change. Research related to quitting smoking, for example, suggests women in the first trimester show the greatest intention to stop smoking, signaling that pregnant women may be most receptive to quitting earlier in pregnancy than those who are further along.[248] While health behavior models that focus on the individual have implications for reducing patient barriers and promoting oral health behavior change, they tend to ignore the role of "macro-level influences within the larger framework of political, economic and cultural forces"[249] that limit the choices of women for whom societal inequities or ignorance reduce access to dental care.

Systems improvement and public policy changes are needed to increase utilization and quality of perinatal oral health services by women and young children. A policy brief that accompanies these Guidelines includes recommendations for funders, policymakers, dental and medical schools, and other advocates of maternal and child health to increase access to services and promote greater collaboration between the oral health and obstetrical communities.

Glossary of Terms

ACOG	American College of Obstetricians & Gynecologists. A nonprofit organization of women's health care physicians advocating high standards of practice and quality health care for women.
ADA	American Dental Association. A national association that promotes good oral health to the public.
Anticipatory guidance	A proactive developmentally based counseling technique that focuses on the needs of a child at each stage of life. Practical, timely information for parents and other caregivers allows them to anticipate impending changes and maximize their child's oral and general health potential.
CDA Foundation	California Dental Association Foundation. The philanthropic affiliate of the California Dental Association whose mission is to improve the oral health of Californians by supporting the dental profession and its efforts to meet community needs.
Chlorhexidine	An antimicrobial agent used as a surgical scrub, mouth rinse and topical antiseptic. It is effective against gram-positive organisms, gram-negative organisms, aerobes, facultative anaerobes and yeast.
Decalcification	The loss of calcium from the bones or teeth. Tooth decalcification is caused by the excessive buildup of plaque on the tooth enamel.
Demineralization	The process of removing minerals, in the form of mineral ions, from dental enamel. Demineralization is another term for "dissolving the enamel." It occurs when the bacteria that are normally found in the mouth use the sugars and carbohydrates from the food we eat to produce acids that dissolve the tooth structure, depleting it of calcium and phosphate.
Dental home	The ongoing relationship between the dentist who is the primary dental care provider and the patient, which includes comprehensive oral health care, beginning no later than age 1 (the official policy of the American Dental Association adopted October 2005). This relationship has beneficial consequences of appropriate care and reduced treatment costs, and provides access to otherwise unavailable services. The concept of a dental home is analogous to the "medical home" construct.

Early Childhood Caries	Also known as "baby bottle caries" or "baby bottle tooth decay," early childhood caries (ECC) is a common bacterial infection characterized by decay in the teeth of infants or young children. According to the American Academy of Pediatric Dentistry, ECC is defined as: one or more decayed, missing (due to caries), or filled tooth surfaces in any primary tooth in a child <71 months (i.e., age 6). In children <age 3, any sign of smooth-surface caries is indicative of severe ECC.
Eclampsia	Seizures (convulsions) in a pregnant woman that are not related to brain conditions. Also referred to as "toxemia with seizures," eclampsia follows preeclampsia. Treating preeclampsia may prevent eclampsia.
Fermentable carbohydrates	Foods containing all forms of sweets and sugars, cooked starches such as pasta and rice, bread, and chip products. These are the ideal substrate for microbial action that stimulates caries development. A food's form influences how long it will be retained in the mouth and consequently the exposure of teeth to acids. Foods that contain fermentable carbohydrates when in contact with oral microorganisms can cause plaque pH to drop, thereby initiating the caries process.
Folic acid	A B vitamin that helps prevent birth defects of the brain and spinal cord when taken before pregnancy, or by the first months of pregnancy. It is available in most multivitamins, as a folic acid-only supplement and in some foods.
Gestational diabetes	A condition in which women without previously diagnosed diabetes exhibit high blood glucose levels during pregnancy. Pregnancy hormones and other factors are thought to interfere with the action of insulin, causing glucose to remain in the bloodstream and glucose levels to rise.
MCAH	Maternal, Child and Adolescent Health. A comprehensive program that supports services and educational programs to maximize the health and quality of life for women, infants, children and adolescents and their families.
MIHA	Maternal and Infant Health Assessment.
Mutans streptococci	Cariogenic bacteria found in dental plaque and one of two index organisms (*Lactobacillus* is the other) used to assess caries susceptibility.

NSAIDs	Nonsteroidal anti-inflammatory drugs are drugs with analgesic, antipyretic (lowering an elevated body temperature and relieving pain without impairing consciousness) and, in higher doses, anti-inflammatory effects. The most prominent members of this group of drugs are aspirin, ibuprofen, and naproxen, partly because they are available over-the-counter in many areas. There is little difference in clinical efficacy among the NSAIDs when used at equivalent doses. Differences among compounds tend to be with regards to dosing regimens (related to the compound's elimination half-life), route of administration, and tolerability profile.
Perinatal	Generally the period around childbirth (i.e., 3 months prior to and a month following). The term is used in this document to more broadly include the entire prenatal and postpartum periods. In its broadest sense of maternal and child health, "perinatal" could include time after and between pregnancies.
Periodontal disease	Also known as gum disease, periodontal disease is caused by infection and inflammation of the gingiva (gum), the periodontal connective tissues and the alveolar bone, which can lead to tooth loss.
Postural hypotensive syndrome	An abnormal decrease in blood pressure when a person stands up that may lead to fainting. A slight fall in systolic blood pressure is normal upon rising. Abnormal postural hypotension involves a decrease in both systolic and diastolic pressures with changes in heart rate.
PRAMS	Pregnancy Risk Assessment Monitoring System. A surveillance project of the Centers for Disease Control and Prevention and state health departments that collects state-specific, population-based data on maternal attitudes and experiences before, during, and shortly after pregnancy.
Pre-eclampsia	High blood pressure and protein in the urine that develops after the 20th week of pregnancy. Some women develop high blood pressure without the proteinuria (protein in urine); this is called pregnancy-induced hypertension (PIH) or gestational hypertension. Both pre-eclampsia and PIH are regarded as very serious conditions and require careful monitoring of mother and baby.
Remineralization	Remineralization is the process of replacing the essential minerals lost from teeth by demineralization.
Supine position	A position of the body: lying down with the face up, as opposed to the prone position, which is face down.
Xylitol	A "tooth friendly" nonfermentable sugar alcohol with indicated dental heath benefits in caries prevention.

Project Participants

Co-Chairs

Ellen J. Stein, MD, MPH *Medical Director* San Francisco County Department of Public Health Maternal, Child and Adolescent Health	**Jane A. Weintraub, DDS, MPH** *Lee Hysan Professor and Chair* Division of Oral Epidemiology and Dental Public Health University of California, San Francisco School of Dentistry

Advisory Committee

Carolyn Brown, DDS *Dental Director, Programs and Development* Native American Health Center San Francisco	**Jeanne Conry, MD** *Permanente Medical Group* Roseville Medical Center Department of Women's Health
Mary Foley, RDH, MPH *Dean* Forsyth School of Dental Hygiene, Massachusetts College of Pharmacy and Health Sciences	**Irene Hilton, DDS, MPH** *Public Health Dentist* San Francisco Department of Public Health Board Member, National Network for Oral Health Access
Margy Hutchison, CNM *Associate Clinical Professor,* University of California, San Francisco, Department of Obstetrics, Gynecology and Reproductive Science Representative, California Nurse-Midwives Association	**Robert Isman, DDS, MPH** *Dental Program Consultant* Medi-Cal Dental Services Branch California Department of Health Care Services
Jayanth Kumar, DDS, MPH *Director* Oral Health Surveillance & Research Bureau of Dental Health New York State Department of Health	**Gayle Mathe, RDH** *Manager, Policy Development* California Dental Association
Rosalía A. Mendoza, MD, MPH *Assistant Professor* University of California, San Francisco, Department of Family and Community Medicine Family Health Center	**Richard Pan, MD, MPH, FAAP** *Associate Professor of Clinical Pediatrics* University of California, Davis, and Vice-Chair American Academy of Pediatrics, District IX

Lorena Martinez-Ochoa *MCAH Program Manager* Family, Maternal and Child Health Programs Contra Costa County Health Services	**Lindsey Robinson, DDS** *President* California Society of Pediatric Dentistry
Renee Samelson, MD, MPH, FACOG *Associate Clinical Professor* Maternal-Fetal Medicine Albany Medical College	**Cheryl H. Terpak, RDH, MS** *Oral Health Consultant* Maternal, Child and Adolescent Health California Department of Public Health
	Maureen Titus, RDHAP, BS California Dental Hygienists' Association

Expert Panel

Gary C. Armitage, DDS, MS *R. Earl Robinson Distinguished Professor* Division of Periodontology Department of Orofacial Sciences University of California, San Francisco	**Kim A. Boggess, MD** *Associate Professor* Division of Maternal Fetal Medicine Department of Obstetrics and Gynecology University of North Carolina at Chapel Hill
Paula Braveman, MD, MPH *Professor of Family and Community Medicine and Director of the Center on Social Disparities in Health* University of California, San Francisco	**Jayanth V. Kumar, DDS, MPH** *Director* Oral Health Surveillance & Research Bureau of Dental Health New York State Department of Health
Aaron Caughey, MD, PhD *Associate Professor in Residence* Department of Obstetrics, Gynecology, and Reproductive Sciences University of California, San Francisco	**Kristen Marchi, MPH** *Senior Epidemiologist* Center on Social Disparities in Health Department of Family and Community Medicine University of California, San Francisco
David W. Chambers, EdM, MBA, PhD *Professor of Dental Education* University of the Pacific Arthur A. Dugoni School of Dentistry	**Panos N. Papapanou, DDS, PhD** *Professor of Dental Medicine* Chairman, Section of Oral and Diagnostic Sciences Director, Division of Periodontics Columbia University College of Dental Medicine

Ronald A. Chez, MD, FACOG *Perinatologist* Retired Professor of Obstetrics and Gynecology	**Bruce L. Pihlstrom, DDS, MS** *Professor Emeritus,* University of Minnesota Oral Health Research Consultant
John D.B. Featherstone, MSc, PhD *Professor and Dean* School of Dentistry University of California, San Francisco	**Renee Samelson, MD, MPH, FACOG** *Associate Clinical Professor* Obstetrics and Gynecology Albany Medical College
James E. (Jef) Ferguson, II, MD, MBA *The John W. Greene, Jr., Professor and Chair* Department of Obstetrics and Gynecology University of Kentucky College of Medicine	**Juan E. Vargas, MD** *Associate Clinical Professor* University of California, San Francisco Department of Obstetrics, Gynecology and Reproductive Sciences, and Radiology *Director of Obstetrics* San Francisco General Hospital
Irva Hertz-Picciotto, PhD, MPH *Professor of Epidemiology and Chief* Division of Environmental & Occupational Health University of California, Davis	

Staff and Consultants

Project Director: **Rolande T. Loftus, MBA** *Program Director* California Dental Association Foundation	Guidelines Writer: **Barbara M. Aved, RN, PhD, MBA** *President, Barbara Aved Associates*

Attachment 1

Oral Health Referral Form for Pregnant Women*

PATIENT NAME
DOB
PRIMARY CARE PROVIDER
Patient ID / Addressograph

Date: _____ Referred to: _____
Reason for referral: ☐ Routine ☐ Bleeding gums ☐ Pain ☐ Other _____
Weeks' gestation *(at time of referral)*: ___ Estimated delivery date: _____ Patient phone: _____
Primary language spoken: _____

☐ **This patient is cleared for routine evaluation and dental care, which may include but is not limited to:**

- Dental X-rays as needed for diagnosis *(with abdominal and neck lead shield)*
- Oral health examination
- Dental prophylaxis
- Scaling and root planing
- Restoration of untreated caries
- Extraction
- Standard local anesthetic *(lidocaine with or without epinephrine)*
- Analgesics (if needed): acetaminophen and/or acetaminophen with codeine *(Nonsteroidal anti-inflammatory drugs are not recommended during pregnancy)*
- Antibiotics (if needed and no known allergies): penicillin, amoxicillin, cephalosporin, clindamycin, erythromycin — not estolate form *(Cipro and tetracycline are not recommended during pregnancy.)*

Significant Medical Conditions:
☐ NONE ☐ YES *(e.g., heart condition, liver disease, kidney disease, etc.)*

_____
_____
_____

Known Allergies: ☐ NONE ☐ YES
Drug(s)/Reactions(s): _____
_____
_____
_____

Current Medications: ☐ NONE
☐ Prenatal vitamins ☐ Iron ☐ Calcium
☐ OTHERS *(Attach updated list of active Rx)*

_____
_____
_____

Any Precautions: ☐ NONE ☐ SPECIFY *(List if any coments or instructions)*

_____
_____
_____

Prenatal care provider *(print name)*: _____
Phone/pager: _____ Fax #: _____
Signature: _____ Date: _____

Dentist: Please fax information back (to prenatal care provider, fax # above) after initial dental visit:
Exam date: _____ ☐ Normal exam/recall ☐ Missed appointment
☐ Needs additional treatment visits for: ☐ Caries ☐ Periodontitis ☐ Referral to oral surgery ☐ Other _____
Comments: _____
_____
_____
Dentist signature: _____ Date: _____
Phone: _____

*Adapted from San Francisco General Hospital and Trauma Center, Community Health Network

Attachment 2

Caries Risk Assessment Form (Ages 0-6)

Patient Name: Score:

Birth Date: Date:

Age: Initials:

		Low Risk (0)	Moderate Risk (1)	High Risk (10)	Patient Risk
Contributing Conditions					
I.	**Fluoride Exposure** (through drinking water, supplements, professional applications, toothpaste)	Yes	No		
II.	**Sugary or Starchy Foods or Drinks** (including juice, carbonated or non-carbonated soft drinks, energy drinks, medicinal syrups)	Primarily at mealtimes	Frequent or prolonged between meal exposures/day	Bottle or sippy cup with anything other than water at bed time	
III.	Eligible for Government Programs (WIC, Head Start, Medicaid or SCHIP)	No		Yes	
IV.	Caries Experience of Mother, Caregiver and/or Other Siblings	No carious lesions in last 24 months	Carious lesions in last 7-23 months	Carious lesions in last 6 months	
V.	Dental Home: established patient of record in a dental office	Yes	No		
General Health Conditions					
I.	**Special Health Care Needs***	No		Yes	
Clinical Conditions					
I.	Visual or Radiographically Evident Restorations/Cavitated Carious Lesions	No carious lesions or restorations in last 24 months		Carious lesions or restorations in last 24 months	
II.	Non-cavitated (incipient) Carious Lesions	No new lesions in last 24 months		New lesions in last 24 months	
III.	Teeth Missing Due to Caries	No		Yes	
IV.	Visible Plaque	No	Yes		
V.	Dental /Orthodontic Appliances Present (fixed or removable)	No	Yes		
VI.	Salivary Flow	Visually adequate		Visually inadequate	
				TOTAL:	

Instructions for Caregiver:

*Patients with developmental, physical, medical or mental disabilities that prevent or limit performance of adequate oral health care by themselves or caregivers.

ADA American Dental Association®

See instructions on p. 64.

Instructions for Attachment 2, p. 63

Indicate 1 or 10 in the last column for each risk factor. If the risk factor was not determined or is not applicable, enter a 0 in the patient risk factor column. Total the factor values and record the score at the top of the page.

A score of 0 indicates that a patient has a low risk for the development of caries. A single high risk factor, or score of 10, places the patient at high risk for development of caries. Scores between 1 and 10 place the patient at a moderate risk for the development of caries. Subsequent scores should decrease with reduction of risks and therapeutic intervention.

The clinical judgment of the dentist may justify a change of the patient's risk level (increased or decreased) based on review of this form and other pertinent information. For example, missing teeth may not be regarded as high risk for a follow-up patient; or other risk factors not listed may be present.

The assessment cannot address every aspect of a patient's health and should not be used as a replacement for the dentist's inquiry and judgment. Additional or more focused assessment may be appropriate for patients with specific health concerns. As with other forms, this assessment may be only a starting point for evaluating the patient's health status.

This is a tool provided for the use of ADA members. It is based on the opinion of experts who utilized the most up-to-date scientific information available. The ADA plans to periodically update this tool based on: 1) member feedback regarding its usefulness, and; 2) advances in science. ADA member-users are encouraged to share their opinions regarding this tool with the Council on Dental Practice.

Attachment 3

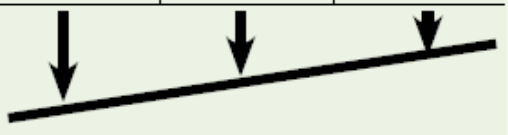
TABLE 1

Caries Risk Assessment Form — Children Age 6 and Over/Adults

Patient Name: _____ Chart #: _____ Date: _____

Assessment Date: Is this (please circle) base line or recall

Disease Indicators (Any one "YES" signifies likely "High Risk" and to do a bacteria test**)	YES = CIRCLE	YES = CIRCLE	YES = CIRCLE
Visible cavities or radiographic penetration of the dentin	YES		
Radiographic approximal enamel lesions (not in dentin)	YES		
White spots on smooth surfaces	YES		
Restorations last 3 years	YES		
Risk Factors (Biological predisposing factors)		YES	
MS and LB both medium or high (by culture**)		YES	
Visible heavy plaque on teeth		YES	
Frequent snack (> 3x daily between meals)		YES	
Deep pits and fissures		YES	
Recreational drug use		YES	
Inadequate saliva flow by observation or measurement (**If measured, note the flow rate below)		YES	
Saliva reducing factors (medications/radiation/systemic)		YES	
Exposed roots		YES	
Orthodontic appliances		YES	
Protective Factors			
Lives/work/school fluoridated community			YES
Fluoride toothpaste at least once daily			YES
Fluoride toothpaste at least 2x daily			YES
Fluoride mouthrinse (0.05% NaF) daily			YES
5,000 ppm F fluoride toothpaste daily			YES
Fluoride varnish in last 6 months			YES
Office F topical in last 6 months			YES
Chlorhexidine prescribed/used one week each of last 6 months			YES
Xylitol gum/lozenges 4x daily last 6 months			YES
Calcium and phosphate paste during last 6 months			YES
Adequate saliva flow (> 1 ml/min stimulated)			YES
**Bacteria/Saliva Test Results: MS: LB: Flow Rate: ml/min. Date:			



VISUALIZE CARIES BALANCE
(Use circled indicators/factors above)
(EXTREME RISK = HIGH RISK + SEVERE SALIVARY GLAND HYPOFUNCTION)
CARIES RISK ASSESSMENT (CIRCLE): EXTREME HIGH MODERATE LOW

Doctor signature/#: _____ Date: _____

Table reprinted from *Journal of the California Dental Association*, October 2007, p. 704.

TABLE 1

CAMBRA for Dental Providers (0-5) Assessment Tool

Caries Risk Assessment Form for Age 0 to 5

Patient name:_____ I.D.#_____ Age_____ Date_____

Initial/base line exam date_____ Caries recall date_____

Respond to each question in sections 1, 2, 3, and 4 with a check mark in the "Yes" or "No" column	Yes	No	Notes
1. Caries Risk Indicators — Parent Interview**			
(a) Mother or primary caregiver has had active dental decay in the past 12 months			
(b) Child has recent dental restorations (see 5b below)			
(c) Parent and/or caregiver has low SES (socioeconomic status) and/or low health literacy			
(d) Child has developmental problems			
(e) No dental home/episodic dental care			
2. Caries Risk Factors (Biological) — Parent Interview**			
(a) Child has frequent (greater than three times daily) between-meal snacks of sugars/cooked starch/sugared beverages			
(b) Child has saliva-reducing factors present, including: 1. Medications (e.g., some for asthma or hyperactivity) 2. Medical (cancer treatment) or genetic factors			
(c) Child continually uses bottle - contains fluids other than water			
(d) Child sleeps with a bottle or nurses on demand			
3. Protective Factors (Nonbiological) — Parent Interview			
(a) Mother/caregiver decay-free last three years			
(b) Child has a dental home and regular dental care			
4. Protective Factors (Biological) — Parent Interview			
(a) Child lives in a fluoridated community or takes fluoride supplements by slowly dissolving or as chewable tablets			
(b) Child's teeth are cleaned with fluoridated toothpaste (pea-size) daily			
(c) Mother/caregiver chews/sucks xylitol chewing gum/lozenges 2-4x daily			
5. Caries Risk Indicators/Factors — Clinical Examination of Child**			
(a) Obvious white spots, decalcifications, or obvious decay present on the child's teeth			
(b) Restorations placed in the last two years in/on child's teeth			
(c) Plaque is obvious on the child's teeth and/or gums bleed easily			
(d) Child has dental or orthodontic appliances present, fixed or removable: e.g., braces, space maintainers, obturators			
(e) Risk Factor: Visually inadequate saliva flow - dry mouth			
**If yes to any one of 1(a), 1(b), 5(a), or 5(b) or any two in categories 1, 2, 5, consider performing bacterial culture on mother or caregiver and child. Use this as a base line to follow results of antibacterial intervention.	Parent/Caregiver Date:		Child Date:
(a) Mutans streptococci (Indicate bacterial level: high, medium, low)			
(b) Lactobacillus species (Indicate bacterial level: high, medium, low)			

Child's overall caries risk status: (CIRCLE) Extreme	Low	Moderate	High

Recommendations given: Yes_____ No_____ Date given_____ Date follow up:_____

SELF-MANAGEMENT GOALS 1) _____ 2)_____

Practitioner signature_____ Date_____

Table reprinted from *Journal of the California Dental Association*, October 2007, p. 689.

Helpful Web Sites for Patients

www.ccfc.ca.gov/parents
Information on health, education, services and support for children younger than 5 and their families from First 5 California.

www.first5oralhealth.org
Site of First Smiles, a California initiative to address the "silent epidemic" of early childhood caries affecting children ages 0-5.

www.aapd.org/foundation/hints.asp
Answers to commonly asked questions from the Foundation of the American Academy of Pediatric Dentistry's "Healthy Smiles, Healthy Children."

www.cdph.ca.gov/certlic/drinkingwater/Documents/Fluoridation/Fluoridationdatafor2008.pdf
California statewide fluoridation table provides information by county on water systems that add fluoride to the optimal level.

www.cda.org/page/patient_education_tools
Patient education tools on a variety of topics available in English, Spanish, Hmong, Chinese, Russian and Vietnamese.

www.cda.org/clinics
Search for clinics in California that offer free or discounted dental services.

www.everywomancalifornia.org
Developed by the Preconception Health Council of California in collaboration with the Maternal Child and Adolescent Health Division of the California Department of Public Health, this Web site provides information about health considerations for women and their partners before they become pregnant for the first time or between pregnancies, often called preconception health.

www.mchoralhealth.org/materials/perinatal.html
National Maternal and Child Oral Health Resource Center.

www.cavityfreeatthree.org/GetMaterials/PatientEducationMaterials
Patient education materials in English and Spanish developed by "Cavity Free at Three," a project of the Caring for Colorado Foundation.

www.cdhp.org/resource/surprising_truth_about_cavities
October 2006 article that appeared in *Parents Magazine*, accessed through the Children's Dental Health Project.

www.womenshealth.gov/faq/oral-health.cfm
Frequently asked questions about oral health answered by the National Women's Health Information Center

www.dhcs.ca.gov/services/chdp/Pages
The Child Health and Disability Prevention is a preventive program that delivers periodic health assessments and services to low income children and youth in California.

www.sharethecaredental.org/website/resources/dentalhealth
The Dental Health Initiative of San Diego/Share the Care offers a number of educational resources featuring their dental mascot, Baxter Beaver.

References

1 Beetstra S et al. A health commons approach to oral health for low-income populations in a rural state. *Am J Public Health*. 2002 January; 92(1): 12–13.

2 Boggess KA. Maternal oral health in pregnancy. *Obstet Gynecol.*. 2008;111:976-986.

3 U.S. Department of Health and Human Services. *Oral health in America: a report of the Surgeon General*. NIH Publication No. 00-4713, Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, National Institute of Dental and Craniofacial Research, May 2000.

4 Silk H, et al. Oral health during pregnancy. *Amer Fam Physician*. 2008;77:1139-1144.

5 Kumar J, Samuelson R, eds. Oral health care during pregnancy and early childhood: practice guidelines. New York, NY: New York State Department of Health, 2006.

6 Dellinger TM, Livingston HM. Pregnancy: physiologic changes and considerations for dental patients. *Dent Clin N Amer*. October 2006;50(4):677-697.

7 Al-Habashneh R et al. Survey of medical doctors' attitudes and knowledge of the association between oral health and pregnancy outcomes. *International J Dent Hygiene*. 2008;6:214-220.

8 Aved B, Meyers L, Burmas E. *California First 5 Oral Health Education and Training Program. Final Evaluation Report*. Barbara Aved Associates, Sacramento, CA. 2008.

9 Drum MA, Chen DW, Duffy RE. Filling the gap: equity and access to oral health services for minorities and the underserved. *Fam Med*. 1998;30(3):206-209.

10 Mouradian WE, Berg JH, Somerman MJ. Addressing disparities through dental-medical collaborations, Part 1: The role of cultural competency in health disparities: training of primary care medical practitioners in children's oral health. *J Dent Educ*. 2003;8(67):860-868.

11 Gajendra S, Kumar JV. Oral health and pregnancy: a review. *NY State Dent J.*. 2004;70:40-44.

12 Offenbacher S, Boggess KA, Murtha AP. Progressive periodontal disease and risk of very preterm delivery. *Obstet Gynecol*. 2006;107;229-36.

13 Gaffield ML, Gilbert BJ, Malvitz DM, Romaguera R. Oral health during pregnancy: an analysis of information collected by the pregnancy risk assessment monitoring system. *J Amer Dent Assoc*. 2001:132;1009-1016.

14 Marchi L, Fisher-Owens S, Weintraub J, Yu Z, and Braveman P. Factors Associated with Non-Receipt of Oral Health Care during Pregnancy. Manuscript under review, Public Health Reports, October 2009.

15 *A Look at California's Medicaid Dental Program: Facts and Figures*. California HealthCare Foundation. May 2007.

16 U.S. Department of Health and Human Services. *Oral health in America: a report of the Surgeon General*. NIH Publication No. 00-4713, Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, National Institute of Dental and Craniofacial Research, May 2000.

17 Vargas CM, Crall JJ, Schneider DA. Sociodemographic distribution of pediatric dental caries: NHANES III, 1988-1994. *J Am Dent Assoc*. 1998;129:1229-1238.

18 *Mommy It Hurts to Chew*. An Oral Health Needs Assessment of California Kindergarten and Third Grade Children. Dental Health Foundation. February 2006.

19 United States General Accounting Office. *Dental disease is a chronic problem among low-income populations*. Report to Congressional Requesters. 2000

20 National Center for Education in Maternal and Child Health and Georgetown University. *Fact sheet: Oral health and learning*. Arlington, VA: NCEMCH; 2001.

21 Fisher-Owens SA, Barker JC, Adams S, Chung LH, et al. Giving policy some teeth: routes to reducing disparities in oral health. *Health Affairs* 2008;27(2):404-412.

22 Allston AA. Improving women's health and perinatal outcomes: the impact of oral diseases. Baltimore, MD:Women's and Children's Health Policy Center, 2002. http://www.jhsph.edu/wchpc/publications/. Accessed June 17, 2009.

23 Strafford K, Shellhaas C, Hade EM. Provider and patient perceptions about dental care during pregnancy. *J Mat Fetal & Neonat Med*. December 2007;21(1):63-71.

24 Henshaw SK. Unintended pregnancy in the United States. *Fam Plann Perspect*. 1998;30:24-29.

25 Takahashi ER, Libet M, Ramstrom K, Jocson MA, and Marie K (Eds). Preconception Health: Selected Measures, California, 2005. Maternal, Child and Adolescent Health Program, California Department of Public Health, Sacramento, CA: October 2007.

26 Boggess KA, Edelstein B. Oral health in women during preconception and pregnancy: implications for birth outcomes and infant oral health. *Matern Child Health J*. 2006;10:S169–S174.

27 Moos MK, Cefalo RC. Preconceptional health promotion: a focus for obstetric care. *Am J Perinatol*. 1987;4:63-67.

28 US Department of Health and Human Services. Caring for our future: the content of prenatal care: a report of the Public Health Service Expert Panel on the Content of Prenatal Care. Washington, DC: US Department of Health and Human Services, Public Health Service. 1989.

29 Johnson K, et al. Recommendations to Improve Preconception Health and Health Care, United States. A Report of the CDC/ATSDR Preconception Care Work Group and the Select Panel on Preconception Care. *MMWR*. April 21, 2006. 55(RR06);1-23.

30 U.S. Department of Health and Human Services. *Oral health in America: a report of the Surgeon General*. NIH Publication No. 00-4713, Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, National Institute of Dental and Craniofacial Research, May 2000.

31 U.S. Department of Health and Human Services. Oral Health in America: A Report of the Surgeon General. NIH Publication No. 00-4713, Rockville, MD: U.S. Department of Health and Human Services, National Institute of Dental and Craniofacial Research. May 2000.

32 Creasy R K, Resnik R. Maternal-Fetal Medicine Principles and Practice. 5th ed. Philadelphia: W. B. Saunders, 2004.

33 Hernández-Díaz S, Werler MM, Walker AM, Mitchell AA. Folic acid antagonists during pregnancy and the risk of birth defects. *New Eng J Med*. November 2002;343(22):1608-1614.

34 Owens JR, Jones JW, Harris F. Epidemiology of facial clefting. *Arch Dis Child*. 1985;60:521-524.

35 Hall J, Solehdin F. Folic acid for the prevention of congenital anomalies. *Euro J Peds*. May 1998;157(6):445-450.

36 Hujoel PP, Bollen AM, Noonan CJ, del Aguila MA. Antepartum dental radiography and infant low birth weight. *JAMA*. 2004; 291(16):1987-1993.

37 Li X, Kolltveit KM, Tronstad L, Olsen I. Systemic diseases caused by oral infection. *Clin Microbiol Rev*. 2000; 13(4):547-558.

38 American Academy of Periodontology statement regarding periodontal management of the pregnant patient. *J Periodontol*. 2004; 75(3):495.

39 Timothe P, Eke PI, Presson SM, Malvitz DM. Dental care use among pregnant women in the United States reported in 1999 and 2002. *Prev Chronic Dis*. 2005;2(1)A10.

40 Gaffield ML, Colley Gilbert BJ, Malvitz DM, Romaguera R. Oral health during pregnancy. An analysis of information collected by the Pregnancy Risk Assessment Monitoring System. *J Am Dent Assoc*. 2006;132(7):1009-1016.

41 Lydon-Rochelle MT, Krakowiak P, Hujoel PP, Peters RM. Dental care use and self-reported dental problems in relation to pregnancy. *Amer J Pub Health*. May 2004;494(5):765-771.

42 Medi-Cal Funded Deliveries 2004. California Department of Health Services, Medical Care Statistics Section. 2006.

43 California Medi-Cal Dental Program. Department of Health Services, Sacramento, CA. *Denti-Cal Bulletin*. December 2005;(21)41.

44 Marchi L, Fisher-Owens S, Weintraub J, Yu Z, and Braveman P. Factors Associated with Non-Receipt of Oral Health Care during Pregnancy. Manuscript under review, Public Health Reports, October 2009.

45 Rieken SE, Terezhalmy GT. The pregnant and breastfeeding patient. *Quintessence Int*. 2006 June;37(6):455-68.

46 Duvekot JJ, Peeters LLH. Maternal cardiovascular hemodynamic adaptation to pregnancy. *Obstet Gynecol Surv*. December 1994;49(12) Supplement:S1.

47 Rosen MA. Management of anesthesia for the pregnant surgical patient. *Anesthesiology*. 1999;91(4):1159-1163.

48 Bonica JJ, McDonald JS. Principles And Practices of Obstetric Analgesia and Anesthesia, 2nd ed. 2004. Williams & Wilkins:Baltimore.

49 Toppozada H, Michaeals L, Toppozada M, et al. The human respiratory nasal mucosa in pregnancy. An electron microscopic and histochemical study. *J Laryngol Otol*. 1982;96:613-626.

50 Hughes SC, Levinson G, Rosen MA (eds.). Schnider and Levinson's Anesthesia for Obstetics, 4th ed. 2001. Lippincott Williams & Wilkins:Philadelphia.

51 Hughes SC, Levinson G, Rosen MA (eds.). Schnider and Levinson's Anesthesia for Obstetics, 4th ed. 2001. Lippincott Williams & Wilkins:Philadelphia.

52 Ali DA, et al. Dental erosion caused by silent gastroesophageal reflux disease. *J Am Dent Assoc*. 2002;133(6): 734-737.

53 Pitkin RM, Witte DL. Platelet and leukocyte counts in pregnancy. *JAMA*. 1979;242:2696-2698.

54 Bremme K, Haemostatic changes in pregnancy. *Best Pract Res Clin Haematol*. 2003;16:153 and Paldas MJ, Ku DW, Lee MJ, et al. Protein Z, Protein S levels are lower in patients with thrombophilia and subsequent pregnancy complications. *J Thromb Haemost*. 2005;3:497.

55 Kidd P. Th1/Th2 Balance:The hypothesis, its limitations, and implications for health and disease. *Altern Med Rev*. 2003;8(3):223-246.

56 Lawrence HP. Salivary markers of systemic disease: Noninvasive diagnosis of disease and monitoring of general health. *J Can Dent Assoc*. 2002; 68(3):170-174.

57 Warburton D, Fraser FC. Spontaneous abortion risks: data from reproductive histories collected in a medical genetics unit. *Hum Genet*. 1964;16: 1-25.

58 Simpson JL. Incidence and timing of pregnancy losses: relevance to evaluating safety of early prenatal diagnosis. *Amer J Med Genet*. June 2005; 35:165-173.

59 Tucker J, McGuire W. Epidemiology of preterm birth. *BMJ*. 2004;329:675-678.

60 Goldenberg RL, Rouse DJ. Prevention of premature birth. *NEJM*. 1998;339(5):313-320.

61 Mercer BM. Preterm premature rupture of the membranes. *Obstet Gyn* January 2003;101(1): 178-193.

62 Michalowicz BS, Hodges JS, DeAngelis AJ, et al. Treatment of periodontal disease and the risk of preterm birth. *NEJM*. November 2006;355(18):1885-1894.

63 Offenbacher S, Beck J, Jared H, Mauriello SM, Mendoza LC, Couper DJ, Stewart DB, Murtha AP, Cochran DL, Dudley DJ, Reddy MS, Geurs NC, Hauth JC. Effects of periodontal therapy on rate of preterm delivery. *Am J Obstet Gynecol*. September 2009;114(3):551-559.

64 Srinivas SK, Sammel MD, Stamilio DM, Clotheir B, Jeffcoat MK, Parry S, Macones GA, Elovitz MA, Metlay J. Periodontal disease and adverse pregnancy outcomes: is there an association? *Am J Obstet Gynecol*. 2009;200:497.e1-497.e8.

65 Garner PR, D'Alton ME, Dudley DK, et al. Preeclampsia in diabetic pregnancies. *Am J Obstet Gynecol*. August 1990;163(2):505-508.

66 Sibai BM, Gordon T, Thom E, et al. Risk factors for preeclampsia in healthy nulliparous women: A prospective multicenter study. The National Institute of Child Health and Human Development Network of Maternal-Fetal Medicine Units. *Am J Obstet Gynecol*. 1995;172(2 Pt 1):642-648.

67 Dekker GA, Robillard PY, Hulsey TC. immune maladaptation in the etiology of preeclampsia: a review of corroborative epidemiologic studies. *Obst & Gynecol Surv*. June 1998;53(6):377-382.

68 Visser W, Wallenburg HCS. Temporising management of severe pre-eclampsia with and without the HELLP syndrome. *Obstet & Gynecol Surv*. August 1995;50(8):571-573.

69 Sibai BM, Gordon T, Thom E, et al. Risk factors for preeclampsia in healthy nulliparous women: A prospective multicenter study. The National Institute of Child Health and Human Development Network of Maternal-Fetal Medicine Units. *Am J Obstet Gynecol*. 1995;172(2 Pt 1):642-648.

70 Herrera JA, et al. Periodontal disease severity is related to high levels of C-reactive protein in pre-eclampsia. J Hyperten. July 2007;25(7):1459-1464.

71 Barak S, et al. Evidence of periopathogenic microorganisms in placentas of women with preeclampsia. *J Periodon*. 2007;78(4):670-676.

72 Lindsay RS. Gestational diabetes: causes and consequences. *Brit J Diab & Vasc Dis*. 2009;9:27-31.

73 Dabelea D, Snell-Bergeon JK, Hartsfield CL, Bischoff KJ, Hamman RF, McDuffie RS. Increasing prevalence of gestational diabetes mellitus (GDM) over time and by birth cohort: Kaiser Permanente of Colorado GDM Screening Program. *Diabetes Care*. 2005;28:579–584.

74 Metzger BE, Lowe LP, Dyer AR *et al*. Hyperglycemia and adverse pregnancy outcomes. *N Engl J Med* 2008;358:1991–2002.

75 Novak KF, Taylor GW, Dawson DR, Ferguson JE, Novak J. Periodontitis and gestational diabetes mellitus: Exploring the link in NHANES III. *J Pub Hlth Dent*. May 2007;66(3):163-168.

76 Armitage G. Bidirectional relationship between pregnancy and periodontal disease. *Periodontology* 2000 (in press for 2009).

77 Belcher C, Doherty M, Crouch SPM. Synovial fluid neutrophil function in RA; the effect of pregnancy associated proteins. *Ann Rheum Dis* 2002;61:379-380.

78 Ismail SK, Kenney L. Review of hyperemesis gravidarum. *Best Pract Res Clin Gaastroenterol*. 2007;21:755-769.

79 M Pirie, I Cooke, G Linden, C Irwin. Dental manifestations of pregnancy. *Obstetrician & Gynaecologist*. 2007;9:1:21-26.

80 Laine MA. *Acta Odontologica Scandinavica*. October 2000;260:257-264.

81 Jensen J, Lilijmack W, Bloomquist C, The effect of female sex hormones on subgingival plaque. *J Peridontol* 1981;52:599-602.

82 Steinberg B. Women's oral health issues. *J Calif Dent Assoc*. 2000;28:663-667.

83 Laine MA. *Acta Odontologica Scandinavica*. October 2000;260:257-264.

84 Y Demir, S Demir, F Aktepe. Cutaneous lobular capillary hemangioma induced by pregnancy. *J Cutan Path*. 2004;31:77-80.

85 Steinberg B. Women's oral health issues. *J Calif Dent Assoc*. 2000;28:663-667.

86 Rose LF, Sex hormonal imbalances, oral manifestations and dental treatment. In, Gonco RJ, Goldman HM, Cohen DW, eds, *Contemporary Periodontics*. Mosby Publishing Co, St. Louis, 221-7, 1990.

87 Rateitschak KG, Tooth mobility changes in pregnancy. *J Periodontol Res* 2:199-206, 1967.

88 Gürsoy M, Pajukanta R, Sorsa T, Könönen E. Clinical changes in periodontium during pregnancy and postpartum. *J Clin Periodontology*. 2008;35:576-583.

89 Tilakaratne et al. Periodontal disease status during pregnancy and three months postpartum in a rural population of Sri-Lankan women. *J Clin Periodontol*. 2000;27:787-792.

90 Silness J, LÖe H. Periodontal disease in pregnancy. II. Correlation between oral hygiene and oral condition. *Acta Odontol Scand*. 1964;22:121-135.

91 Moss KL JD Beck, S Offenbacher. Clinical risk factors associated with incidence and progression of periodontal conditions in pregnant women. *J Clin Periodontol*. 2005;32492-498.

92 Guggenheimer J, Moore PA. Xerostomia:etiology, recognition and treatment. *J Am Dent Assoc*. 2003;134(1):61-69.

93 Schafer TE, Adair, SM Prevention of dental disease. The role of the pediatrician. *Pediatric Clinics of North America*. 2000 Oct;47(5):1021-1042, v-vi.

94 Offenbacher S, Katz V, Fertik G, Collins J, Boyd D, Maynor G, et al. Periodontal infection as a possible risk factor for preterm low birth weight. *J Periodontol*. 1996;67:1103–13.

95 Coonrod DV, et al.The clinical content of preconception care: infectious diseases in preconception care. *Amer J Obstet & Gynecol* 2008 (Dec);Supp;S296-S309.

96 Genco R. Risk factors for periodontal disease. In: Rose L, Genco R, Mealey B, Cohen D, eds. Canada: BC Decker, 2000.

97 Siqueira FM, Cota LO, Costa JE et al. Intrauterine growth restriction, low birth weight, and preterm birth: adverse pregnancy outcomes and their association with maternal periodontitis. *J Periodontol*. 2007;78:2266-2276.

98 Toygar HU, Seydaoglu G, Kurklu S et al. Periodontal health and adverse pregnancy outcome in 3,576 Turkish women. *J Periodontol*. 2007;78:2081-2094.

99 Lunardelli AN, Peres MA. Is there an association between periodontal disease, prematurity and low birth weight? A population-based study. *J Clin Periodontol*. 2005;32:938-946.

100 Meurman JH, Furuholm J, Kaaja R et al. Oral health in women with pregnancy and delivery complications. *Clin Oral Investig*. 2006;10:96-101.

101 Heimonen A, Rintamaki H, Furuholm J et al. Postpartum oral health parameters in women with preterm birth. *Acta Odontol Scand*. 2008;66:334-341.

102 Offenbacher S, Katz V, Fertik G et al. Periodontal infection as a possible risk factor for preterm low birth weight. *J Periodontol*. 1996;67:1103-1113.

103 Siqueira FM, Cota LO, Costa JE et al. Maternal periodontitis as a potential risk variable for preeclampsia: a case-control study. *J Periodontol*. 2008;79:207-215.

104 Vettore MV, Leao AT, Leal Mdo C et al. The relationship between periodontal disease and preterm low birthweight: clinical and microbiological results. *J Periodontal Res*. 2008;43:615-626.

105 Davenport ES, Williams CE, Sterne JA et al. Maternal periodontal disease and preterm low birthweight: case-control study. *J Dent Res*. 2002;81:313-38.

106 Buduneli N, Baylas H, Buduneli E et al. Periodontal infections and pre-term low birth weight: a case-control study. *J Clin Periodontol*. 2005;32:174-181

107 Noack B, Klingenberg J, Weigelt J et al. Periodontal status and preterm low birth weight: a case control study. *J Periodontal Res*. 2005;40:339-345.

108 Lopez NJ, Smith PC, Gutierrez J. Higher risk of preterm birth and low birth weight in women with periodontal disease. *J Dent Res*. 2002;81:58-63.

109 Boggess KA, Beck JD, Murtha AP et al. Maternal periodontal disease in early pregnancy and risk for a small-for-gestational-age infant. *Am J Obstet Gynecol*. 2006;194:1316-1322.

110 Jeffcoat MK, Geurs NC, Reddy MS et al. Periodontal infection and preterm birth: results of a prospective study. *J Am Dent Assoc.* 2001;132:875-880.

111 Agueda A, Ramon JM, Manau C et al. Periodontal disease as a risk factor for adverse pregnancy outcomes: a prospective cohort study. *J Clin Periodontol.* 2008;35:16-22.

112 Boggess KA, Lieff S, Murtha AP et al. Maternal periodontal disease is associated with an increased risk for preeclampsia. *Obstet Gynecol.* 2003;101:227-31.

113 Ruma M, Boggess K, Moss K et al. Maternal periodontal disease, systemic inflammation, and risk for preeclampsia. *Am J Obstet Gynecol.* 2008;198:389.e1-5.

114 Offenbacher S, Boggess KA, Murtha AP et al. Progressive periodontal disease and risk of very preterm delivery. *Obstet Gynecol.* 2006;107:29-36.

115 Mobeen N, Jehan I, Banday N et al. Periodontal disease and adverse birth outcomes: a study from Pakistan. *Am J Obstet Gynecol.* 2008;198:514. e1-8.

116 Mitchell-Lewis D, Engebretson SP, Chen J et al. Periodontal infections and pre-term birth: early findings from a cohort of young minority women in New York. *Eur J Oral Sci.* 2001;109:34-39.

117 Moore S, Ide M, Coward PY et al. A prospective study to investigate the relationship between periodontal disease and adverse pregnancy outcome. *Br Dent J.* 2004;197:251-8; discussion 247.

118 Farrell S, Ide M, Wilson RF. The relationship between maternal periodontitis, adverse pregnancy outcome and miscarriage in never smokers. *J Clin Periodontol.* 2006;33:115-120.

119 Moore S, Ide M, Coward PY et al. A prospective study to investigate the relationship between periodontal disease and adverse pregnancy outcome. *Br Dent J.* 2004;197:251-8; discussion 247.

120 Farrell S, Ide M, Wilson RF. The relationship between maternal periodontitis, adverse pregnancy outcome and miscarriage in never smokers. *J Clin Periodontol.* 2006;33:115-120.

121 Srinivas SK, Sammel MD, Stamilio DM, Clothier B, Jeffcoat MK, Parry S, Macones GA, Elovitz MA, Metlay J. Links Periodontal disease and adverse pregnancy outcomes: is there an association? *Am J Obstet Gynecol.* May 2009;200(5):497.e1-8.

122 Coonrod DV et al. The clinical content of preconception care: infectious diseases in preconception care. *Amer J Obstet & Gynecol* 2008 (Dec);Supp;S296-S309.

123 Michalowicz BS, Hodges JS, DiAngelis AJ et al. Treatment of periodontal disease and the risk of preterm birth. *N Engl J Med.* 2006;355:1885-1894.

124 Offenbacher S, Beck J, Jared H, et al. Maternal oral therapy to reduce obstetric risk(MOTOR): A report of a mulitcentered periodontal therapy randomized-controlled trial on rate of preterm delivery. *Am J Obstet Gynecol.* 2008 (Dec);199, SMFN Abstracts, Suppl:S2.

125 Macones G, Jeffcoat M, Parry S, et al. Screening and treating periodontal disease does not reduce incidence of preterm birth: Results from the PIPS Study. *Am J Obstet Gynecol.* 2008 (Dec);199, SMFN Abstracts, Suppl:S3.

126 Michalowicz BS, DiAngelis AJ, Novak MJ et al. Examining the safety of dental treatment in pregnant women. *J Am Dent Assoc.* 2008;139:685-695.

127 Michalowicz BS, Hodges JS, DiAngelis AJ et al. Treatment of periodontal disease and the risk of preterm birth. *N Engl J Med.* 2006;355:1885-1894.

128 Novak MJ, Novak KF, Hodges JS et al. Periodontal bacterial profiles in pregnant women: response to treatment and associations with birth outcomes in the obstetrics and periodontal therapy (OPT) study. *J Periodontol.* 2008;79:1870-1879.

129 Loesche WJ, Hockett RN, Syed SA, The predominant cultivable flora of tooth surface plaque removed from institutionalized subjects. *Archs Oral Biol.* 17:1311-25, 1973.

130 Berkowitz RJ, Acquisition and transmission of mutans streptococci. *J Cal Dent Assoc.*2003;31(2):135-138.

131 Kuramitsu HK. Molecular genetic analysis of the virulence of oral bacterial pathogens: an historical perspective. *Crit Rev Oral Biol Med.* 2003;14(5):331-344.

132 Featherstone JDB. The caries balance: contributing factors and early detection. *J Cal Dent Assoc.* 2003;31 (2):129-33.

133 Berkowitz RJ, Acquisition and transmission of mutans streptococci. *J Cal Dent Assoc.*2003;31(2):135-138.

134 Caufield PW, Wannemuehler YM, Hansen JB. Familial clustering of the Streptococcus mutans cryptic plasmid strain in a dental clinic population. *Infect Immun.* 1982;38(2):785-787.

135 Li Y, Caufield PW et al. Mode of delivery and other maternal factors influence the acquisition of Streptococcus mutans in infants. *J Dent Res.* 2005(Sept);84(9):806-811.

136 Alaluusua S., et al. Oral colonization by more than one clonal type of mutans streptococcus in children with nursing-bottle dental caries. *Arch Oral Biol.* 1996;41(2):167-73.

137 Lindquist B, Emilson CG. Colonization of Streptococcus mutans and Streptococcus sobrinus genotypes and caries development in children to mothers harboring both species. *Caries Res.* 2004;38(2):95-103.

138 Li Y, Caufield PW et al. Mode of delivery and other maternal factors influence the acquisition of Streptococcus mutans in infants. *J Dent Res.* 2005(Sept);84(9):806-811.

139 Longo PL, Mattos-Graner RO, Mayer MP. Determination of mutacin activity and detection of mutA genes in Streptococcus mutans genotypes from caries-free and caries-active children. *Oral Microbiol Immunol.* 2003;18(3):144-149.

140 Liu Y, Zou J, Shang R, Zhou XD. Genotypic diversity of Streptococcus mutans in 3- to 4-year-old Chinese nursery children suggests horizontal transmission. *Arch Oral Biol.* 2007;52:876-881.

141 Klein MI, Florio FM, Pereira AC, Hofling JF, Goncalves RB. Longitudinal study of transmission, diversity, and stability of Streptococcus mutans and Streptococcus sobrinus genotypes in Brazilian nursery children. *J Clin Microbiol.* 2004;42:4620-4626.

142 Kohler B, et al. Longitudinal study of intrafamilial mutans streptococci ribotypes. *Eur J Oral Sci.* 2003;111(5): 383-389.

143 Saarela M, et al. Transmission of oral bacterial species between spouses. *Oral Micro Immunol.* 1993;(Dec);8(6):349-354.

144 Featherstone JDB, et al. Caries management by risk assessment: consensus statement, April 2002. *J Cal Dent Assoc.* 2003;31 (3):257-269.

145 Kowash MB, Pinfield P, Smith J., Curzon MEJ. Dental health education: effectiveness on oral health of a long-term health education programme for mothers with young children. *British Den J.* 2000;188:201 – 205.

146 Patrick DL, Shuk Yin Lee R, Nucci M, Grembowski D, Zane Jolles C, Milgrom P. Reducing oral health disparities: a focus on social and cultural determinants. *BMC Oral Health* 2006; 6(Suppl 1):S4.

147 Lopez NJ, Smith PC, Gutierrez J. Periodontal therapy may reduce the risk of preterm low birth weight in women with periodontal disease: a randomized controlled trial. *J Periodontol.* 2002;73:911-924. In Johnson K, et al. Recommendations to Improve Preconception Health and Health Care, United States. A Report of the CDC/ATSDR Preconception Care Work Group and the Select Panel on Preconception Care. *MMWR.* April 21, 2006. 55(RR06);1-23.

148 Ly KA, Milgrom P, Rothen M. Xylitol, sweeteners, and dental caries. *Pediatr Dent.* 2006;28:154 63; discussion 192-198.

149 Isongas P, Soderling E, Pienihakkinen P, Alanen P. Occurrence of dental decay in children after maternal consumption of xylitol chewing gum, a follow-up from 0 to 5 years of age. *J Dent Res.* 2000;79:1885-1889.

150 LY KA, Riedy CA, Milgrom P et al. Xylitol gummy bear snacks: a school-based randomized clinical trial. *BMC Oral Health.* 2008;8:20

151 Li Y, Wang W, Caufield PW. The fidelity of mutans streptococci transmission and caries status correlate with breast-feeding experience among Chinese families. *Caries Res,* 2000;34(2):123-32.

152 Erickson P, Mazhari E. Investigation of the role of human breast milk in caries development. *Pediatr Dent.* 1999;21(2):86-90.

153 Van Palenstein Helderman WH, Soe W. van't Hof MA. Risk factors of Early Childhood Caries in a Southeast Asian population. *J Dent Res.* 2006;85(1):85-88.

154 Azevedo TD, Bezerra AC, de Toledo OA. Feeding habits and severe Early Childhood Caries in Brazilian preschool children. *Pediatr Dent.* 2005;27(1):28-33.

155 Valaitis R, Hesch R, Passarelli C, Sheedan D, Sinton J. A systematic review of the relationship between breastfeeding and Early Childhood Caries. *Can J Pub Health.* 2000;91(6):411-417.

156 American Academy of Periodontology statement regarding periodontal management of the pregnant patient. *J Periodontol.* 2004; 75(3):495.

157 Günay H, Dmoch-Bockhorn K, Günay Y, Geurtsen, W. Effect on caries experience of a long-term preventive program for mothers and children starting during pregnancy. *Clin Oral Invest.* November 1998;2:137-142.

158 Patrick DL, Shuk Yin Lee R, Nucci M, Grembowski D, Zane Jolles C, Milgrom P. Reducing oral health disparities: a focus on social and cultural determinants. *BMC Oral Health* 2006; 6(Suppl 1):S4.

159 A report of the American Dental Association Council on Scientific Affairs *JADA* March 2008;.139.

160 American Academy of Periodontology statement regarding periodontal management of the pregnant patient. *J Periodontol.* 2004; 75(3):495.

161 Offenbacher S, Beck J, Jared H, Mauriello SM, Mendoza LC, Couper DJ, Stewart DB, Murtha AP, Cochran DL, Dudley DJ, Reddy MS, Geurs NC, Hauth JC. Effects of periodontal therapy on rate of preterm delivery. *Am J Obstet Gynecol.* September 2009;114(3):551-559.

162 Srinivas SK, Sammel MD, Stamilio DM, Clotheir B, Jeffcoat MK, Parry S, Macones GA, Elovitz MA, Metlay J. Periodontal disease and adverse pregnancy outcomes: is there an association? *Am J Obstet Gynecol.* 2009;200:497.e1-497.e8.

163 Michalowicz BS, DiAngelis AJ, Novak MJ, Buchanan W, Papapanou PP, Mitchell DA, Curran AE, Lupo VR, Ferguson JE, Bofill, J, Matseoane S, Deinard AS Jr., Rogers TB. Examining the safety of dental treatment in pregnant women. *J Am Dent Assoc* 2008;139;685-695.

164 Moore PA. Selecting drugs for the pregnant dental patient. *JADA* September 1998;129:1281-1286.

165 Toppenberg KS, Hill DA, Miller DP. Safety of radiographic imaging during pregnancy. *Am Fam Physician* 1999; 59(7):1813-1818.

166 Matteson SR, Joseph LP, Bottomley W, Finger HW, Frommer HH, Koch RW et al. The report of the panel to develop radiographic selection criteria for dental patients. *Gen Dent.* 1991; 39(4):264-270.

167 American Dental Association, U.S. Food and Drug Administration. The Selection of Patients for Dental Radiograph Examinations. Available at: www.ada.org.

168 Wasylko L, Matsui D, Dykxhoorn SM, Rieder MJ, Weinberg S. A review of common dental treatments during pregnancy; implications for patients and dental personnel. *J Can Dent Assoc.* 1998;64(6):434-439.

169 Rosen MA. Nitrous oxide for relief of labor pain: A systematic review. *Am J Obstet Gynecol.* 2002;186:S110-26.

170 Becker DE, Rosenberg M. Nitrous Oxide and the Inhalation Anesthetics. *Anesth Prog.* 2008;55:124-131.

171 Becker DE, Rosenberg M. Nitrous Oxide and the Inhalation Anesthetics. *Anesth Prog.* 2008;55:124-131.

172 Moore PA: Selecting drugs for the pregnant dental patient. *J Am Dent Assoc.* 1998;129:1281-1286.

173 Becker DE, Rosenberg M. Nitrous Oxide and the Inhalation Anesthetics. *Anesth Prog.* 2008;55:124-131.

174 Becker DE, Rosenberg M. Nitrous Oxide and the Inhalation Anesthetics. *Anesth Prog.* 2008;55:124-131.

175 Santos AC, Braveman FR, Finster M. Obstetric anesthesia. In: Barash PG, Cullen BF, Stoelting RK (eds.). *Clinical Anesthesia,* 5th ed. Philadephis: Lippiincott-Raven, 2006. As cited in Becker DE, Rosenberg M. Nitrous Oxide and the Inhalation Anesthetics. *Anesth Prog.* 2008;55:124-131.

176 Rosen MA. Management of anesthesia for the pregnant surgical patient. *Anesthesiology.* 1999;91(4):1159-1163.

177 Becker DE, Rosenberg M. Nitrous Oxide and the Inhalation Anesthetics. *Anesth Prog.* 2008;55:124-131.

178 Becker DE, Rosenberg M. Nitrous Oxide and the Inhalation Anesthetics. *Anesth Prog.* 2008;55:124-131.

179 Moore PA: Selecting drugs for the pregnant dental patient. *J Am Dent Assoc.* 1998;129:1281-1286.

180 Mazze RI, Kallen B. Reproductive outcome after anesthesia and operation during pregnancy: a registry study of 5405 cases. *AmJ Obstet Gynecol.* 1989;161:1178-1185. As cited in Becker DE, Rosenberg M. Nitrous Oxide and the Inhalation Anesthetics. *Anesth Prog.* 2008;55:124-131.

181 Aldridge LM,Tunstall ME. Nitrous oxide and the fetus: a review and the results of a retrospective study of 175 cases of anaesthesia for insertion of Shirodkar suture. *Br J Anaesth.* 1986;58:1348-1356. As cited in Becker DE, Rosenberg M. Nitrous Oxide and the Inhalation Anesthetics. *Anesth Prog.* 2008;55:124-131.

182 Rosen MA. Management of anesthesia for the pregnant surgical patient. *Anesthesiology.* 1999;91(4):1159-1163.

183 Becker DE, Rosenberg M. Nitrous Oxide and the Inhalation Anesthetics. *Anesth Prog.* 2008;55:124-131.

184 FDA 2006: http://www.fda.gov/ohrms/dockets/ac/06/transcripts/2006-4218t1-01.pdf.

185 G Hansen, R Victor, E Engeldinger, C Schweitzer. Evaluation of the mercury exposure of dental amalgam patients by the mercury triple test. *Occu Environ Med.* 2004;61;535-540.

186 Sällsten G, Thorén J, BarregÅrd L, et al. Long-term use of nicotine chewing gum and mercury exposure from dental amalgam fillings. *J Dental Res.* 1996;75(1):594-598.

187 Al-Salehi SK. Effects of bleaching on mercury ion release from dental amalgam. *J Dent Res.* 2009 Mar;88(3):239-43. PubMed PMID: 19329457.

188 Clarkson TW. The three modern faces of mercury. *Environ Health Perspect.* 2002;110 Suppl 1:11-23.

189 Luglie PF, Campus G, Chessa G, Spano G, Capobianco G, Fadda GM, et al. 2005. Effect of amalgam fillings on the mercury concentration in human amniotic fluid. *Arch Gynecol Obstet.* 271(2):138-142.

190 ADA Statement on Dental Amalgam, revised July 2008. http://www.ada.org/prof/resources/positions/statements/amalgam.asp. Accessed May 18, 2009.

191 Rowland AS, Baird DD, Weinberg CR, Shore DL, Shy CM, Wilcox AJ. The effect of occupational exposure to mercury vapour on the fertility of female dental assistants. *Occup Environ.* 1994;Med 51(1): 28-34.

192 Heidam LZ. Spontaneous abortions among dental assistants, factory workers, painters, and gardening workers: a follow up study. *J Epidemiol Community Health.* 184;38(2):149-155.

193 Lindbohm ML, Ylostalo P, Sallmen M, Henriks-Eckerman ML, Nurminen T, Forss H, et al. Occupational exposure in dentistry and miscarriage. *Occup Environ Med.* 2007;64(2):127-133.

194 Rowland AS, Baird DD, Weinberg CR, Shore DL, Shy CM, Wilcox AJ. The effect of occupational exposure to mercury vapour on the fertility of female dental assistants. *Occup Environ.* 1994;Med 51(1): 28-34.

195 Heidam LZ. Spontaneous abortions among dental assistants, factory workers, painters, and gardening workers: a follow up study. *J Epidemiol Community Health.* 1984;38(2):149-155.

196 Lindbohm ML, Ylostalo P, Sallmen M, Henriks-Eckerman ML, Nurminen T, Forss H, et al. Occupational exposure in dentistry and miscarriage. *Occup Environ Med* 2007; 64(2):127-133.

197 Ericson A, Kallen B. Pregnancy outcome in women working as dentists, dental assistants or dental technicians. *Int Arch Occup Environ Health* 1989;61(5): 329-333.

198 Hujoel PP, Lydon-Rochelle M, Bollen AM, Woods JS, Geurtsen W, del Aguila MA. Mercury exposure from dental filling placement during pregnancy and low birth weight risk. *Am J Epidemiol* 2005;161(8): 734-740.

199 Daniels JL, Rowland AS, Longnecker MP, Crawford P, Golding J. Maternal dental history, child's birth outcome and early cognitive development. *Paediatr Perinat Epidemiol.* 2007;21(5):448-457.

200 FDA Issues Final Regulation on Dental Amalgam. July 28, 2009. http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm173992.htm Accessed July 29, 2009.

201 www.fda.gov/MedicalDevices/ProductsandMedicalProcedures/DentalProducts/DentalAmalgam/default/htm. Accessed July 29, 2009.

202 Schweikl H, Spagnuolo G, Schmalz G. 2006. Genetic and cellular toxicology of dental resin monomers. *J Dent Res* 85(10): 870-877.

203 Pulgar R, Olea-Serrano MF, Novillo-Fertrell A, Rivas A, Pazos P, Pedraza V, et al. Determination of bisphenol A and related aromatic compounds released from bis-GMAbased composites and sealants by high performance liquid chromatography. *Environ Health Perspect.* 2000;108(1): 21-27.

204 http://www.ada.org.

205 Joskow R, Barr DB, Barr JR, Calafat AM, Needham LL, Rubin C. Exposure to bisphenol A from bis-glycidyl dimethacrylate-based dental sealants. *J Am Dent Assoc* 2006; 137(3):353–62.

206 Vandenberg LN, Hauser R, Marcus M, et al. Human exposure to bisphenol A (BPA). *Reprod Toxicol.* 2007;24(2):139-177.

207 Heazell A, Clift J (eds). Obstetrics for Anaesthetists. 2008. Oxford: Cambridge University Press.

208 Jiminez E. Patterns of regular drug use in Spanish childbearing women: changes elicited by pregnancy. *Euro J Clin Pharm.* 1998:54(8):645-651.

209 Larimore WL. Drug use during pregnancy and lactation. *Prim Care.* 2000;27:35-53.

210 Glover DD, Amonkar M, Rybeck BF, Tracy TS. Prescription, over-the-counter, and herbal medicine use in a rural, obstetric population. *Am J Obstet Gynecol.* 2003;188:1039-1045.

211 Dellinger TM, Livingston HM. Pregnancy: physiologic changes and considerations for dental patients. *Dent Clin N Amer.* October 2006;50(4):677-697.

212 Gonsalves, WC, Skelton J, Heaton L, et al. Family medicine residency directors' knowledge and attitudes about pediatric oral health education for residents *J Dent Educ* 2005;69(4):446-452.

213 Hilton IV, Stephen S, Barker JC, Weintraub JA. Cultural factors and children's oral health care: a qualitative study of carers of young children. *Community Dent Oral Epidemiol* 2007;35:429-438.

214 American Academy of Pediatrics. Policy Statement. Oral Health Risk Assessment Timing and Establishment of the Dental Home. *Pediatr.* May 2003;111(5):1113-1116.

215 Caufield PW, Griffen AL. Dental caries. An infectious and transmissible disease. *Pediatr Clin North Am.* 2000; 47(5):1001-19.

216 Berkowitz RJ. Causes, treatment and prevention of early childhood caries: a microbiologic perspective. *J Can Dent Assoc.* 2003; 69(5):304-307.

217 Berkowitz RJ. Causes, treatment and prevention of early childhood caries: a microbiologic perspective. *J Can Dent Assoc.* 2003; 69(5):304-307.

218 Adair SM. Evidence-based use of fluoride in contemporary pediatric dental practice. *Pediatr Dent.* 2006;28(2):1330142.

219 Recommendations for using fluoride to prevent and control dental caries in the United States. Centers for Disease Control and Prevention. *MMWR* 2001;50(RR-14):1-42.

220 Ramos-Gomez F, Crall J, Gansky, Slayton R, Featherstone J. Caries risk assessment appropriate for the age 1 visit (infants and toddlers). *J Calif Dent Assoc.* October 2007;35(10):687-702.

221 Professionally applied topical fluoride: Evidence-based clinical recommendations. *J Am Dent Assoc.* 2006;137;1151-1159.

222 Douglass JM, Douglass AB, Silk HJ. A practical guide to infant oral health. *Am Fam Physician,* 2004;70(11):2113-2120.

223 Hale KJ. Oral health risk assessment timing and establishment of the dental home. *Pediatrics.* 2003;111(5 Pt 1):1113-1116.

224 Mouradian WE, Wehr E, Crall JJ. Disparities in children's oral health and access to dental care *JAMA.* 2000;284:2625-2631.

225 Siew C, Strock S, Ristic H et al. Assessing a potential risk factor for enamel fluorosis: a preliminary evaluation of fluoride content in infant formulas. *JADA* 2009;140:1238-1244.

226 http://www.cdc.gov/FLUORIDATION/safety/infant_formula.htm

227 Pendrys DG. Risk of enamel fluorosis in nonfluoridated and optimally fluoridated populations: considerations for the dental professional. *J Am Dent Assoc.* 2000;131(6):746-755.

228 Casamassimo P. Bright Futures in Practice: Oral Health. Arlington, VA: National Center for Education in Maternal and Child Health. 1996.

229 Boggess KA, Edelstein B. Oral health in women during preconception and pregnancy: implications for birth outcomes and infant oral health. *Matern Child Health J.* 2006;10:S169–S174.

230 Ramos-Gomez F. Oral health disparities among Latinos in California: implications for a binational agenda. California Program on Access to Care, Findings. June 2008.

231 Rushton VE, Horner K, Worthington HV. Factors influencing the frequency of bitewing radiography in general dental practice. *Comm Dent Oral Epi.* May 2006; 24(4):272-276.

232 Personal communication, June 18, 2009, TDIC Risk Manager.

233 Aved BM, Meyers L, Burmas E. Increasing dental care for very young children: what can training accomplish? *J Calif Dent Assoc.* December 2008;36(12):931-940.

234 Aved BM, Meyers L, Burmas E. *First 5 California Oral Health Education and Training Program: Final Evaluation Report.* Sacramento, CA. March 2008.

235 Becker MH, Maiman LA. Sociobehavioral determinants of compliance with health and medical care recommendations. *Med Care.* 1975;13(1):10-14.

236 Teutsch C. Patient-doctor communication. *Med Clin North Am.* 2003;87(5):1115-1145.

237 Armitage G. Effects of being pregnant on oral health. Perinatal Oral Health Consensus Conference. Sacramento, CA. February 20-21, 2009.

238 U.S. Department of Health and Human Services. *Oral health in America: a report of the Surgeon General.* NIH Publication No. 00-4713, Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, National Institute of Dental and Craniofacial Research, May 2000.

239 Ramos-Gomez F. Oral health disparities among Latinos in California: implications for a binational agenda. California Program on Access to Care, Findings. June 2008.

240 Stewart DCL, Ortega AN, Dausey D, Rosenheck R. Oral health and use of dental services among Hispanics. *J Pub Health Dent.* May 2007;62(2):84-91.

241 Aved BM, Meyers L, Burmas E. *First 5 California Oral Health Education and Training Program: Final Evaluation Report.* Sacramento, CA. March 2008.

242 Edelstein BL. Dental care considerations for young children. *Spec Care Dentist* 2002;22(3):11S-25S.

243 Hilton IV, Stephen S, Barker JC, Weintraub JA. Cultural factors and children's oral health care: a qualitative study of carers of young children. *Community Dent Oral Epidemiol* 2007;35:429-438.

244 Hobson WL, Knochel ML, Byington CL, Young PC, et al. Bottled, filtered, and tap water use in Latino and non-Latino children. *Arch Pediatr Adolesc Med.* 2007;161(5):457-461.

245 Barker JC, Horton SB. An ethnographic study of Latino preschool children's oral health in rural California: Intersections among family, community, provider and regulatory sectors. *BMC Oral Health.* 2008;8: 6831-6838.

246 Kelly SE, Binkley CJ, Neace WP, Gale BS. Barriers to care-seeking for children's oral health among low-income caregivers. *Am J Pub Health.* August 2005;95(8):1345-1351.

247 DiClemente CC, Schlundt D, Gemmell L. Readiness and stages of change in addiction treatment. *Amer J Addictions.* 2004;13:103–119.

248 Hutchison, KE Stevens VM, Collins FL. Cigarette smoking and the intention to quit among pregnant smokers. *J Behav Med.* 1996;19:307-316.

249 Patrick DL, Shuk Yin Lee R, Nucci M, Grembowski D, Zane Jolles C, Milgrom P. Reducing oral health disparities: a focus on social and cultural determinants. *BMC Oral Health.* June 2006;6(Suppl 1):S4.

Acknowledgments

We would like to acknowledge the organizations at left that generously provided funding to make this program possible.

Special thanks to ACOG District IX for its support and collaboration.

1201 K Street, Suite 1511
Sacramento, CA 95814

cdafoundation.org
foundationinfo@cda.org