Oral Health Care in Pregnancy

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Abstract

Pregnancy is a specific time in a woman's life filled with complex changes in health, including the oral cavity. During this time, dental and perinatal care teams can be influential in helping women initiate and maintain essential habits to improve health and prevent adverse outcomes. There is research evidence that dental providers are reluctant to treat dental problems during pregnancy. Barriers to practice identified by dentists include lack of education, time, financial constraints, and concern for the safety treating pregnant women. Factors that facilitate dental care for pregnant women include purposeful assessment, referrals from prenatal providers, and continuing education for dental team members. Multiple organizations recommend the treatment of oral health conditions during pregnancy to promote health and prevent pregnancy complications. In order to promote community-based partnerships in a healthcare system, dentists are encouraged to develop an intentional plan to increase collaboration with other members of the women's healthcare team. Prior to developing a system wide intervention to improve access to dental care during pregnancy, dental team members were surveyed to identify barriers and facilitators which promote or hinder care in their practice. The data acquired will be used to inform the design and implementation of an intervention to specifically meet the needs of patients and providers in that system.

Keywords: dental health, pregnancy, health outcomes, interprofessional collaboration

Oral Health Care in Pregnancy

Prenatal care is an important part of pregnancy that includes direct care and patient education to promote healthy behaviors which benefit both mother and child. It is also a time in which providers can prevent potential health problems and treat existing conditions. The oral cavity is a potential site of disease and portal of entry for bacteria that may affect one's general health status. Thus, assessing oral health care encompasses both primary and secondary prevention and should be an integral piece of prenatal care (U.S. Department of Health and Human Services [DHHS], 2000).

Problem Statement

Oral health is an important part of general health and should be maintained during pregnancy and throughout the lifespan. Pregnancy is a time in a women's life which is filled with complex physiologic changes in her health. These physiologic changes can exacerbate oral health conditions that may complicate pregnancy. Gingivitis, benign oral gingival lesions, tooth mobility, tooth erosion, dental caries, and periodontitis may impact pregnancy outcomes (American College of Obstetricians and Gynecologists [ACOG], 2013). Unfortunately, oral health is often not provided to pregnant women and pregnant women often do not seek oral health care during this time.

Poor oral health in pregnancy has been linked to unfavorable birth outcomes in women who are from low socioeconomic groups or minorities (Erchick et al., 2019; Lopez, DaSilva, Ipinza, & Gutierrez, 2005). These outcomes have a potential result of lifelong complications, family stress, and increased expenditure. Despite awareness, little improvement has been achieved in birth outcomes among vulnerable populations (March of Dimes, 2019). Such data

have led organizations to seek effective interventions that could improve the health and wellbeing of pregnant women and their infants.

Purpose and Rationale

Investigators in the United States have demonstrated that dentists diverged from scientific literature on several recommendations related to dental care (Alves et al., 2012). Dentists in the United States report barriers such as a knowledge, time, economics, financial constraints, skills, dental staff resistance, and peer pressure (Lee et al., 2010). Furthermore, researchers in Brazil revealed that dentists not exposed to professional education regarding oral health during pregnancy presented with less favorable attitudes towards providing dental care to pregnant women (Alves et al., 2012). Administration and staff in Federally Qualified Health Centers (FQHCs) are seeking strategies to improve the uptake of quality, evidence-based care.

The purpose of this project was to examine the effects of oral health on pregnancy and identify barriers that may be hindering pregnant women from receiving oral health treatment during pregnancy in a system of federally qualified health centers.

Background/Significance

During pregnancy, hormones such as estrogen and progesterone are produced in large amounts causing changes in the gingiva (Karimi, Hamissi, Naeini, & Karimi, 2016). Poor oral health is associated with infections, gingivitis, and periodontal disease. Periodontal disease is characterized by a group of inflammatory conditions, typically caused by oral bacteria that can progress from reversible accumulation of plaque and inflammation of gingival tissue to irreversible breakdown of the supportive tissues of the teeth (Erchick et al., 2019).

Pregnant women who have pre-existing poor dental hygiene are at an increased risk for gingivitis and periodontitis due to inflammatory changes, hormone influence, and increased

acidity in the mouth. Oral bacteria and periodontitis have been linked to intrauterine infections, preterm birth, and small for gestational age neonates among poor and minority women (Ide & Papapanou, 2013; Karimi et al., 2016; Vamos et al., 2015). Oral inflammation and infection stimulate a physiologic response in the immune system that activates the release of cytokines and other inflammatory mediators. These biochemicals produce a response in the maternal system that, among other effects, stimulates the mechanisms that may induce contractions of sufficient strength and frequency to result in premature birth. This phenomenon can result in preterm rupture of membranes (PROM) that puts the mother at risk for an intrauterine infection. Intrauterine infections, caused by bacteria, may initiate an inflammatory response that can trigger the initiation of preterm labor and subsequently a preterm delivery (Kemp, 2014).

Babies who are born prematurely may not achieve their full potential birth weight, and are subject to other neonatal complications because of their shortened gestation. These infants are subject to respiratory dysfunction, feeding difficulties, developmental delays, vision and hearing problems, and cerebral palsy. In 2016, the rate of preterm birth rose for the second straight year among minority women (Centers for Disease Control and Prevention [CDC], 2018). The CDC and other organizations have undertaken research to understand why preterm births disproportionately occur in minority women and what can be done to help prevent them (CDC, 2018). In addition to compromising neonates, periodontal disease during pregnancy has also been associated with adverse maternal outcomes such as systemic inflammation, preeclampsia, and spontaneous abortion (Lopez et al., 2005; Marchi, Fisher-Owen, Weintraub, Yu, & Braveman, 2010).

Perinatal and neonatal morbidity and mortality remain a concern. Thousands of babies, approximately one in ten, are born each year preterm and/or with low birth weight. These births

result in prolonged hospital stays and increased healthcare costs and are directly related to racial and ethnic disparities (March of Dimes, 2019). Although the exact rate is not known, it is believed that some of these preterm births could be avoided by early identification and treatment of existing dental disorders during pregnancy.

Oral Health in Community Health Centers

Although periodontal health is recognized as an important component of general wellbeing, oral health remains neglected in low income communities (Erchick et al, 2019). Dental care is directly related to income level and dental insurance coverage, making it unlikely that low socioeconomic status (SES) individuals, the underinsured, or uninsured have access to a dental provider (ACOG, 2013; Thompson, Cheng, & Strobino, 2013). The Surgeon General warns that oral health disorders are associated with many disease processes which are affecting our most vulnerable citizens (DHHS, 2000).

Oral Health Screening and Treatment

Dental and perinatal teams can be instrumental in helping women establish dental care and improve pregnancy and lifelong oral health habits. Adequate oral health care is characterized by brushing twice a day, flossing daily, avoiding sugary snacks, and seeing a dental professional twice a year (American Dental Association [ADA], 2018). Assessing oral health status at a prenatal visit, providing reassurance regarding the safety of examination, diagnosis, and treatment of oral conditions, and referral for dental care are essential components of comprehensive interdisciplinary prenatal care (ACOG, 2013). Treatment of oral health conditions during pregnancy is recommended and should not be delayed until the completion of pregnancy (ACOG, 2013; ADA, 2018).

Current Practice

Approximately 40% of pregnant women have some form of periodontal disease (Erchick et al., 2019; Vamos et al., 2015). According to a report from the Surgeon General, this is most commonly encountered in ethnic minority women and those using public health services (DHHS, 2000). Most obstetricians acknowledge a need for oral health care in pregnancy, but approximately 80% do not ask oral health screening questions during prenatal visits and over 90% do not routinely refer patients to a dentist (Strafford, Shellhaas, & Hade, 2008). There is anecdotal evidence that dental clinics are not treating patients with oral health conditions at specific trimesters in pregnancy and others will not schedule an appointment without a written referral from the prenatal provider.

Despite the known risks to mother and fetus, women across the nation are not consistently receiving oral health care during pregnancy. Barriers for not receiving oral health care and treatment during pregnancy include high cost, unavailability of services, and the misconception that women should not receive dental treatment when pregnant (George et al., 2017). To address this concern, national organizations have established guidelines recommending that all expectant women receive oral health education, assessment, and referrals for dental care from their perinatal care provider (George et al., 2017). Once perinatal providers and pregnant women have increased awareness, it is equally important that a consensus is reached among dentists. If not, barriers that prevent pregnant women from receiving necessary dental care will continue to exist.

Understanding the importance of oral health during pregnancy requires a comprehensive, interdisciplinary approach. The opinions and knowledge of nurse practitioners, certified nurse

midwives, physicians, and dentists can be barriers or facilitators to women receiving oral health care during pregnancy (Alves et al., 2012).

Screening, Referral, and Treatment

One of the quality indicators in Healthy People 2020 is to increase the proportion of children, adolescents, and adults who have used the oral health care system in the past year (DHHS, 2000, p. 33-59). Additionally, several national organizations, including the American Academy of Pediatrics (AAP), ACOG, and the ADA, have undertaken efforts to improve the overall oral health of women during pregnancy. Researchers suggest that oral health is important during pregnancy and is crucial to overall health and wellbeing for mom and baby. Preventive, diagnostic, and restorative dental treatment is safe during pregnancy and should not be withheld or delayed until delivery (ACOG, 2013; National Maternal and Child Oral Health Resource Center, 2012).

In order to achieve the Health People 2020 goal, all stakeholders should be encouraged to initiate an action-oriented plan to involve dental professionals and staff using every encounter with pregnant women to provide counseling and services to alleviate possible health risks. To form such a plan, system and personnel barriers and facilitators to dental care within systems must be identified.

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Internal Evidence

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Each state has a primary care association that works to promote and facilitate the development and delivery of affordable and accessible community-oriented care. Community health centers (CHC) employ primary care practitioners, dentists, women's health providers, registered nurses, behavioral health specialists, social workers, and pediatricians. There are several times the number of providers in the form of staff in clinical and administration roles.

They include medical assistants, dental assistants, receptionists, and those in positions to manage the day to day operations and sustainability of the clinic. In addition, CHCs provide care to thousands of patients each year, many of whom are under or uninsured. Within a system of Federally Qualified Health Centers located in one county in the southwest United States, oral health in pregnancy has been identified as an unmet need in care despite the existence of dental units within the system. Interviews with stakeholders in the clinics and with the state community health association led to the identification of a goal to increase dental screenings, establish a formal dental care referral process, and increase interprofessional collaboration among prenatal providers and dentists. Currently, they have no tracking system in place that could provide empirical data to support their assumptions. A gap analysis to provide information about assessment and follow up related to oral health during pregnancy has been completed among the prenatal providers. A companion gap analysis to assess the processes within the dental health team related to oral health care in pregnancy has been completed and is the subject of this report.

PICO Question

This inquiry has led to the clinically relevant PICO question, among dental professionals and staff at a federally qualified community health center (P), what factors facilitate (I) or inhibit (C) oral health care for women during pregnancy (O)?

Search Strategy

Databases searched for the literature review included PubMed, Cumulative Index of Nursing and Allied Health Literature (CINAHL), and PsycInfo. Keywords included; *pregnancy, pregnant women, oral health, dental health, outcomes, birth outcomes, childbirth outcomes, neonatal outcomes, and maternal outcomes.*

Exclusion criteria included articles in the non-English language and articles published prior to 2010 to establish the most current knowledge about the topic. Reviewing the titles and abstracts of the articles yielded 30 relevant studies. Additionally, the reference lists of these articles were scanned to identify additional sources of relevant data. Full text copies of the most relevant and high-quality studies were obtained and reviewed. Rapid critical appraisal checklists were used to reduce the number of articles down to the ten most relevant and highest quality studies. Studies selected to inform the project design and implementation demonstrate the relationship between the chosen PICOT components; pregnant women, dental care, barriers, facilitators, and overall pregnancy health status or outcomes (Appendix A).

Critical Appraisal & Synthesis of Evidence

The articles chosen for review include one cohort study, two cross sectional studies, five randomized controlled trials, one non-randomized pilot study, and one Cochrane review. Quality and strength of the evidence was determined by the Fineout-Overholt and Melnyk's (2009) rapid critical appraisal. All studies included pregnant or postpartum women with varying degrees of satisfactory oral health status. There was limited bias throughout the articles. Demographics included mean age less than 30 with the majority having a high school education. Socioeconomic status (SES) ranged from below poverty to high income as determined by federal SES guidelines. Studies selected for inclusion were conducted in various areas of the world.

Measurement tools included pre and post intervention surveys, health record review, and oral health assessments. Outcome areas of interest included barriers, facilitators, preterm birth rate, low birth weight, and overall oral health status in pregnant women (Appendix A).

Barriers inhibiting dental care during pregnancy include cost, availability, misconceptions, lack of education among dentists, and decreased awareness of procedure safety

among pregnant women (Suri, Singla, & Suri, 2017). Additional barriers include concern for safety of dental procedures during a specific trimester of pregnancy, the safety of medications, and the fear of dental team responsibility if harm were to occur to a pregnant woman (Umoh & Azodo, 2013).

In order to examine knowledge and attitudes of dental providers within a system of federally qualified health centers in the southern United States, data collection is essential. Topics of interest should include knowledge, education, perceived barriers, and current practice (George et al., 2017). Implementation of oral health initiatives based on guidelines is often a slow process in which barriers must be acknowledged before intervention can be adopted (Jackson et al., 2015).

Interventions associated with an increased uptake of women seeking dental care during pregnancy include screening during prenatal visits, oral health education among dental and prenatal providers, oral examinations, and referrals (Suri, Singla, & Suri, 2017). In their survey of general dentists conducted within the United States, researchers found that completion of continuing education on oral health care in pregnancy for dental team members was associated with a stronger belief in counseling and treatment (Kloetzel et al., 2012). Furthermore, dentists were more likely to provide treatment if the patient presented with a written referral from the prenatal care provider (Jackson et al., 2015).

Community based partnerships have demonstrated improved access to and receipt of dental care in pregnant women. Increasing the number of pregnant women receiving care is likely to improve with coordinated interdisciplinary approaches to education and referrals. Providing a referral informs the dentist of prenatal provider support and reassures the patient of the safety and importance of the recommendation (Kloetzel, Huebner, & Milgrom, 2011).

There is rigorous evidence that oral health care in pregnancy and treatment of periodontal disease may aid in reducing the number of preterm births or low birth weight infants among low SES pregnant women and women with high risk pregnancies. In multiple studies, periodontal treatment during pregnancy was associated with a decrease of gingival bleeding on probing, a decrease of oral inflammation, reduction of supragingival calculus, improved clinical attachment level, and a decrease of gingival plaque. Additionally, oral health care in pregnancy was not associated with any adverse outcomes leading to the assumption that care should be provided to pregnant women and not delayed until the conclusion of pregnancy (Appendix B).

Barriers and facilitators have been acknowledged among dentists in previously conducted surveys throughout the world. In order to address an identified unmet need in the screening, referral, and treatment process in the federally qualified health centers in southern United States, a gap analysis was needed to identify barriers and facilitators for that care. Once that knowledge was acquired, tested interventions that were successful in environments with similar agency, staff, and patient characteristics can be compared to the environment where this gap analysis was conducted to aid in designing and implementing an intervention that is the right fit.

Theory Application/Conceptual Framework

The Quality Health Outcomes Model (QHOM) was selected as the conceptual framework for this project due to its goodness and fit to the design and implementation of an oral health intervention in pregnancy (Appendix C). The QHOM was indirectly used to synthesize nine articles in this review. The QHOM is sufficiently broad and is used to suggest key variables in clinical intervention (Mitchell et al., 1998). The structure of this model references a linear process of knowledge collection and intervention, which in turn affects outcomes. Additionally,

it provides a framework that aids the design, implementation, and evaluation of organizational
and system level interventions.

When applying this framework to oral health in pregnancy at the project site, a gap in
care was identified. A gap analysis among dentists and dental team members, when added to the
data already obtained from the perinatal team, can inform system and unit level policy and
procedural changes specific to the FQHC participants and lead to the development and
implementation of one or more interventions that will improve assessment, referral, and
treatment of oral health care needs during pregnancy.

EBP Model or Quality Improvement Model

The quality improvement model for this project was the Knowledge to Action (KTA)
Framework (Appendix D). This dynamic, team model was applied in the initial stages of this
project because the goal of the project was to answer a question (knowledge inquiry). Once that
inquiry was articulated, a problem was identified, and it was decided that a gap analysis was
needed to identify the conditions that were contributing to the problem. Because the identified
problem had to do with dental care during pregnancy, it was decided that stakeholders in the
perinatal care and dental care units should be queried to complete a gap analysis to understand
barriers and facilitators to inform the design and implementation of an intervention. Once an
intervention is in place, the health centers can evaluate outcomes and sustain knowledge
acquisition and application in a dynamic fashion.

The KTA framework is intended to help individuals gain insight that will improve
outcomes and strengthen the health care system. Each dynamic phase of this model was used
sequentially to guide such knowledge into practice change. Oral health care during pregnancy
requires a collaboration of efforts between perinatal and dental providers. Once data from the

survey completed by dental service providers and staff is analyzed and combined with the data

from the perinatal teams, system level interventions will be designed and applied to initiate

evidence-based dental care for pregnant women. This model was an appropriate choice to guide

the project because it uses knowledge creation to inform the action phase of system level change.

Methods

Project Summary

A gap analysis in a system of Federally Qualified Health Centers in Maricopa County,

Arizona was completed in partnership with the Arizona Alliance for Community Health Centers

(AACHC). A survey was administered to dental clinicians and staff at a group of community

clinics to identify facilitators and barriers related to oral health care for pregnant women. The

data obtained will be used to design and implement an intervention to increase screening,

referral, and treatment of oral health conditions during pregnancy. There are no financial

conflicts of interests. In kind support for the project was provided by the state Primary Care

Association (PCA) and Arizona State University (ASU). A budget that detailed the anticipated

costs for the project is provided in Appendix E.

Process

All current employees in the dental service units at a group of FQHCs were invited to

participate in an online, 77 item survey distributed via Survey Monkey. Participant recruitment

occurred in the fall of 2019 through project emails, site visits, and live presentations to

encourage participation in the project. The survey was available for four weeks. The survey

instrument was determined to be reliable and valid via psychometric testing. The survey

instrument evaluates multiple domains related to oral health in pregnancy. Those domains

include counseling pregnant patients, efficacy of counseling and treatment, pressures on the

dental profession, periods of pregnancy appropriate to perform routine services, the prescribing

of pharmaceuticals, identifying pregnancy status, authorizing procedures on pregnant women,

emergency services during pregnancy, and education related to oral health in pregnancy

(Appendix F). A total of 128 dental health clinicians and staff were invited to participate in the

survey. From that participant pool, 53 individuals elected to participate. Fifty-two (52)

individuals completed the survey accounting for a 40.6% response rate. One survey was

discarded as less than 50% of the questions were answered. The intent-to-treat standard was

applied for the analysis to reconcile the occurrence of missing data in seven survey responses.

Results

Demographics

Participants included dentists (n=12; 23.1%), specialty dentists (n=1; 1.9%), dental

hygienists (n=9; 17.3%), dental assistants (n=21; 40.9%), patient services representatives (n=5;

9.6%), office managers (n=3; 5.8%), and appointment center specialists (n=1; 1.9%).

Outcomes

Oral health and pregnancy. Questions were administered to obtain knowledge

regarding perceptions related to pregnant women and oral health care. The majority (n=51;

98.1%) strongly agree that oral health is connected to systemic health and a large portion (n=41;

78.9%) strongly agree that bacteria causing tooth decay in moms can be passed on to babies. A

large majority (n=47; 90.4%) strongly agree that hormonal changes in pregnant women increase

their risk of gum disease but only 30 participants (57.7%) strongly agree that periodontal disease

is associated with miscarriage, preterm birth, and low birth weight infants.

Counseling pregnant patients. Questions regarding counseling pregnant women were

addressed. All participants (n=52; 100%) strongly agree that counseling pregnant women about

oral health is important and 47 participants (90.4%) strongly agree that counseling a pregnant

woman about oral health can improve the oral health of her baby. When asked if they have the

skills to counsel pregnant women, only 40 participants (76.9%) strongly agree they are prepared.

Thirty participants (57.9%) strongly disagree that their dental practice is too busy to provide

counseling about oral care for pregnant patients and 20 participants (38.5%) neither agree nor

disagree that insurance plans compensate the dental practice adequately for time spent on

counseling pregnant women. The majority of participants (n=38; 73.1%) strongly agree it is the

responsibility of the dental provider to counsel a pregnant woman on the dangers of smoking and

49 participants (94.2%) strongly agree that a pregnant woman should be counseled to have a

dental provider look at her baby's teeth when they first erupt. Over half (n=29; 55.8%) strongly

disagree that explaining the possible link between periodontal disease and preterm birth takes too

much time out of the schedule and 35 participants (67.3%) strongly disagree that explaining the

link between dental caries in mothers and dental caries in babies takes too much time out of the

schedule.

      Efficacy of counseling and treatment. When asked about the efficacy of counseling and

treatment, 39 participants (75%) strongly agree that it is worth their time to counsel pregnant

patients about their diet and 22 participants (42.3%) strongly disagree that physicians are better

able than dentists to counsel pregnant patients about oral health. Furthermore, the majority of

participants (n=48; 92.3%) strongly agree that dental treatment should be a part of a women's

prenatal care. The majority of participants (n=41; 78.9%) strongly agree that pregnant patients

are more likely to seek dental care if their physician recommends it. Thirty-six participants

(69.2%) strongly disagree that there is little they can do to affect a pregnant women's oral

hygiene and 41 participants (78.9%) believe it is important for a pregnant woman to have her

blood pressure taken during a dental appointment. Approximately one-fourth of participants (n=14; 26.9%) neither agree nor disagree that a dental provider has the ability to identify possible complications of a pregnancy and more than half (n=27; 51.9%) strongly agree it is safe to provide dental treatment to a pregnant woman. Furthermore, 21 participants (40.4%) neither agree nor disagree that they are concerned about being sued if something goes wrong in a pregnancy after dental treatment.

Pressure on the dental profession. Twenty participants (38.5%) strongly disagree that clinicians in the community will be critical of the agency staff if they provide necessary oral health care to pregnant patients and the majority of participants (n=38; 73.1%) strongly agree that patients would feel positively about their clinic if staff members provide comprehensive care to pregnant patients.

Routine Services. Participants were asked during which period of pregnancy they believe it is appropriate to provide each of the following routine services. Forty-seven participants (90.4%) believe oral health instructions can be performed anytime during pregnancy. Fifty participants (96.2%) believe prophy (routine surface cleaning procedures performed by dental clinicians), and 38 participants (73.1%) believe scaling and root planing (deep cleaning below the gum line) are safe throughout anytime during pregnancy. Twenty-five participants (48.1%) believe site specific antibiotics (medicine inserted subgingivally into a pocket) should be prescribed for emergency procedures only and 41 participants (78.9%) agree that fluoride varnish treatment can be performed anytime during pregnancy. More than half (n=29; 55.8%) agree that a single periapical x-ray can be performed at any time during pregnancy but 22 participants (42.3%) believe full mouth x-rays should never be performed during pregnancy. Twenty-six participants (50%) believe an injection of local anesthetic such as lidocaine, a single

tooth extraction (n=38; 73.1%), and an amalgam (mercury, silver, copper, and tin) restoration

(n=23; 44.2%) should only be performed as an emergency only procedure. Thirty-one

participants (59.6%) agree that composite (tooth colored) restoration can be performed anytime

during pregnancy and 36 participants (69.2%) believe root canal therapy should be performed as

an emergency only procedure. For the final two questions of this section, participants were asked

at what point in pregnancy crown and bridge could be performed and half (n=26; 50%) believe

this should be performed as an emergency procedure only while the majority (n=47; 90.4%)

believe a pregnant woman should never be given nitrous oxide or oxygen sedation.

Pharmaceuticals. Participants were asked how often they recommend or prescribe the

following pharmaceuticals. Thirty-seven participants (71.2%) state they never recommend non-

steroidal or anti-inflammatory agents such as ibuprofen, 22 participants (42.3%) sometimes

recommend acetaminophen, 42 (80.8%) never recommend aspirin, 40 (76.9%) never recommend

pain medicine containing codeine or other narcotics, 21 (40.4%) never recommend

chlorhexidine, 18 (34.6%) sometimes recommend oral antibiotics, and 43 (82.7%) never

recommend periostat (doxycycline).

Pregnancy status. Participants were asked how they learn the pregnancy status of their

patients. Forty (76.9%) state the receptionist does not ask for pregnancy status when scheduling

an appointment. Forty-nine participants (94.2%) state there is a question about pregnancy in the

routine health update that the patient fills out. Thirty-eight participants (73.1%) agree their

patients reveal in casual conversation and 40 participants (76.9%) ask if they suspect a patient

might be pregnant. Forty-four participants (84.6%) state a staff member will note it on the

patient's chart if someone determines a patient is pregnant but 31 participants (59.6%) state a

staff member will not note it on the daily schedule.

Performing/authorizing procedures. Participants were asked how often they perform or authorize the following procedures on pregnant women. Thirty-nine participants (75%) state they often provide oral hygiene instructions, 37 (71.2%) often provide prophy, 17 (32.7%) often provide scaling and root planing, 30 (57.7%) don't perform or authorize site specific antibiotics, 15 (28.9%) sometimes provide fluoride varnish treatment, 19 (36.5%) sometimes perform single periapical x-ray, 22 (42.3%) never perform full mouth x-rays, and 19 (36.5%) don't perform or authorize an injection of local anesthetic. Twenty-three participants (44.2%) don't perform or authorize single tooth extractions, amalgam restoration (n=27; 51.9%), composite restoration (n=25; 48.1%), root canal therapy (n=27; 51.9%), or a crown and bridge (n=25; 48.1%). Twenty-six participants (50%) never authorize nitrous oxide and oxygen sedation to pregnant women.

Emergency Services. When asked which periods of pregnancy they believe it is appropriate for patients to have each of the following emergency services performed, 19 participants (36.5%) believe tooth extraction should only be performed during the second trimester. Twenty-five participants (48.1%) believe never or don't know when an open and broach could be performed. Fifteen participants (28.9%) believe incision and draining of an abscess can be performed at any point in pregnancy and 15 participants (28.9%) admit to either not knowing or believing this should never be performed. Thirty-two participants (61%) either don't know or believe injection of local anesthetic should never be performed at any point in pregnancy. When asked if they believe a temporary filling can be performed during pregnancy, 22 participants (42.2%) believe it can be performed at any time during pregnancy.

Education. Participants were asked about their beliefs on continuing education. Thirty-five participants (67.3%) strongly agree that a continuing ed program about care for pregnant patients would be of interest. Twenty-eight participants (53.9%) strongly agree that receiving

examples of a checklist to initiate conversations with their patients about oral health care during

pregnancy would interest them and 35 participants (67.3%) strongly agree that receiving

education materials to provide to their patients interests them. When asked about incorporating

new procedures into their practice or the dental office, 21 (40.4%) strongly agree that it is easy.

Of those surveyed, 33 (63.5%) of participants enjoy experimenting with new procedures or ways

of doing things.

Correlations. Kendall correlations were performed using Intellectus Software.

Correlations were examined based on an alpha value of 0.05. A significant positive correlation

was observed between providers believing it is worth their time to counsel pregnant patients and

team members desiring information about a continuing education program on care for pregnant

patients ($r_s = 0.30$, $p = .031$). The correlation coefficient between providers believing it is worth

their time to counsel pregnant patients and team members desiring information about a

continuing education program on care for pregnant patients was 0.30, indicating a small effect

size.

Discussion

Demographics

The response rate included a representative mix of dental team members including

dentists, dental hygienists, dental assistants, office managers, appointment center specialists, and

patient service representatives. All surveyed team members have been identified as participants

linked to scheduling, treating, or interacting with pregnant women.

Oral Health in Pregnancy

Knowledge scores are high overall. However, the majority of participants do not strongly

agree that periodontal disease is associated with miscarriage, preterm birth, or low birth weight

infants. Knowledge of the relationship between periodontal disease and adverse pregnancy outcomes has been demonstrated to be strongly correlated with pregnant women receiving access to oral health care. Additionally, the majority of participants do not strongly agree that bacteria that cause tooth decay in moms can be passed onto babies. Effective management strategies for early childhood caries is encouraged by multiple organizations. Organizations associated with dental health encourage dental team members to acknowledge the fact that maternal oral bacteria level is associated with oral infections among children and predicts increased early childhood caries (Chaffee et al., 2014).

Counseling Pregnant Patients

All participants surveyed acknowledge the value in counseling pregnant women about oral health during pregnancy. Participants believe they have time counsel patients and that education fits into their daily schedule. The majority the participants believe they have the skills to educate pregnant women, but further study results reveal continuing education may be a benefit to increasing knowledge.

Efficacy of Counseling and Treatment

The majority of participants believe dental treatment should be a part of a women's prenatal care and that women would be more likely to seek care if recommended by their perinatal provider. Survey participants do not consistently agree that dental care is safe during pregnancy and many are unsure if a dental health professional would have the ability to prevent pregnancy complications. Although the rate of oral health disease affecting pregnancy is unknown, it is believed some preterm births among low SES women could be avoided by early identification and treatment of existing dental conditions during pregnancy and that dental health professionals have the ability to make a positive impact on the health and wellbeing of pregnant

women. In addition to potentially preventing pregnancy complications, oral health treatment during pregnancy is associated with improved oral and overall health (ACOG, 2013).

Pressure on the Dental Profession

The majority of survey participants are not concerned about receiving criticism from the community if they provide dental care to pregnant women and they agree that patients will feel positive about their clinic if they provide comprehensive dental care to pregnant women.

Routine Services

In this section of the survey, participants were asked which during which period of pregnancy they believed it was safe to perform routine dental procedures. The responses to questions in this section demonstrate the uncertainty of safe dental care treatment for pregnant women. In a committee opinion issued from ACOG, the safety of dental procedures and the recommendation to treat pregnant women is outlined. Patients and providers should be reassured that prevention, diagnosis, and treatment of oral health conditions included x-rays and local anesthesia are safe during pregnancy (ACOG, 2013). Additionally, conditions such as extractions, root canals, and restoration of untreated caries may be managed at any point in pregnancy and delaying treatment may result in further complications.

Pharmaceuticals

Survey participants were asked how often they prescribe particular medications to pregnant women. Acetaminophen is the drug of choice for analgesic during pregnancy and can be used at any point during pregnancy. If utilized, medications such as aspirin, ibuprofen, and narcotics should be closely monitored. Antibiotic use in pregnancy may be appropriate but antibiotics such as doxycycline are contraindicated after the 18th week in pregnancy.

Pregnancy Status

Survey respondents reported various ways that pregnancy status is obtained in their clinic. A standardized approach to obtaining pregnancy status may aid in documentation improvement and pregnancy awareness among all dental team members.

Performing/Authorizing Procedures

Participants were asked how often they authorize or perform procedures on pregnant women. Survey responses varied based on position held on the dental unit. Pregnancy is defined as a teachable moment and a time where assessment and treatment of oral health conditions may be possible. Perinatal and dental professionals are encouraged to establish a collaborative, standardized approach to meeting oral health needs during pregnancy and ensuring treatment is being performed (ACOG, 2013).

Emergency Services

Survey respondents were asked which point in pregnancy they believe routine and emergency dental services are appropriate. The Health Resources and Services Administration's Maternal and Child Health Bureau, in collaboration with ACOG and the ADA, stress the safety of performing all dental procedures during any point in pregnancy. Dental and perinatal team members are encouraged to inform women that conditions which require immediate treatment, such as extractions, root canals, and restoration (amalgam or composite) of untreated caries, may be managed at any time during pregnancy. Oral bacteria may result in additional health concerns and treatment should not be delayed until the conclusion of pregnancy (ACOG, 2013).

Education

Dental team members agree that continuing education related to oral health in pregnancy would be of benefit to their practice. Additionally, they agree a safety checklist would be useful

when educating pregnant women. Dental team members believe it's easy to incorporate new procedures into their practice and they enjoy practicing new ways of doing things. If dental team members are provided with education as it relates to oral health care in pregnancy, the uptake of dental services for pregnant women has the potential to increase.

Strengths and Limitations

Strengths of this project include a robust response rate, high survey completion rate, and diverse representation of dental health team members. The survey tool utilized in testing was evaluated for content validity through psychometric assessment. Survey length provided a diverse pool of questions for review of current processes, beliefs, and desires among respondents.

Limitations to the project include self-reported behaviors from participants as this may impact the accuracy of information. Self-reporting of dental team members may increase the response of how one believes they should be practicing instead of how they are actually practicing. The survey tool utilized consisted of 77 questions. Most respondents answered all questions. One respondent discontinued the survey prior to completion and 7 survey participants excluded one question each. The length of the survey may have contributed to missed data.

Recommendations

Dental and perinatal providers are encouraged to review survey results from participating FQHCs. After obtaining results, providers are encouraged to identify facilitators and barriers as they relate to pregnant women receiving oral health care treatment. Once identified, a system wide intervention should be implemented to standardize screening, referral, and treatment of oral health conditions during pregnancy.

Evidence suggests that dental treatment during pregnancy is safe and recommended (ACOG, 2013). Preliminary recommendations to overcome barriers include continuing education for staff members, interdisciplinary collaboration among specialties, and referrals from the perinatal department.

Continuing education for staff members. Various team members participate in the scheduling and performance of dental treatment for pregnant women. Dental health team members including front desk staff, dental hygienists, dental assistants, referral coordinators, practice managers, and dentists can be influential in promoting positive oral health habits during pregnancy. Formal education programs for all dental team members may impact specific behaviors related to promoting dental care to pregnant women and may positively impact treatment rates. Oral health education regarding pregnant women has been shown to improve confidence and attitudes toward providing oral health care during pregnancy and is strongly linked to increasing treatment rates (George et al., 2016). Team members strongly agree that oral health is connected to systemic health and they indicate a desire to receive formal continuing education training.

Interdisciplinary collaboration among specialties. CHCs offer various comprehensive health services which include prenatal and dental care. Health centers reduce disparities by providing care management to patients with multiple healthcare needs. CHCs employ numerous employees who operate in various roles. Interdisciplinary collaboration between dental and perinatal team members may provide positive, consistent messages to pregnant women who are subject to health disparities. Team members should receive consistent education and be encouraged to collaborate with other specialties to overcome barriers to care.

Referrals from the perinatal department. Written referrals from prenatal providers to the dental department have been strongly linked to the completion of oral health treatment for pregnant women (George et al., 2016). Written referrals provide recommendation to the need and safety of dental treatment during pregnancy. Referrals can be hand delivered to the dental office, provided to the patient, or sent electronically.

Conclusion

Preterm births and low birth weight infants remain a public health burden and costs can be lowered when intervention is tailored to specific populations. Although not all pregnancy complications can be prevented, all healthcare providers can take positive measures towards promoting healthy habits and safe care. A gap analysis previously conducted among perinatal providers in the metropolitan southwest United States will complement this gap analysis among the dental team to aid in developing a system wide intervention to standardize screening, referral, and treatment of oral health conditions in pregnant women. The intervention will be data driven, and designed in the context of research evidence for best practices in oral health care during pregnancy.

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Appendix A

Table A1

Evaluation Table

Citation	Theory/ Conceptual Framework	Design/Method/ Purpose	Sample/Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Decision for practice
Gesase et al. (2018).

The association between periodontal disease and adverse pregnancy outcomes in Northern Tanzania: A cross sectional study

Country: Northern Tanzania, Africa

Funding: Self-funded by authors

Bias: None recognized | Inferred to the Quality Health Outcomes model | **Design:** CSS

Purpose: To determine the prevalence of periodontal disease and associated adverse pregnancy outcomes among women delivering at the KCMC | N=1117 **Demographics:** Edu: 38.9% post-secondary. Mean age: 28.5. Marital status: 90% married. Parity 1-3: 86.6%.

Setting: Tertiary teaching hospital with an average of 3,300 deliveries per year.

Inclusion: All pregnant women delivering at the KCMC labor ward, ages 18-46, GA 28wks-42wks. | **IV**- PD

DV1: PTB (<37 wks. gestation)

DV2: PE

DV3: LBW (<2,500 grams)

DV4: premature rupture of membranes | Structured questionnaire including sociodemographic characteristics, previous obstetric history, and index pregnancy information

File review

Clinical periodontal exam: CPI scoring

0 = no PD 1= gingivitis (BOP, probing depth ≤ 3mm) 2= gingivitis (calculus with plaque seen or felt on probing) | SPSS version 20. Descriptive statistics summarized using mean and SD for continuous variables while frequency and proportions used for categorical variables.

OR with 95% CI estimated using multivariable logistic model.

p-value less than 0.05 (2 tailed) considered statistically significant. | Prevalence of PD: 14.2%.

DV1- (aOR=2.32;95% CI:1.33-4.27)

DV2: (aOR=4.12; 95%CI:2.20-7.90)

DV3: (aOR=2.41;95% CI:1.34-4.33)

DV4: (aOR=1.83; 95%CI:0.75-4.21) | **LOE**: II

Strengths: large sample size

Weaknesses: Study carried out at tertiary hospital where most of community lives in urban setting. Education level of participants may have not represented entire population. Attrition rate not discussed.

Conclusion: Maternal periodontal disease is a potential independent risk |

Abbreviation Key: **abx-** antibiotics**; aOR-** adjusted odds ratio; **BOP-** bleeding on probing**; CAL –** clinical attachment level; **CG-** control group**; CI-** confidence interval; **CPI-** community periodontal index; **CSS-** cross-sectional study; **CWF-** community water fluoridation; **DSU-** dental services utilization; **DT-** dental treatment; **DV-** dependent variable; **FA-** fetal anomalies; **FE-** final evaluation; **GA-** gestational age; **GCF-** gingival crevicular fluid; **GI-** gingival index; **HRP-** high risk pregnancy; **IG-** intervention group; **IV-** independent variable; **KCMC-** Kilimanjaro Christian Medical Centre; **LBW-** low birth weight; **LRP-** low risk pregnancy; **MCRCT-** Multi-centre randomized controlled trial; **MG-** multiple gestation; **MIOH-DS**– Midwifery initiated oral health-dental service; **ML-** medium low; **mm-** millimeters; **N-** number; **NSPT-** non surgical periodontal treatment; **NSW-** New South Wales; **OH-** oral health; **OR-** odds ratio; **OT-**orthodontic treatment; **PD-** periodontal disease; **PE-** pre-eclampsia; **PI-**plaque index; **PNC-** prenatal care; **PPD-** periodontal probing depth; **PQ-** post questionnaire; **PT-** periodontal treatment; **PTB-** preterm birth; **PTLBW-** preterm low birth weight; **PVMC –** Presidente Vargas Maternal Hospital; **RR-** risk ratio; **SD-** standard deviation; **SEC-** socioeconomic status; **wks-** weeks; **y.o.-** year old

| | | | | | 3= periodontitis (pathological pocket >3mm & <6mm) 4=periodontitis (pathological pocket ≥ 6mm) | | | | indicator for PE, LBW, and PTB.

Feasibility/application to pt. population: Periodontal assessment and therapy should form part of the preventive antenatal care as exam as treatment can reduce reoccurrence or deterioration. |
| **Exclusion:** MG, any systemic infection apart from periodontitis, and those who lacked the number of teeth necessary to register the CPI.

Attrition: Not discussed | | | | | | | | | |

Citation	Theory/ Conceptual Framework	Design/Method Purpose	Sample/Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Decision for practice
Weidlich et al., 2013.

Effect of nonsurgical periodontal therapy and strict plaque control on preterm/low birth weight: A randomized controlled clinical trial. | Inferred to be Protection Motivation Theory | **Design**: RCT

Purpose: Assess the effect of comprehensive nonsurgical periodontal treatment and strict plaque control performed during pregnancy on the | N – 303
IG – 145
CG-154

Demographics: Edu: Elementary (CG 46.75%, IG 51.73%); Age: 20-30(CG 64.28%, IG 66.9%); SEC: ML (CG 50.65%, IG 51.04%); non- | **IV**- Comprehensive NSPT

DV1- PTB (<37 weeks gestation)

DV2- LBW (<2500 grams)

Comprehensive NSPT - Completed before the 24th week of | Chart Review

PTB (birth occurring before 37 weeks gestation)

LBW (birth weight less than 2500grams)

Randomly allocated to EG using block-stratified | Categorical data were summarized by absolute and relative frequencies.

Comparisons between groups performed using Chi-square and Fisher's exact test. | PTB (CG 9.09% vs IG 11.72%, p=0.57)

LBW (CG 2.6% vs IG 4.1%, p=0.59)

Reduction of plaque (IG 48.5% vs CG 10.32%, p<0.001)

Gingival | **Level of Evidence**: II

Strengths: Study design employed; very low attrition rate achieved; well balanced; meticulous PT and strict plaque control implemented |

Citation	Theory/ Conceptual Framework	Design/Method/ Purpose	Sample/Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Finding/Results	Level/Quality of Evidence; Decision for practice
Country: Brazil **Funding:** Partially supported by the National Council of Research- Brazil and the Department of Periodontology, University of Oslo, Norway. **Bias:** None recognized		reduction of PTLBW	Caucasian (CG 31.17%, IG 32.41%) **Setting:** Pregnant women seeking PNC at PVMH. **Inclusion:** 18-35 y.o., <20 wks. gestation **Exclusion:** MG, receiving OT, needing abx prophylaxis for DT **Attrition**: CG:2 lost to follow up (1.2%). IG:1 lost to follow up & 1 lost to undetermined GA (1.4%)	pregnancy including excavation and sealing of cavities, removal of overhanging restorations, extraction of hopeless teeth, supragingival calculus removal, and subgingival sealing, root planning under local anesthesia, and oral hygiene instruction.	strategy according to smoking extent (<5 of >5 cigarettes per day) Structured questionnaire comprising demographics, socioeconomic status, medical and dental history used to collect maternal data.	Continuous data summarized by means, SD, CI, and groups were compared by independent sample t tests. p-value <0.05 considered statistically significant	bleeding (IG 23.31% vs CG 2.5%, p<0.001) Supragingival calculus (IG 21.33% vs CG 4.13%, p<0.001) BOP (IG 38.05% vs. CG 2.56%, p<0.001)	**Weaknesses:** Sample size smaller than recent studies **Conclusion:** PT and strict plaque control significantly improved periodontal health. However, no reduction of PTLBW rates were observed. **Feasibility/appli cation to pt. population:** Successful PT performed up to the second trimester of gestation may significantly improve periodontal inflammation.
George et al., 2018	Inferred to the Quality Health Outcomes model	**Design:** MCRCT	N=639 **n**=215 (CG)	**IV**-MIOH-DS program	10 item questionnaire pre	SPSS 21, descriptive statistics	Uptake of dental services- p<0.001 (20.2%	**Level of Evidence**: II

Abbreviation Key: abx- antibiotics**; aOR-** adjusted odds ratio; **BOP-** bleeding on probing; **CAL –** clinical attachment level; **CG-** control group**; CI-** confidence interval; **CPI-** community periodontal index; **CSS-** cross-sectional study; **CWF-** community water fluoridation; **DSU-** dental services utilization; **DT-** dental treatment; **DV-** dependent variable; **FA-** fetal anomalies; **FE-** final evaluation; **GA-** gestational age; **GCF-** gingival crevicular fluid; **GI-** gingival index; **HRP-** high risk pregnancy; **IG-** intervention group; **IV-** independent variable; **KCMC-** Kilimanjaro Christian Medical Centre; **LBW-** low birth weight; **LRP-** low risk pregnancy; **MCRCT-** Multi-centre randomized controlled trial; **MG-** multiple gestation; **MIOH-DS**– Midwifery initiated oral health-dental service; **ML-** medium low; **mm-** millimeters; **N-** number; **NSPT-** non surgical periodontal treatment; **NSW-** New South Wales; **OH-** oral health; **OR-** odds ratio; **OT-**orthodontic treatment; **PD-** periodontal disease; **PE-** pre-eclampsia; **PI-**plaque index; **PNC-** prenatal care; **PPD-** periodontal probing depth; **PQ-** post questionnaire; **PT-** periodontal treatment; **PTB-** preterm birth; **PTLBW-** preterm low birth weight; **PVMC –** Presidente Vargas Maternal Hospital; **RR-** risk ratio; **SD-** standard deviation; **SEC-** socioeconomic status; **wks-** weeks; **y.o.-** year old

Evaluation of a midwifery initiated oral health-dental service program to improve oral health and birth outcomes for pregnant women: A multi-centre randomized controlled trial. **Country:** Australia **Funding:** National Health and Medical Research Counsel (project grant App1022007) **Bias:** None recognized	**Purpose:** To assess the effectiveness of a MIOH-DS program in improving uptake of dental services, oral health knowledge, quality of oral health, oral health status, and birth outcomes of pregnant women	**n=** 212 (IG1) **n=** 212 (IG2) **Demographics:** Age (CG 29.0, IG1 29.1, IG2 29.0), private insurance (CG 16.4%, IG1 14.4%, IG2 21.2%), tertiary education (CG 52.6%, IG1 54.6%, IG2 52.1%) **Setting:** Three large metropolitan public hospitals in Sidney, Australia **Inclusion:** >18 y.o., single LRP between 12-20 wks. gestation **Exclusion:** Known FA, HRP, unable to attend dental treatment regularly	**DV1**-Uptake of dental services **DV2**-Oral health knowledge **DV3**-Quality of oral health **DV4**-Oral health status **DV5**-Birth outcomes MIOH-DS program- IG1 received a midwifery intervention from midwives involving OH education, screening, and referrals to existing dental pathways. IG2- received midwifery intervention and a dental intervention involving assessment/treatment cost free	and post intervention Final dental evaluation	Pearson's chi-squared analysis; Logistic regression; ANOVA; t-test; Kruskal-Wallis p-value <0.05 considered statistically significant	CG, 28.3% IG1, 87.2% IG2) Women's OH knowledge- p=0.03 Quality of OH – p<0.001 OH status – p<0.001 Birth outcomes - no significant differences between groups for prematurity or LBW	**Strengths:** Successful implementation and evaluation of OH model of care for midwifery practice. Feasible to implement. **Weaknesses:** Only included women visiting a public hospital during pregnancy **Conclusion:** No effect in improving birth outcomes among pregnant women **Feasibility/application to pt. population:** MIOH-DS program is effective in improving DSU, oral hygiene, OH knowledge, and quality of oral health among

Abbreviation Key: abx- antibiotics**; aOR-** adjusted odds ratio; **BOP-** bleeding on probing**; CAL –** clinical attachment level; **CG-** control group**; CI-** confidence interval; **CPI-** community periodontal index; **CSS-** cross-sectional study; **CWF-** community water fluoridation; **DSU-** dental services utilization; **DT-** dental treatment; **DV-** dependent variable; **FA-** fetal anomalies; **FE-** final evaluation; **GA-** gestational age; **GCF-** gingival crevicular fluid; **GI-** gingival index; **HRP-** high risk pregnancy; **IG-** intervention group; **IV-** independent variable; **KCMC-** Kilimanjaro Christian Medical Centre; **LBW-** low birth weight; **LRP-** low risk pregnancy; **MCRCT-** Multi-centre randomized controlled trial; **MG-** multiple gestation; **MIOH-DS**– Midwifery initiated oral health-dental service; **ML-** medium low; **mm-** millimeters; **N-** number; **NSPT-** non surgical periodontal treatment; **NSW-** New South Wales; **OH-** oral health; **OR-** odds ratio; **OT-**orthodontic treatment; **PD-** periodontal disease; **PE-** pre-eclampsia; **PI-**plaque index; **PNC-** prenatal care; **PQ-** post questionnaire; **PT-** periodontal treatment; **PTB-** preterm birth; **PTLBW-** preterm low birth weight; **PVMC –** Presidente Vargas Maternal Hospital; **RR-** risk ratio; **SD-** standard deviation; **SEC-** socioeconomic status; **wks-** weeks; **y.o.-** year old

			Attrition: IG1: 29% PQ, 59% FE; IG2: 39% dental intervention, 27% PQ, 52% FE)					pregnant women.

Citation	Theory/ Conceptual Framework	Design/Method/ Purpose	Sample/Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Decision for practice
Albert et al., 2011. An examination of periodontal treatment, dental care, and pregnancy outcomes in an insured population in the United States. **Country**: USA **Funding**: Supported by the New York State Foundation for Science, Technology, and Innovation; Aetna; and Clinical and Translational	Inferred to the Quality Health Outcomes model	**Design:** Retrospective Cohort study **Purpose:** Examine whether periodontal treatment or other dental care is associated with adverse birth outcomes within a medical and dental insurance database.	N=23441 n=464 (group1) n=622 (group2) n=8010 (group3) n=2024 (group4) n=12,321 (group5) **Demographics:** Mean age: 30.9 years, 63% reside where population is 1-10% African American, 56.4% reside where income exceeds the 80th percent nationally **Setting:** Aetna Data Warehouse representing	**IV:** PT, dental prophylaxis, and other dental treatment **DV1:** PTB **DV2:** LBW Group 1: first instance of periodontal treatment occurred before delivery Group 2: First instance of periodontal treatment occurred postdelivery Group 3: Only prophylactic	Claims data review of ICD-9 and CDT-3 coding	SPSS version 15.0 Descriptive statistics to characterize the study cohort. Pearson $x2$, one way analysis of variance, Kruskal-Wallis test, logistic regression analysis	**Observed probability of LBW:** (group1: 3.7%, group2 1.8%, group3 3.3%, group4 4.6%, group5 5%) **Observed probability of PTD:** (group1 9.9%, group2 6.3%, group3 7.6%, group4 9.4%, group5 10.1%) Those who did not receive any dental care during the study period had the highest rates of	**Level of Evidence:** IV **Strengths:** Large cohort study **Weaknesses:** May not be representative of insured women nationwide. **Conclusion:** Receiving preventive dental treatment is associated with a lower incidence of adverse birth outcomes compared with instances when no dental

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			pregnant women in 47 US states	treatment at least once during observation			LBW and PTB outcomes	services are delivered
Science aware from the National Institute of Health **Bias**: None recognized			**Inclusion**: Fully insured women participating in medical and dental insurance plans who delivered between 1/1/2003 and 9/30/2006. **Exclusion:** 5627 women had ICD-9 codes with presence of medical exclusion factors **Attrition:** Not discussed	Group 4: Received other dental treatment but no PT or prophylaxis during observation Group 5: No dental treatment of any kind during period of observation				**Feasibility/Appl ication to patient practice:** Pregnant women should be screened and referred for oral care in order to prevent undesired outcomes.
Citation	**Theory/ Conceptual Framework**	**Design/Method/ Purpose**	**Sample/Setting**	**Major Variables & Definitions**	**Measurement/ Instrumentatio n**	**Data Analysis (stats used)**	**Findings/ Results**	**Level/Quality of Evidence; Decision for practice**
Moreira et al., 2015 Periodontal treatment outcomes during pregnancy and postpartum.	Inferred to the Quality Health Outcomes Model	**Design**: RCT **Purpose:** To compare periodontal therapy outcomes during	N= 90 n=49 (IG) n=41 (CG) **Demographics:** Age between 20-25 y.o.	**IV**- PT **DV1:** PI **DV2:** GI **DV3:** PPD **DV4:** CAL **DV5:** BOP **DV6:** GCF	Periodontal examination to include: Plaque index, gingival index, periodontal probing depth, clinical	SPSS Chi-square, Fisher's exact test, *t* test, Shapiro-Wilk test	DV1: PI (CG 1.27 to 0.28, IG 1.42 to 0.42) DV2: GI (CG 1.32 to 1.0, IG 1.28 to 0.98)	**Level of Evidence**: II **Strengths:** Limited previous comparison of PT in pregnancy vs. postpartum

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Country: Brazil **Funding:** Supported by the National Council of Research-Brazil & scholarship from CAPES **Bias**: None recognized	pregnancy and after delivery.	(CG:42.3%, IG:35.1%), Caucasian (CG: 63.5%, IG:68.4%), high school education (CG: 40.4%, IG: 36.8%) **Setting:** dental unit of Maternal Hospital Presidente Vargas. **Inclusion:** 18-35 y.o., <20 wks. gestation **Exclusion:** MG, receiving OT, needing abx prophylaxis for DT **Attrition:** 21% CG, 14% IG	**PT:** Excavation of sealing of cavities, removal of overhanging restorations, extractions of hopeless teeth, and supra/subgingival sealing and root planning under local anesthesia.	attachment level, bleeding on probing, and gingival crevicular fluid volume	DV3: PPD (CG 2.42 to 2.05, IG 2.43 to 2.1) DV4: CAL (CG 0.18 to 0.17, IG 0.13 to 0.13) DV5: BOP (CG 45.71% to 8.07%, IG 49.14% to 11.10%) p=0.95 DV6: GCF (CG 0.44 to 0.29, IG 0.5 to 0.34) No statistically significant differences were observed between groups concerning plaque index, gingival index, periodontal probing depth, clinical attachment level, and gingival crevicular fluid Periodontal therapy significantly reduced	**Weaknesses:** Lack of blindness among researchers as sample was taken from previously conducted RCT. **Conclusion:** Hormonal changes during pregnancy do not interfere in treatment outcomes in women with widespread gingival inflammation and limited periodontal destruction. **Feasibility/Application to patient practice:** Periodontal health can be reestablished irrespective of the hormonal challenge that takes place

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							periodontal inflammation in both groups.	during pregnancy. PT therapy is safe can be performed during pregnancy without serious adverse events.
Citation	**Theory/ Conceptual Framework**	**Design/Purpose /Method**	**Sample/Setting**	**Major Variables & Definitions**	**Measurement/I nstrumentation**	**Data Analysis (stats used)**	**Findings/ Results**	**Level/Quality of Evidence; Decision for practice**
Geisinger et al., 2014 Oral health education and therapy reduces gingivitis during pregnancy. **Country**: USA **Funding**: Supported in part by funding and materials from Procter & Gamble Corporation **Bias**: None recognized	Inferred to the Quality Health Outcomes Model	**Design:** Pilot Study, non-randomized **Purpose:** To evaluate an intensive protocol aimed at reducing gingivitis in pregnant women and pilot data for large-scale randomized controlled trials investigating oral hygiene measures to reduce pregnancy gingivitis and	N= 96 **Demographics:** Race (black 82.5%), Education (high school diploma 70%), Unmarried (88.3%) **Setting:** Center for Reproductive Health at the University of Alabama at Birmingham. **Inclusion:** GA between 16 and 24 weeks with GI scores ≥2 at	**IV**: OH education and therapy **DV1**: PI **DV2**: Gingival inflammation **DV3**: PPD **DV4**: CAL OH education and therapy: Educational DVD at baseline and copy for home, clinical evaluation of intra and extra oral structures at baseline and all subsequent study visits, one on	Examination performed by single examiner trained in study protocol and examination procedures at baseline, 4 weeks, and 8 weeks after prophylaxis and intensive oral hygiene measures	ANOVA Statistical significance set at p<0.01	DV1: PI (1.35 baseline to 0.61 at 8 week follow up) p<0.001 DV2: Gingival inflammation (1.45 at baseline to 0.75 at 8 week follow up) p<0.001 DV3: PPD (3.41 mm at baseline to 2.97 mm at 8 week follow up) p<0.001 DV4: CAL (2.26mm at baseline to 2.02mm at 8	**LOE:** III **Strengths:** Well suited study for widespread public health intervention **Weaknesses:** Lack of control subjects who were observed did not receive prophylaxis and intensive oral hygiene instructions during pregnancy **Conclusion:** Intensive oral

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		alter maternity outcomes	≥50% of tooth sites, free from periodontitis, at least 16 y.o., 20 natural teeth minimally **Exclusion:** plural gestation, previous spontaneous PT, body mass index <19.88, or bacterial vaginosis **Attrition:** 19%	one intervention, reinforcement of home care with periodic cell phone messages			week follow up) p<0.001	hygiene regimen decreased gingivitis in pregnant patients. **Feasibility/Application to patient practice:** Low cost interventions may result in overall improvement of maternal and fetal oral and systemic health. Repeated and systematic oral hygiene instruction may aid in reducing gingivitis noted in pregnant women and should be implemented in prenatal education
Citation	**Theory/ Conceptual Framework**	**Design/Purpose /Method**	**Sample/Setting**	**Major Variables & Definitions**	**Measurement/I nstrumentation**	**Data Analysis (stats used)**	**Findings/ Results**	**Level/Quality of Evidence; Decision for practice**

Ramesh Reddy et al., 2014 The effect of phase-1 periodontal therapy on pregnancy outcome in chronic periodontitis patients. **Bias**: None recognized **Country**: India **Funding**: None recognized	Inferred to the Quality Health Outcomes Model	**Design:** RCT **Purpose:** Determine the effect of non-surgical periodontal therapy on pregnancy outcomes in women with periodontitis and to detect IgM and IgG status in cord blood during delivery.	N=20 n=10 (CG) n=10 (IG) **Demographics**: Age: (CG 27.04, IG 26.23), GA: (CG 18.15 wks., IG 16.35 wks.) **Setting**: Department of Periodontology, Narayana Dental College and Hospital and Jubilee Govt. Mother and Child Hospital **Inclusion**: 18-35 y.o., 12-24 weeks GA, diagnosed periodontitis, no treatment within the previous 6 months **Exclusion**: Current smokers, history of alcohol consumption, taking systemic medications,	IV – Phase-I periodontal therapy **DV1**: Oral health index **DV2**: bleeding index **DV3**: PPD **DV4**: CAL **DV5**: PTB **DV6**: LBW Phase I periodontal therapy – therapy before 28 weeks gestation and maintenance until delivery	Precise case history, clinical examination, and complete periodontal examination. Chart Review LBW defined as <2,500 gms. PTD defined as <37 weeks gestation	ANOVA, χ^2 analysis	DV1: Oral health index (CG 5.0 to 4.8, IG 4.2 to 1.0) p<0.001 DV2: bleeding index (CG 3.8 to 3.3, IG 3.3 to 1.2) p<0.001 DV3: PPD (4.9 to 4.4, IG 4.5 to 1.9) p<0.001 DV4: CAL (CG 5.0 to 4.7, IG 4.9 to 2.2) p = 0.001 DV5: PTB (CG10%, IG 0%) DV6: LBW (CG20%, IG0%)	**LOA:** II **Strengths:** Zero percent attrition rate. **Weaknesses:** Small sample size **Conclusion:** Women with periodontitis are two to three times more likely to deliver a preterm, low birth weight infant than periodontally healthy women. **Feasibility/Appl ication to patient practice:** Periodontal therapy may be useful in reducing the occurrence of LBW and PTB

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				have systemic diseases
				Attrition: None (0%)

Citation	Theory/ Conceptual Framework	Design/Purpose /Method	Sample/Setting	Major Variables and Definition	Measurement/I nstrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Decision for practice
Pirie et al., 2013 Intrapregnancy non-surgical periodontal treatment and pregnancy outcome: A randomized controlled trial **Bias:** None recognized **Funding**: None recognized **Country**: Ireland	Inferred to the Quality Health Outcomes Model	**Design:** RCT **Purpose:** Investigate the potential link between maternal periodontitis and pregnancy outcomes, specifically LBW and PTB	N=99 n= 50 (CG) n=49 (IG) **Demographics**: Mean age: (CG 20.5 years, IG 30.5 years), Number of years in full time education (CG 15.8, IG 15.8), high social class (CG 38%, IG 61%), Null parity (CG46%, IG 41%) **Setting**: Antenatal clinic in the Royal Jubilee Maternity Service, Belfast, Northern Ireland	IV – Intrapregnancy non-surgical PT **DV1**: PTB <37 weeks gestation) **DV2**: LBW (<2500 grams) Intrapregnancy non-surgical PT – completed by the end of gestational week 24. Consisted of oral hygiene instructions, supragingival and subgingival scaling and root planning (SRP) of sites with PDs greater than or equal to 4mm,	Periodontal examination by one examiner who had been calibrated to a gold standard examiner Chart review of medical notes	Independent sample T test Level of significance set at p<0.05 ANCOVA, Mann-Whitney U, Wilcoxon signed-ranks test	DV1: PTB (CG, 2% IG,8%) DV2: LBW (CG 2%, IG 6%) No improvement noted in PTB or LBW seen in control group vs. investigation group Plaque present: % of sites (pre treatment 79, post treatment 37) p<0.001 BOP present: % of sites (pre treatment 76, post treatment 50) p<0.001	**LOA:** II **Strengths:** Independent finding that periodontal treatment during pregnancy improved clinical periodontal parameters **Weaknesses:** Periodontal disease in participants may not have been severe enough, majority Caucasian population, and relatively small sample size

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							PD greater than or equal to 4 mm: % of sites (pretreatment 19.9, post treatment 6.1) p<0.001	**Conclusions:** Non-surgical periodontal treatment, performed during weeks 20 to 24 of pregnancy, does not influence pregnancy outcomes in the Caucasian population.
Inclusion: >18y.o., singleton pregnancy, and ≥20 teeth			and polishing of all teeth					
Exclusion: MG, diabetes, known pregnancy complications, requiring abx prophylaxis, aggressive periodontitis, or PT in the past 12 months								**Feasibility/Application to patient practice:** Study showed improvement in oral health when PT was initiated during pregnancy even though it didn't show changes in birth outcomes.
Attrition: None (0%)								
Citation	**Theory/ Conceptual Framework**	**Design/Purpose /Method**	**Sample/Setting**	**Major Variables & Definition**	**Measurement/ Instrumentation**	**Data Analysis (stats used)**	**Findings/ Results**	**Level/Quality of Evidence; Decision for practice**
Zhang et al., 2019	Inferred to the Quality Health Outcomes Model	**Design:** CSS **Purpose:** To examine the	N=9234 **Demographics**: All white, non-	**IV1**: Dental cleaning during pregnancy	Massachusetts Pregnancy Risk Assessment	SAS 9.4, SUDAAN 11.0, Chi square	DV: PTB rate Neither dental cleaning during	**LOA:** II **Strengths:** Population based

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Dental cleaning, community water fluoridation, and preterm birth, Massachusetts: 2009-2016

Bias: None recognized

Funding: Centers for Disease Control and Prevention grant

Country: United States | association of maternal dental cleaning during pregnancy and exposure to CWF on preterm birth using a population-based survey of women who recently gave birth | Hispanic (66.2%), 30-39 years old (53.6%), college degree (50.6%), household income above 200% FPL (58.6%), born in US (72.9%), normal BMI prior to becoming pregnancy (54.9%)

Setting: Women delivering in Massachusetts from 2009-2016

Inclusion: All women delivering singleton, live births

Exclusion: adoption, surrogates, MB

Attrition: None (0%) | **IV2**: CWF

DV: PTB rate (<37 weeks gestation)

Confounders: Maternal race/ethnicity, age, education, FPL, insurance status, pre-pregnancy diabetes, prior preterm birth, nativity, and pre-pregnancy BMI | Monitoring System survey

Massachusetts Department of Public Health, Office of Oral Health, CWF town lists | pregnancy or CWF (11.5%)

Dental cleaning only (7.7%)

CWF only (9%)

Dental cleaning and CWF (7.4%)

After adjusting for confounders, women who received dental cleaning and CWF were 26% less likely to have a preterm birth than women who received neither. [aRR 0.74, 95% CI (0.55-0.98), aRR 0.74, 95% CI (0.57-0.95)].

Women who received dental cleaning alone and dental cleaning with CWF have significantly lower prevalence of PTB compared with | survey strengthening generalizability, able to account for relevant confounders strengthening internal validity, study provides a replicable framework for other PRAMS states

Weaknesses: Unknown if additional dental services were provided, women's length of residency in CWF unavailable

Conclusion: Women who had dental cleaning during pregnancy and lived in a community with water fluoridation had lower prevalence of PTB. |

Abbreviation Key: **abx**- antibiotics**; aOR**- adjusted odds ratio; **BOP**- bleeding on probing**; CAL** – clinical attachment level; **CG- control group; CI**- confidence interval; **CPI**- community periodontal index; **CSS**- cross-sectional study; **CWF**- community water fluoridation; **DSU**- dental services utilization; **DT**- dental treatment; **DV**- dependent variable; **FA**- fetal anomalies; **FE**- final evaluation; **GA**- gestational age; **GCF**- gingival crevicular fluid; **GI**- gingival index; **HRP**- high risk pregnancy; **IG**- intervention group; **IV**- independent variable; **KCMC**- Kilimanjaro Christian Medical Centre; **LBW**- low birth weight; **LRP**- low risk pregnancy; **MCRCT**- Multi-centre randomized controlled trial; **MG**- multiple gestation; **MIOH-DS**– Midwifery initiated oral health-dental service; **ML**- medium low; **mm**- millimeters; **N**- number; **NSPT**- non surgical periodontal treatment; **NSW**- New South Wales; **OH**- oral health; **OR**- odds ratio; **OT**-orthodontic treatment; **PD**-periodontal disease; **PE**- pre-eclampsia; **PI**-plaque index; **PNC**- prenatal care; **PPD**- periodontal probing depth; **PQ**- post questionnaire; **PT**- periodontal treatment; **PTB**- preterm birth; **PTLBW**- preterm low birth weight; **PVMC** – Presidente Vargas Maternal Hospital; **RR**- risk ratio; **SD**- standard deviation; **SEC**- socioeconomic status; **wks**- weeks; **y.o.**- year old

								women who had neither after controlling for confounders	**Feasibility/Application to patient practice:** Promotion of dental cleanings during pregnancy and CWF improve birth outcomes and women's health which suggest they should be recommended
Citation	**Theory/ Conceptual Framework**	**Design/Purpose /Method**	**Sample/Setting**	**Major Variables and Definition**	**Measurement/ Instrumentation**	**Data Analysis (stats used)**	**Findings/ Results**		**Level/Quality of Evidence; Decision for practice**
Iheozor-Ejiofor et al., 2017 Treating periodontal disease for preventing adverse birth outcomes in pregnant women **Bias**: 10 studies unclear risk and 5 studies low risk	Inferred to the Quality Health Outcomes Model	**Design:** Meta-Analysis, Cochrane Review **Purpose:** To assess the effects of treating periodontal disease in pregnant women in order to prevent or reduce perinatal and maternal morbidity and mortality	N=7161 15 studies **Demographics**: Mean GA (14.0 to 39.6 weeks), age (22.2-30.5 years) **Setting**: RCTs conducted in either university hospitals, public hospitals, public health clinics, antenatal clinics, maternity	**IV** – Periodontal treatment **DV1**: PTB (<37 weeks gestation) **DV2**: LBW (<2500 grams) **DV3**: small for gestational age **DV4**: Perinatal Mortality **DV5**: Maternal Mortality	Electronic search review including Cochrane Oral Health's Trials Register, Cochrane Pregnancy and Childbirth's Trials Register, Cochrane Central Register of Controlled Trials, MEDLINE Ovid, Embase Ovid, LILACS BIREME Virtual	Effect measures include the odds ratio (OR), risk ratio (RR), or risk difference (RD) for dichotomous data, mean difference (MD) or standardized mean difference (SMD) for continuous data	DV1: PTB: 11 studies. 5671 participants. There is no clear difference in preterm birth < 37 weeks (RR 0.87, 95% CI 0.70 to 1.10; I2 = 66%) DV2: LBW: 7 studies. Periodontal treatment may reduce the incidence of low		**LOA**: I **Strengths**: Diverse group ranging from mild to severe PD. **Weaknesses**: Variation in definition of periodontitis across studies, high risk of bias due to lack of blinding of

Funding: Research institutes, the government, scientific research fund, a university, "institutional support", and a manufacturer of oral healthcare products

Country: North America, South America, Asia, Europe, and Australia

hospitals or a combination of university and antenatal clinics

Inclusion: all RCTs investigating the effects of periodontal treatment in preventing or reducing perinatal and maternal morbidity and mortality, diagnosed PD or gingivitis

Exclusion: studies where obstetric outcomes were not reported, non-randomization, inclusion of pregnant women regardless of periodontal status

Attrition: varies per study

DV6: Pre-Eclampsia

DV7: Adverse effects of therapy

Health Library, ClinicalTrials.gov, & World Health Organization International Clinical Trials Registry Platform

birth weight < 2500 g (9.7% with PT versus 12.6% with no treatment. RR 0.67, 95% CI 0.48 to 0.95; I2 = 59%)

DV3: Small for gestational age: 7 studies. Periodontal treatment may lead to no clear difference in births of babies which are small for gestational age when compared with no treatment (RR 0.97, 95% CI 0.81 to 1.1)

DV4: Perinatal Mortality, 3 studies. It is uncertain whether periodontal treatment increases or decreases perinatal mortality (RR 0.85, 95% CI

participants in 13 studies

Conclusion: It is not clear if periodontal treatment during pregnancy has an impact on preterm birth (low-quality evidence). There is low-quality evidence that periodontal treatment may reduce low birth weight (< 2500 grams)

Feasibility/Application to patient practice: There may be insufficient evidence to determine if/which PD treatment during pregnancy is better but treatment did not inflict harm or poor outcomes and therefore

Abbreviation Key: **abx-** antibiotics**; aOR-** adjusted odds ratio; **BOP-** bleeding on probing**; CAL –** clinical attachment level; **CG-** control group**; CI-** confidence interval; **CPI-** community periodontal index; **CSS-** cross-sectional study; **CWF-** community water fluoridation; **DSU-** dental services utilization; **DT-** dental treatment; **DV-** dependent variable; **FA-** fetal anomalies; **FE-** final evaluation; **GA-** gestational age; **GCF-** gingival crevicular fluid; **GI-** gingival index; **HRP-** high risk pregnancy; **IG-** intervention group; **IV-** independent variable; **KCMC-** Kilimanjaro Christian Medical Centre; **LBW-** low birth weight; **LRP-** low risk pregnancy; **MCRCT-** Multi-centre randomized controlled trial; **MG-** multiple gestation; **MIOH-DS**– Midwifery initiated oral health-dental service; **ML-** medium low; **mm-** millimeters; **N-** number; **NSPT-** non surgical periodontal treatment; **NSW-** New South Wales; **OH-** oral health; **OR-** odds ratio; **OT-**orthodontic treatment; **PD-** periodontal disease; **PE-** pre-eclampsia; **PI-**plaque index; **PNC-** prenatal care; **PPD-** periodontal probing depth; **PQ-** post questionnaire; **PT-** periodontal treatment; **PTB-** preterm birth; **PTLBW-** preterm low birth weight; **PVMC –** Presidente Vargas Maternal Hospital; **RR-** risk ratio; **SD-** standard deviation; **SEC-** socioeconomic status; **wks-** weeks; **y.o.-** year old

0.51 to 1.43; I2 = 21%)	may be beneficial.
DV5: Maternal mortality: 4 studies. 0% mortality rate.	
DV6: Pre-Eclampsia: 3 studies. It is uncertain whether periodontal treatment results in a difference in pre-eclampsia when compared to no treatment (RR 1.10, 95% CI 0.74 to 1.62)	
DV7: Adverse effects of therapy: 4 studies. 0% adverse effects	

Abbreviation Key: abx- antibiotics**; aOR-** adjusted odds ratio; **BOP-** bleeding on probing**; CAL –** clinical attachment level; **CG-** control group**; CI-** confidence interval; **CPI-** community periodontal index; **CSS-** cross-sectional study; **CWF-** community water fluoridation; **DSU-** dental services utilization; **DT-** dental treatment; **DV-** dependent variable; **FA-** fetal anomalies; **FE-** final evaluation; **GA-** gestational age; **GCF-** gingival crevicular fluid; **GI-** gingival index; **HRP-** high risk pregnancy; **IG-** intervention group; **IV-** independent variable; **KCMC-** Kilimanjaro Christian Medical Centre; **LBW-** low birth weight; **LRP-** low risk pregnancy; **MCRCT-** Multi-centre randomized controlled trial; **MG-** multiple gestation; **MIOH-DS**– Midwifery initiated oral health-dental service; **ML-** medium low; **mm-** millimeters; **N-** number; **NSPT-** non surgical periodontal treatment; **NSW-** New South Wales; **OH-** oral health; **OR-** odds ratio; **OT-**orthodontic treatment; **PD-** periodontal disease; **PE-** pre-eclampsia; **PI-**plaque index; **PNC-** prenatal care; **PPD-** periodontal probing depth; **PQ-** post questionnaire; **PT-** periodontal treatment; **PTB-** preterm birth; **PTLBW-** preterm low birth weight; **PVMC –** Presidente Vargas Maternal Hospital; **RR-** risk ratio; **SD-** standard deviation; **SEC-** socioeconomic status; **wks-** weeks; **y.o.-** year old

Appendix B

Table B1

Synthesis Table

	Gesase	Weidlich	George	Albert	Moreira	Geisinger	Ramesh-Reddy	Pirie	Zhang	Iheozor-Ejiofor
Year	2018	2012	2018	2011	2015	2014	2013	2013	2019	2017
CSS	X								X	
RCT		X	X		X		X	X		
Cohort				X						
Pilot						X				
Cochrane										X
Demographics										
Mean age (yrs.)	28.5	20-30	29	30.9	20-25	not stated	26.23	30.5	30-39	22.2-30.5
% Non-Caucasian		32.41			31.6	82.5			33.8	
Findings										
Preterm birth rate				↓			↓		↓	
Low birth weight				↓			↓		↓	↓
Oral health status		↑	↑		↑	↑	↑	↑		
Independent Variables										
Non-surgical therapy		X								
MIOH-DS			X							
Periodontal treatment				X	X		X	X		X
Dental prophylaxis				X						
Dental Treatment				X						
Oral health education and therapy						X				
Dental cleaning									X	

Abbreviation Key: abx- antibiotics**; aOR-** adjusted odds ratio; **BOP-** bleeding on probing**; CAL –** clinical attachment level; **CG-** control group**; CI-** confidence interval; **CPI-** community periodontal index; **CSS-** cross-sectional study; **CWF-** community water fluoridation; **DSU-** dental services utilization; **DT-** dental treatment; **DV-** dependent variable; **FA-** fetal anomalies; **FE-** final evaluation; **GA-** gestational age; **GCF-** gingival crevicular fluid; **GI-** gingival index; **HRP-** high risk pregnancy; **IG-** intervention group; **IV-** independent variable; **KCMC-** Kilimanjaro Christian Medical Centre; **LBW-** low birth weight; **LRP-** low risk pregnancy; **MCRCT-** Multi-centre randomized controlled trial; **MG-** multiple gestation; **MIOH-DS**– Midwifery initiated oral health-dental service; **ML-** medium low; **mm-** millimeters; **N-** number; **NSPT-** non surgical periodontal treatment; **NSW-** New South Wales; **OH-** oral health; **OR-** odds ratio; **OT-**orthodontic treatment; **PD-** periodontal disease; **PE-** pre-eclampsia; **PI-**plaque index; **PNC-** prenatal care; **PPD-** periodontal probing depth; **PQ-** post questionnaire; **PT-** periodontal treatment; **PTB-** preterm birth; **PTLBW-** preterm low birth weight; **PVMC –** Presidente Vargas Maternal Hospital; **RR-** risk ratio; **SD-** standard deviation; **SEC-** socioeconomic status; **wks-** weeks; **y.o.-** year old

Appendix C

Figure C1

Quality Health Outcomes Model
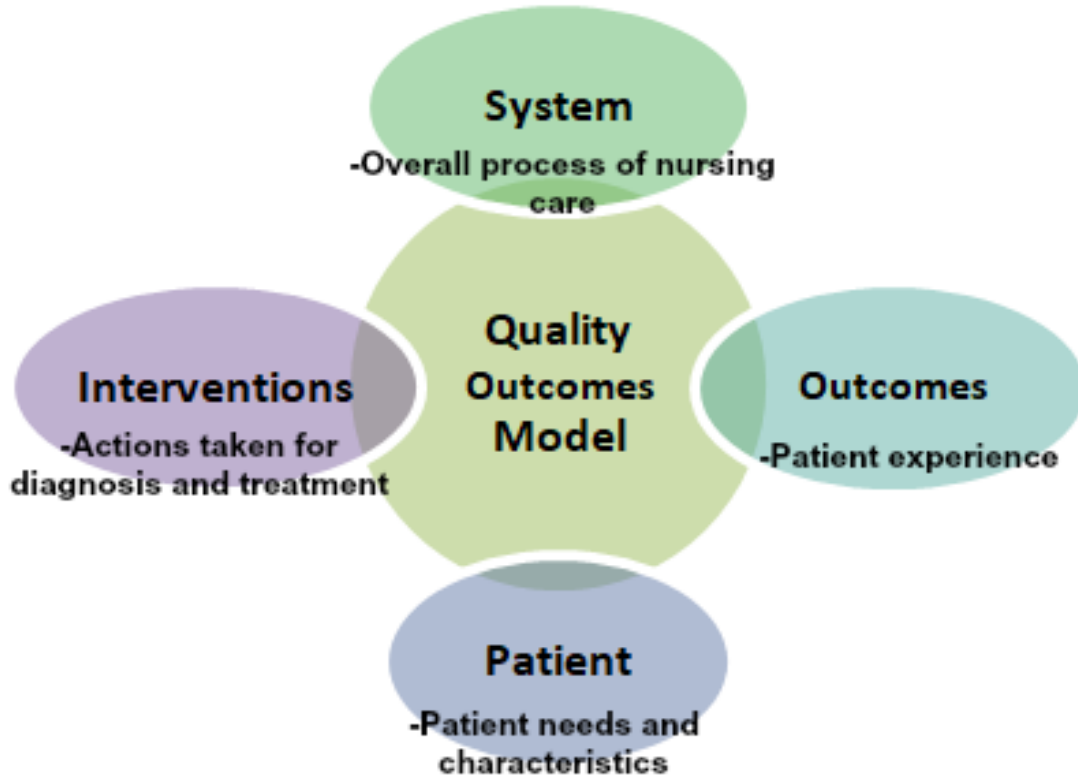
Appendix D

Figure D1

Knowledge to Action Framework

Select, Tailor, Implement Interventions

Monitor Knowledge Use

Assess Barriers/ Facilitators to Knowledge Use

Evaluate Outcomes

Knowledge Inquiry

Knowledge Synthesis

Knowledge Tools/ Products

Adapt Knowledge to Local Context

Sustain Knowledge Use

Identify Problem

Determine the Know/Do Gap

Identify, Review, Select Knowledge
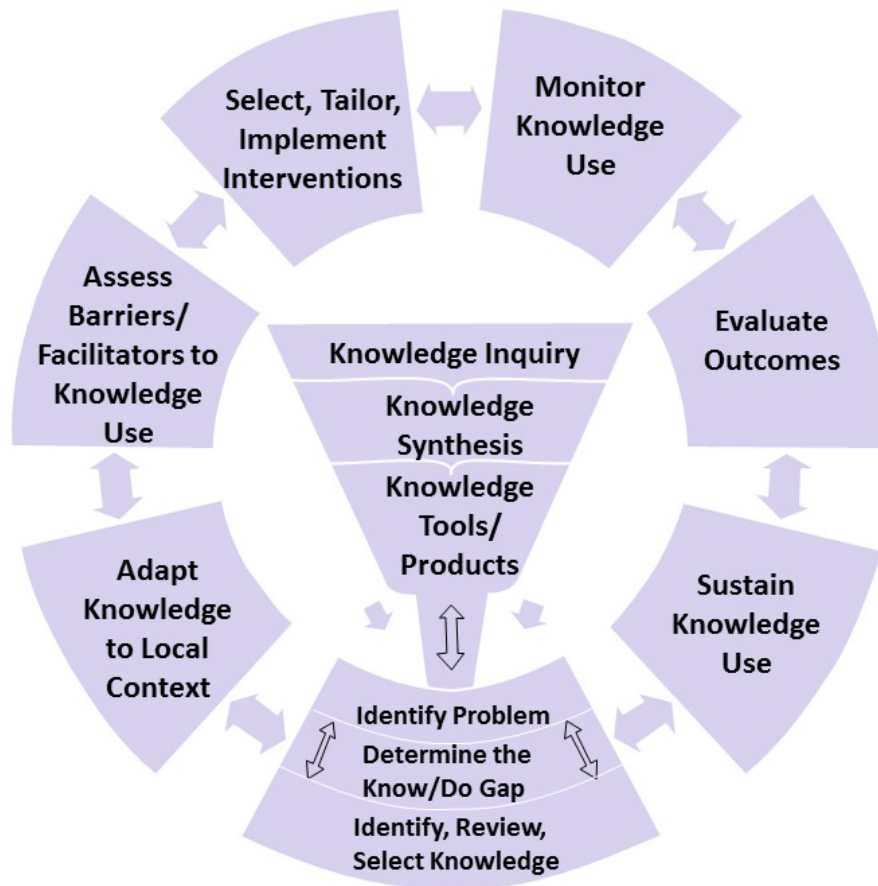
Appendix E

Figure E1

Budget

Category	Activity	Projected Cost	Out of Pocket Expenses	In Kind Support
Personnel	Project Director- DNP student (project plan/IRB submission/implementation/ data analysis) June 2019- April 2020	$40/hr ~5 hours week for 10 months		$8,000
	Project Mentor- Dr. Denise Link	$65/hr ~2 hours/wk for 10 months		$5,200
	Dental Providers (reading emails/completing survey)	$80/hr ~30 minutes each x~25 providers		$1,000
	Project Champion and Oral Health Coordinator at AACHC	$45/hr ~5 hours/month for 10 months		$2,250
Tools	Survey Monkey utilization for 1 year	$75/month x12 months	$900	
	SPSS software	Available for a discounted rate through ASU	$125	
Facility/Project Implementation	Project introduction and promotion at ~5 facilities (room utilization)			$250
	Refreshments & snacks provided during introduction/completion report		$500	
	Project completion report at ~5 facilities (room utilization)			$250
Total Projected Costs:			$1,525	$16,950

Appendix F

Table F1

Oral Health in Pregnancy Survey Results

Variable	*n*	*%*
What is your position held on dental unit		
Appointment Center Specialist	1	1.92
Dental Assistant	21	40.38
Dental Hygienist	9	17.31
Dentist	12	23.08
Office Manager	3	5.77
Patient Services Representative	5	9.62
Specialty Dentist	1	1.92
Oral health is connected to systemic health		
Strongly agree	51	98.08
Strongly disagree	1	1.92
Bacteria that cause tooth decay in moms can be passed on to babies		
Neither agree/disagree	2	3.85
Somewhat agree	6	11.54
Somewhat disagree	2	3.85
Strongly agree	41	78.85
Strongly disagree	1	1.92
Hormonal changes in pregnant women increase their risk of gum disease		
Somewhat agree	4	7.69
Somewhat disagree	1	1.92
Strongly agree	47	90.38
Periodontal disease is associated with miscarriage, preterm birth, and low birth weight		
Neither agree/disagree	14	26.92
Somewhat agree	6	11.54
Strongly agree	30	57.69
Strongly disagree	2	3.85
Counseling pregnant women about oral health is important		
Strongly agree	52	100
Counseling a pregnant woman about oral health can improve the oral health of her baby		
Neither agree/disagree	2	3.85

Somewhat agree	3	5.77
Strongly agree	47	90.38

I have the skills to counsel pregnant patients

Neither agree/disagree	7	13.46
Somewhat agree	5	9.62
Strongly agree	40	76.92

Our dental practice is too busy to provide counseling about oral care for pregnant women

Neither agree/disagree	8	15.38
Somewhat agree	6	11.54
Somewhat disagree	7	13.46
Strongly agree	1	1.92
Strongly disagree	30	57.69

Insurance plans compensate our dental company adequately for time spent on counseling pregnant women

Neither agree/disagree	20	38.46
Somewhat disagree	10	19.23
Strongly agree	4	7.69

It is the responsibility of the dental provider to counsel a pregnant woman on the dangers of smoking

Neither agree/disagree	6	11.54
Somewhat agree	7	13.46
Somewhat disagree	1	1.92
Strongly agree	38	73.08

A pregnant woman should be counseled to have a dental provider look at their baby's teeth when they first erupt

Somewhat agree	3	5.77
Strongly agree	49	94.23

Explaining the possible link between periodontal disease and preterm birth takes too much time out of the schedule

Neither agree/disagree	5	9.62
Somewhat agree	5	9.62
Somewhat disagree	11	21.15
Strongly agree	2	3.85
Strongly disagree	29	55.77

Explaining the link between dental caries in mothers and dental caries in babies takes too much time out of the schedule

Neither agree/disagree	3	5.77
Somewhat agree	4	7.69

Somewhat disagree	9	17.31
Strongly agree	1	1.92
Strongly disagree	35	67.31
It is worth our time to counsel pregnant patients about their diet		
Neither agree/disagree	2	3.85
Somewhat agree	8	15.38
Somewhat disagree	2	3.85
Strongly agree	39	75
Strongly disagree	1	1.92
Dental treatment should be a part of woman's prenatal care		
Neither agree/disagree	1	1.92
Somewhat agree	3	5.77
Strongly agree	48	92.31
Physicians are better able than dentists to counsel pregnant patients about oral health		
Neither agree/disagree	11	21.15
Somewhat agree	3	5.77
Somewhat disagree	11	21.15
Strongly agree	5	9.62
Strongly disagree	22	42.31
Patients more likely to seek dental care if their physician recommends it		
Neither agree/disagree	1	1.92
Somewhat agree	10	19.23
Strongly agree	41	78.85
There is little I can do to affect a woman's oral hygiene		
Neither agree/disagree	8	15.38
Somewhat disagree	8	15.38
Strongly disagree	36	69.23
It is important for a pregnant woman to have her blood pressure taken during a dental appointment		
Neither agree/disagree	1	1.92
Somewhat agree	7	13.46
Strongly agree	41	78.85
A dental provider has the ability to identify possible complications of a pregnancy		
Neither agree/disagree	14	26.92
Somewhat agree	11	21.15
Somewhat disagree	8	15.38
Strongly agree	6	11.54

Strongly disagree	13	25

It is safe to provide dental treatment to pregnant women

Neither agree/disagree	6	11.54
Somewhat agree	14	26.92
Somewhat disagree	5	9.62
Strongly agree	27	51.92

I am concerned about being sued if something goes wrong in a pregnancy after dental treatment

Neither agree/disagree	21	40.38
Somewhat agree	9	17.31
Somewhat disagree	8	15.38
Strongly agree	5	9.62
Strongly disagree	9	17.31

Clinicians in the community will be critical of us if we provide necessary oral health care to pregnant patients

Neither agree/disagree	13	25
Somewhat agree	7	13.46
Somewhat disagree	2	3.85
Strongly agree	10	19.23
Strongly disagree	20	38.46

Patients would feel positively about our clinic if we provide comprehensive care to pregnant patients

Neither agree/disagree	5	9.62
Somewhat agree	9	17.31
Strongly agree	38	73.08

During which period of pregnancy do we believe routine services are appropriate?
Oral hygiene instructions

Anytime during pregnancy	47	90.38
Anytime during pregnancy, Emergency only	1	1.92
Emergency only	4	7.69

Prophy

Anytime during pregnancy	50	96.15
Anytime during pregnancy, Emergency only	1	1.92
Emergency only	1	1.92

Scaling and root planning

Anytime during pregnancy	38	73.08
Emergency only	13	25
Never	1	1.92

Site specific antibiotic (e.g. Perio Chip, Arestin)

Anytime during pregnancy	11	21.15
Emergency only	25	48.08
Never	16	30.77

Fluoride varnish treatment

Anytime during pregnancy	41	78.85
Anytime during pregnancy, Emergency only	1	1.92
Emergency only	6	11.54
Never	4	7.69

Single periapical x-ray

Anytime during pregnancy	29	55.77
Anytime during pregnancy, Emergency only	1	1.92
Emergency only	22	42.31

Full mouth x-rays

Anytime during pregnancy	13	25
Anytime during pregnancy, Emergency only	1	1.92
Emergency only	16	30.77
Never	22	42.31

Injection of local anesthetic (e.g., lidocaine)

Anytime during pregnancy	23	44.23
Anytime during pregnancy, Emergency only	1	1.92
Emergency only	26	50
Never	2	3.85

Single tooth extraction

Anytime during pregnancy	14	26.92
Emergency only	38	73.08

Amalgam restoration

Anytime during pregnancy	22	42.31
Emergency only	23	44.23
Never	7	13.46

Composite restoration

Anytime during pregnancy	31	59.62
Emergency only	18	34.62
Never	3	5.77

Root canal therapy

Anytime during pregnancy	14	26.92
Emergency only	36	69.23
Never	2	3.85

Crown and bridge

Anytime during pregnancy	18	34.62
Emergency only	26	50
Never	8	15.38

Nitrous oxide and oxygen sedation

Anytime during pregnancy	1	1.92
Emergency only	4	7.69
Never	47	90.38

How often do you recommend or prescribe the following pharmaceuticals?
Non-steroidal, anti-inflammatory agents, NSAIDS (e.g., Ibuprofen)

Never	37	71.15
Rarely	10	19.23
Sometimes	5	9.62

Acetaminophen (e.g. Tylenol)

Never	9	17.31
Often	10	19.23
Rarely	11	21.15
Sometimes	22	42.31

Aspirin

Never	42	80.77
Rarely	7	13.46
Sometimes	3	5.77

Pain medicines containing codeine or other narcotics (e.g., Vicodin or Oxycodone)

Never	40	76.92
Rarely	7	13.46
Sometimes	5	9.62

Chlorhexidine

Never	21	40.38
Often	4	7.69
Rarely	9	17.31
Sometimes	18	34.62

Oral antibiotics

Never	16	30.77
Often	3	5.77
Rarely	15	28.85
Sometimes	18	34.62

Periostat (doxycycline)

Never	43	82.69
Rarely	6	11.54
Sometimes	3	5.77

How do you learn the pregnancy status of your patients?
The receptionists asks for pregnancy status when scheduling an appointment

No	40	76.92
Yes	12	23.08

There is a question about pregnancy in the routine health update that the patient fills out

No	3	5.77
Yes	49	94.23

Our patients tell us in casual conversation

No	14	26.92
Yes	38	73.08

We ask if we suspect a patient might be pregnant

No	12	23.08
Yes	40	76.92

If a staff member determines a patient is pregnant, she/he noted it on the patient's chart

No	8	15.38
Yes	44	84.62

If a staff member determines a patient is pregnant/she/he notes it on the daily scheduled

No	31	59.62
Yes	21	40.38

How often to you perform/authorize the following procedures on pregnant women?
Oral hygiene instruction

I don't perform or authorize this service	8	15.38
Often	39	75
Rarely	1	1.92
Sometimes	4	7.69

Prophy

I don't perform or authorize this service	10	19.23
Never	1	1.92
Often	37	71.15
Rarely	2	3.85
Sometimes	2	3.85

Scaling and root planing

I don't perform or authorize this service	15	28.85
Never	3	5.77
Often	17	32.69
Rarely	5	9.62
Sometimes	12	23.08
Site specific antibiotic (e.g., Perio Chip, Arestin)		
I don't perform or authorize this service	30	57.69
Never	16	30.77
Often	1	1.92
Rarely	1	1.92
Sometimes	4	7.69
Fluoride varnish treatment		
I don't perform or authorize this service	11	21.15
Never	6	11.54
Often	14	26.92
Rarely	6	11.54
Sometimes	15	28.85
Single periapical x-ray		
I don't perform or authorize this service	9	17.31
Often	17	32.69
Rarely	7	13.46
Sometimes	19	36.54
Full mouth x-rays		
I don't perform or authorize this service	9	17.31
Never	22	42.31
Often	6	11.54
Rarely	8	15.38
Sometimes	7	13.46
Injection of local anesthetic (e.g., lidocaine)		
I don't perform or authorize this service	19	36.54
Never	3	5.77
Often	10	19.23
Rarely	6	11.54
Sometimes	14	26.92
Single tooth extraction		
I don't perform or authorize this service	23	44.23
Never	1	1.92
Often	6	11.54

Rarely	8	15.38
Sometimes	14	26.92
Amalgam restoration		
I don't authorize or perform this service	27	51.92
Never	4	7.69
Often	4	7.69
Rarely	9	17.31
Sometimes	8	15.38
Composite restoration		
I don't authorize or perform this service	25	48.08
Never	1	1.92
Often	9	17.31
Rarely	7	13.46
Sometimes	10	19.23
Root canal therapy		
I don't perform or authorize this service	27	51.92
Never	6	11.54
Often	3	5.77
Rarely	6	11.54
Sometimes	10	19.23
Crown & bridge		
I don't authorize or perform this service	25	48.08
Never	11	21.15
Often	2	3.85
Rarely	6	11.54
Sometimes	8	15.38
Nitrous oxide and oxygen sedation		
I don't perform or authorize this service	24	46.15
Never	26	50
Rarely	1	1.92
Sometimes	1	1.92

During which periods of pregnancy do you believe it is appropriate for patients to have each of the following emergency services, even if you do not provide this service

Tooth extraction		
1st trimester	2	3.85
1st trimester, 2nd trimester, 3rd trimester	11	21.15
1st trimester, 3rd trimester	1	1.92
2nd trimester	19	36.54

2nd trimester, 3rd trimester	4	7.69
3rd trimester	7	13.46
Never/Don't know	8	15.38
Open and broach		
1st trimester	1	1.92
1st trimester, 2nd trimester, 3rd trimester	7	13.46
1st trimester, 3rd trimester	1	1.92
2nd trimester	13	25
2nd trimester, 3rd trimester	3	5.77
3rd trimester	2	3.85
Never/Don't know	25	48.08
Incision and draining an abscess		
1st trimester	2	3.85
1st trimester, 2nd trimester	1	1.92
1st trimester, 2nd trimester, 3rd trimester	15	28.85
1st trimester, 3rd trimester	1	1.92
2nd trimester	12	23.08
2nd trimester, 3rd trimester	3	5.77
3rd trimester	3	5.77
Never/Don't know	15	28.85
Injection of local anesthetic (e.g., Marcaine)		
1st trimester	2	3.85
1st trimester, 2nd trimester	1	1.92
1st trimester, 2nd trimester, 3rd trimester	1	1.92
2nd trimester	11	21.15
2nd trimester, 3rd trimester	2	3.85
3rd trimester	3	5.77
Never/Don't know	32	61.54
Temporary filling		
1st trimester	5	9.62
1st trimester, 2nd trimester, 3rd trimester	22	42.31
2nd trimester	11	21.15
3rd trimester	5	9.62
Never/Don't know	9	17.31
Information about a Continuing Ed program on care for pregnant patients interests me		
Neither agree/disagree	5	9.62
Somewhat agree	12	23.08

Strongly agree	35	67.31

Receiving examples of a checklist to initiate conversations with our patients about oral health care during pregnancy interests me

Neither agree/disagree	7	13.46
Somewhat agree	16	30.77
Strongly agree	28	53.85
Strongly disagree	1	1.92

Receiving education materials to provide to our pregnant patients interests me

Neither agree/disagree	5	9.62
Somewhat agree	11	21.15
Strongly agree	35	67.31
Strongly disagree	1	1.92

Do you agree or disagree that it is easy to incorporate new procedures in your practice of dentistry or in the dental office

Neither agree/disagree	5	9.62
Somewhat agree	17	32.69
Somewhat disagree	3	5.77
Strongly agree	21	40.38
Strongly disagree	6	11.54

Which best describes your feelings about trying new ways of doing things, or adding changes, to your job responsibilities

I enjoy experimenting with new procedures or ways of doing things.	33	63.46
I only try new procedures or ways of doing things when regulations require them.	3	5.77
I only try new procedures when the ADA and/or FDA approve them.	7	13.46
I prefer to wait until new procedures have been established for awhile.	6	11.54
I prefer to wait until others have tried new procedures or ways of doing things.	3	5.77