

Fall 2019

Perceptions of Dental Hygienists' role on the prenatal care team

Lisa Westhoff

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Perceptions of Dental Hygienists' Role on the Prenatal Care Team

A Thesis

Presented in Partial Fulfillment of the Requirements for the

Degree of Masters of Science

in

Dental Hygiene

in the

College of Graduate Studies

Eastern Washington University

by

Lisa Westhoff RDH, BSDH

Fall 2019

Major Professor: Lorie Speer RDH, BS, MSDH

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PERCEPTIONS OF DH ROLE ON THE PRENATAL CARE TEAM

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PERCEPTIONS OF DH ROLE ON THE PRENATAL CARE TEAM

Human Subjects Approvals

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TO: Lisa Westhoff, Department of Dental Hygiene

FROM: Ruth A. Galm, ^{RG}EWU Human Protections Administrator

DATE: January 7, 2019

SUBJECT: Perceptions of Dental Hygienists' Role on the Prenatal Care Team (HS-5657)

With the amendments provided on January 6, 2019, human subjects protocol HS-5657 entitled "Perceptions of Dental Hygienists' Role on the Prenatal Care Team" has been approved as an exemption from federal regulations under CFR Title 45, Part 46.101(b) (1-6).

A signed and approved copy of your application is attached.

Student research qualifying for an exempt IRB review is valid for a period of one year. If subsequent to initial approval, the research protocol requires minor changes, the Office of Grant and Research Development should be notified of those changes. Any major departure from the original proposal must be reviewed through a Change of Protocol application submitted to the IRB before the protocol may be altered. Please refer to HS-5657 on future correspondence as appropriate as we file everything under this number.

Cc: HS-5657 file
Prof. Lori Speer, RPI
Prof. Ann O'Kelley Wetmore, Dept. Chair
Graduate Office

PERCEPTIONS OF DH ROLE ON THE PRENATAL CARE TEAM

HS-5657

Application for Exempt Research
EWU Institutional Review Board for Human Subjects Research

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Principal Investigator (PI): Lisa M. Westhoff Title: RDH, BSDH Department: Dental Hygiene Address: 1060 Chipeta Ave, Grand Junction, CO 81501 Phone number: (719) 688-5472 E-mail: lwesthoff@eagles.ewu.edu	<div style="text-align: center;">DEC 20 2018</div> <i>If PI is a student, complete this section:</i> Responsible Project Investigator (RPI) (faculty/staff sponsor): Lorie Speer RDH, BS, MSDH Department: Dental Hygiene Campus address/Mail stop: Health Science Building 270Q Phone number: (509) 828-1294 E-mail: lspeer@ewu.edu
Project Title: Perceptions of Dental Hygienists' Role on the Prenatal Care Team	
For students only: Is this research being done to meet a course, thesis or other academic requirement? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No If yes, please specify: Master's Thesis Requirement If not, why is it being done?	
Project anticipated starting date: January 2, 2019 Anticipated termination date: January 2, 2020	
Funding: <input checked="" type="checkbox"/> Non-funded <input type="checkbox"/> Internal funding <input type="checkbox"/> External funding Funding agency (if applicable): n/a Grant or Contract Number: n/a	
Check the type of exemption applicable to the project using the "Exemption Decision Aid" on the next page: <input checked="" type="checkbox"/> 1. <input type="checkbox"/> 2. <input type="checkbox"/> 3. <input type="checkbox"/> 4. <input type="checkbox"/> 5. <input type="checkbox"/> 6. <input type="checkbox"/> None	
Rationale for exemption. Why should this project be exempt? This project should be exempt as it examines Colorado dental hygienists and obstetricians perceptions and knowledge in regards to prenatal care in a survey form and does not include any of 12 twelve conditions that exclude an exemption.	
Please state the purpose and methodology of the research: This proposed research will use a non-experimental, mixed-methods, single test study design to examine dental hygienists' and obstetricians' attitudes towards and perceptions of dental hygienists as part of the prenatal care team. The rationale for the mixed methods design is to provide evaluation of dental hygienists' perceptions of their own abilities and knowledge as well as obstetricians' perceptions of dental hygienists abilities and knowledge and to gain insight into the attitudes each respective healthcare provider has towards IPC between dental hygienists and obstetricians. The ultimate goal of this research is to determine if a connection exists between knowledge and perceptions of oral health and prenatal care, knowledge of dental hygiene abilities in Colorado, and perceptions of dental hygienists as a member in the prenatal care team.	
Describe the procedures: what specifically will subjects do? If data are anonymous, describe the data gathering procedure for insuring anonymity. Data will be collected by survey of obstetricians and dental hygienists in Colorado. Surveys will be sent electronically through Survey Monkey, which decreases cost of research by eliminating travel and can be sent multiple times. Quantitative and qualitative data will be gathered in the form of a Likert scale and open-ended question survey instrument developed by the PI (See Appendix B). No survey has previously existed. This survey is validated through content validity by a panel of experts, which includes clinical dental hygienists, educators, pediatric occupational therapist, healthcare program directors, and researchers. The survey instrument uses a 5-point Likert scale ranging from "strongly agree" (5) to "strongly disagree" (1) and open-ended questions and is divided into three subscales: knowledge/perceptions of oral health and prenatal care (subscale 1), knowledge of Colorado licensed dental hygiene scope of practice (subscale 2), and perceptions of dental hygienists' interprofessional role in the prenatal care team (subscale 3). Demographic data includes licensed dental hygienist or licensed obstetrician, experience (years practicing), collaboration with a dental hygienist/obstetrician, highest level of education, type of practice environment, age, and gender. Minimal risk will be involved for participating licensed dental hygienists and obstetricians and participation is voluntary. Withdrawal from participation is permissible at any time during the study. Should a participant choose to discontinue, no consequence or impact will occur. Licensed dental hygienists and obstetricians who volunteer to participate in the study will give consent to participation when beginning electronic survey. Information regarding this study will be kept in the PI's personal, password protected computer to insure anonymity.	

PERCEPTIONS OF DH ROLE ON THE PRENATAL CARE TEAM

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This study will utilize a purposive sampling method composed of licensed obstetricians and licensed dental hygienists in Colorado. The Registered Dental Hygienist employment population in Colorado, as of May 2017, is between 2,730 and 5,430. Employment of obstetricians and gynecologists, as of May 2017, in Colorado is between 210 and 570. In order to properly represent the each group, more dental hygienists will be sampled in comparison to obstetricians.

Colorado Dental Hygienists Association (CODHA) and American College of Obstetricians and Gynecologists (ACOG) will aid in the electronic distribution of a single test study through email to their association members. The PI will compose a cover letter (see Appendix A) that includes a Survey Monkey link to be forwarded through email and posted to social media platforms by CODHA and ACOG. The use of Survey Monkey ensures participants cannot complete more than one survey.

Study participants will be invited to provide contact information, through a Google forms link separate from the survey instrument in order to maintain anonymity, to be entered into a drawing for a \$50 gift card. The gift card offers incentive for completing the survey instrument and aims to increase response rate.

Upon EWU IRB approval, the steps to implementation will proceed as follows:
Step 1. Once the PI obtains IRB approval, the PI will communicate with CODHA and CAOG to coordinate electronic distribution of the survey instrument (Appendix B) via a Survey Monkey link included in a cover letter (Appendix A). Electronic distribution will include email, Facebook, Twitter, and all other social media platforms utilized by CODHA and CAOG and their respective members.
Step 2. The PI will electronically distribute the survey instrument via Survey Monkey link and cover letter to CODHA and CAOG for electronic distribution to their respective Colorado members with a three-week completion time frame.
Step 3. The PI will coordinate an electronic reminder to be sent to Colorado dental hygienists and obstetricians through their respective associations at week 2 of the completion time frame.
Step 4. The PI will begin analyzing data collected with the survey instrument.
Step 5. The PI will collaborate with the statistician to review analyzed results for better understanding. Results will be reviewed and an explanation provided to assess the validity of the study.

Attach all surveys, questionnaires, cover letters, information sheets, etc. (including required IRB contact information (See "Procedures..." on page 3)

I certify that the information provided above is accurate and the project will be conducted in accordance with applicable Federal, State and university regulations:
 PI Signature: *[Signature]* Date: 12/18/2018
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Recommendations and Action:	Date	Approve/Disapprove
RPI Signature: <i>[Signature]</i> <i>(Needed only if PI is a student)</i>	12/19/2018	D
Ann O'Kelley Wetmore <i>ann o'kelley wetmore</i> IRB Rep. or Dept. Chair Print & Sign: <i>(Needed if PI is a student OR for faculty PI if required by department)</i>	Digitally signed by Ann O'Kelley Wetmore Date: 2018.12.19 10:23:38 -08'00'	A D
IRB Signature: <i>Ruth C. Halm</i> 1/7/19		A D
<input type="checkbox"/> Subject to the following conditions: <i>as amended on 1/6/19</i>		
Approved from <i>1/7/19</i> to <i>1/6/20</i>		

PERCEPTIONS OF DH ROLE ON THE PRENATAL CARE TEAM

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TO: Lisa Westhoff, Department of Dental Hygiene
FROM: Ruth A. Galh, ^{RG}EWU Human Protections Administrator
DATE: January 7, 2019
SUBJECT: Perceptions of Dental Hygienists' Role on the Prenatal Care Team (HS-5657)

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A signed and approved copy of your application is attached.

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Cc: HS-5657 file
Prof. Lori Speer, RPI
Prof. Ann O'Kelley Wetmore, Dept. Chair
Graduate Office

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TO: Lisa Westhoff, Department of Dental Hygiene
FROM: Ruth A. Galm, EWU Human Protections Administrator
DATE: March 11, 2019
SUBJECT: Change of Protocol for Perceptions of Dental Hygienists' Role on the Prenatal Care Team (HS-5657)

Your Change of Protocol application for HS-5657 entitled "Perceptions of Dental Hygienists' Role on the Prenatal Care Team" has been approved and is approved.

The change is effective from March 11, 2019, through January 6, 2020, the anniversary date of the original application approval.

A signed and approved copy of the COP application is attached.

Please refer to HS-5657 on future correspondence as appropriate as we file everything under this number.

Cc: HS-5657 file
Prof. Lori Speer, RPI
Prof. Ann O'Kelley Wetmore, Dept. Chair
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HS-5657

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Application for Change of Protocol

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Change of Protocol Change of Protocol AND Renewal of Approval

NOTE: To be approved for BOTH a Change of Protocol AND Renewal of Approval, the project needs to be within 30 days of its expiration date.

<p>HS number: HS-5657 Principal Investigator (PI): Lisa M. Westhoff Title: RDH, BSDH Department: Dental Hygiene Address: 1060 Chipeta Ave, Grand Junction, CO 81501 Phone number: (719) 688-5472 E-mail: lwesthoff@eagles.ewu.edu</p>	<p>If PI is a student, complete this section: Responsible Project Investigator (RPI) (faculty/staff sponsor): Lorie Speer RDH, BS, MSDH Department: Dental Hygiene Address/Mail stop: Health Science Building 270Q Campus phone number: (509) 828 -1294 E-mail: lspeer@ewu.edu</p>
<p>Project title: Perceptions of Dental Hygienists' Role on the Prenatal Care Team</p>	

CHANGE OF PROTOCOL

Briefly describe and explain the reason(s) for the change(s) to the protocol (may attach a separate document):
 The American College of Obstetricians and Gynecologists (ACOG) has declined to assist in the data collection process targeting Colorado Obstetricians. Without their assistance in forwarding the approved cover letter and electronic survey instrument, I am unable to collect data as planned. Another organization, Denver Health and Hospital Authority (DHHA) has agreed to assist in data collection by forwarding the approved cover letter and survey instrument to obstetricians.

Does the new protocol alter the level of risk for the subjects or change the subject population to a more vulnerable one? Y N
 Please explain answer:
 The same implementation steps and process will take place. The protocol alter will only change who is forwarding the approved cover letter and survey instrument by email to obstetricians. The protocol alter is a substitution change. Denver Health and Hospital Authority (DHHA) will be substituted for American College of Obstetricians and Gynecologists (ACOG). No emails will be collected by the PI and no personal data will be collected by the PI.

RENEWAL OF APPROVAL

Provide: Original approval date: / / Revised expected end date: / /
 Was the research originally scheduled for completion within a year from the date of first approval? Y N
 If yes, why has it not been completed? (may attach a separate document)
 Provide a revised expected timeline for completion of the project:

I certify that the information provided above is accurate and the project will be conducted in accordance with applicable Federal, State and university regulations.
 PI Signature: *Lisa M. Westhoff* Date: 03/07/2019

Submit this original, signed + two copies (3 in total) to the Office of Grant and Research Development, 210 Showalter (SHW)

Recommendations and Action:	Date	Approve/Disapprove
RPI Signature: <i>Lorie Speer</i> <i>(Needed only if PI is a student)</i>	3/8/19	(A) D
IRB Rep. or Dept. Chair Print & Sign: <i>Ann Kelley Wedmore</i> <i>(Needed if PI is a student OR for faculty PI if required by department)</i>	<i>annkellywedmore</i>	(A) D
IRB Signature: <i>Ruth A. Halm</i>	3/11/19	(A) D
<input type="checkbox"/> Subject to the following conditions: <i>none 3/11/19 - 1/6/20</i>		

PERCEPTIONS OF DH ROLE ON THE PRENATAL CARE TEAM

Abstract

Purpose: The purpose of this study was to examine dental hygienists' perceptions of their role on the prenatal care team and perceptions of obstetricians towards the role of dental hygienists as part of the prenatal care team.

Methods: Data was collected from an anonymous electronic Likert-style survey sent to obstetricians at Denver Health and Hospitality Authority (DHHA) and Colorado Dental Hygienists' Association (CODHA) members. Statistical analysis included descriptive statistics to provide an overview of survey data from all three subscales: knowledge (subscale 1), scope (subscale 2), and perceptions (subscale 3) and the standard t-Test to determine differences between demographics (collaboration with an obstetrician, highest level of education, and public health experience) and subscales.

Results: The perceptions of obstetricians were not evaluated since the response rate ($n=2$) was not representative of the population. Whereas, the perceptions of dental hygienists were represented ($N=106$). Overall, surveyed Colorado dental hygienists ($N=106$) had a positive perception in all subscales respectively ($M=4.4638$, $M=4.7529$, $M=4.7864$). However, there are some outliers worth noting. Dental hygienists perceived dental radiographs and dental treatment more negatively with more variance. Independent sample t-test suggests having practiced with an obstetrician and in public health makes a significant difference in all subscale scores.

Conclusion: Dental hygienists are in a position to use current practice guidelines to provide preventive oral health care and be an integral member of the prenatal care team.

PERCEPTIONS OF DH ROLE ON THE PRENATAL CARE TEAM

Acknowledgements

I want to thank my thesis chair Lorie Speer for her steady guidance and support throughout my thesis. I also want to thank my committee members Sarah Jackson and Lucretia Berg for their fresh eyes and suggestions when I needed feedback and recommendations.

Most of all, I want to thank my parents for their unwavering encouragement and belief in me. And above all, I want to thank Jerry for always being there and supporting me through all the trials and tribulations. You have kept me going when I doubted myself. I couldn't have done this without you.

Table of Contents

Abstract.....	x
Acknowledgements.....	xi
List of Figures.....	xiv
List of Tables.....	xv
Introduction/Literature Review.....	1
Introduction to the Research Question.....	1
Statement of the Problem.....	2
Overview of the Research.....	3
Summary.....	27
Methodology.....	28
Research Methods or Design.....	28
Procedures.....	29
Human Subjects Protection/Informed Consent.....	29
Sample Source/Plan, Size, Description of Setting.....	29
Variables.....	30
Instruments (reliability/validity).....	30
Equipment.....	31
Steps to Implementation.....	31
Statistical Analysis.....	31
Summary.....	32
Results.....	33
Description of Sample.....	33
Statistical Analysis.....	34
Discussion.....	57
Summary of Major Findings.....	57
Discussion.....	58
Limitations.....	70
Recommendations/Suggestions for Additional Research.....	71

References	74
Appendices	87
Vita.....	91

List of Figures

Figures

Figure 1: An overview of the IHI Triple AIM.....23

List of Tables

Tables

Table 1: Colorado licensed dental hygienists (n=106).....	34
Table 2: Subscale 1-Knowledge/perceptions of oral health and prenatal care ...	36
Table 3: Subscale 2-Knowledge of Colorado dental hygiene scope of practice.....	38
Table 4: Subscale 3-Perceptions of dental hygienists interprofessional role in the prenatal care team.....	39
Table 5: Subscale 1, 2, and 3 statistics	40
Table 6: DH who have and have not collaborated with an OB	41
Table 7: Independent Samples t-Test: DH who have and have not collaborated with an OB.	42
Table 8: Years licensed.	43
Table 9: Independent Samples t-Test: Years licensed	44
Table 10: Level of education	45
Table 11: Independent Samples t-Test: Level of education	46
Table 12: Age.....	47
Table 13: Independent Samples t-Test: Age.....	48
Table 14: Public health.....	49
Table 15: Independent Samples t-Test: Public health	50
Table 16: Collaboration benefit theme.....	53
Table 17: Collaborative benefit quotes	54
Table 18: Envision collaboration themes	56
Table 19: Envision collaboration quotes	56

Table 20: Dental hygiene career opportunities 62

Table 21: Direct integration of dental hygienists in prenatal care settings 66

Introduction/Literature Review

Introduction to the Research Question

The increasing recognition of interprofessional collaboration within health care has opened opportunities for dental hygienists to play an essential role outside of traditional clinical dental practice, such as prenatal care in medical office settings (Lyle, Grill, Olmsted, & Rothen, 2016). Interprofessional collaborations create a shared responsibility and care of patients between health care professionals in order to achieve comprehensive optimal health and outcomes (U.S. Department of Health and Human Services [HHS], 2014). Collaboration between dental hygienists and obstetricians can help educate and achieve optimal health for women before, during, and after pregnancy and also achieve optimal health for their children.

Physicians may agree hormonal changes related to pregnancy can cause gingivitis, but many advise the delay of dental treatment until after pregnancy (Al-Habashneh, Aljundi, & Alwaeli, 2008). Much of this hesitancy is due to the lack of dental care knowledge and the existence of an oral systemic link, the connection between oral health and overall health (Al-Habashneh et al., 2008). Clinical studies and systematic reviews have documented a connection between pregnancy, plaque deposits, inflammatory response, and pathogenic oral bacterial profile (Carrillo-de-Albornoz, Figuero, Herrera, & Bascones-Martínez, 2010; Carrillo-de-Albornoz, Figuero, Herrera, Cuesta, & Bascones-Martínez, 2012; Figuero, Carrillo-de-Albornoz, Herrera, & Bascones-Martínez, 2010; Figuero, Carrillo-de-Albornoz, Martín, Tobías, & Herrera, 2013). The acknowledgement of pregnancy gingivitis does not include the vast oral

systemic connections between pregnancy and oral health that include preeclampsia, periodontitis, low birth weight and preterm birth babies (Chambrone, Pannuti, Guglielmetti, & Chambrone, 2011; Guimarães et al., 2012; Kunnen et al., 2010). There is also substantial evidence of cariogenic bacterial vertical transmission from mother to child, which can lead to a higher risk of early childhood caries (Chaffee, Gansky, Weintraub, Featherstone, & Ramos-Gomez, 2014; dos Santos Junior, Valdeci Elias, de Sousa, Rebeca Maria Brasileiro, Oliveira, de Caldas Junior, Arnaldo França, & Rosenblatt, 2014; Leong, Gussy, Barrow, Silva-Sanigorski, & Waters, 2013; Nakai, Mori, & Tamaoka, 2016).

Statement of Problem

Oral health before, during, and after pregnancy, as well as infant oral care, is often not discussed with women during prenatal care interactions (Al Habashneh et al., 2005; George et al., 2012; Hashim & Akbar, 2014). This may be due to the obstetrician's lack of education or confidence of oral health knowledge or time constraints placed on obstetricians (Al Habashneh et al., 2005; George et al., 2012; Hashim & Akbar, 2014). Dental hygienists may directly fill this health care void by working side by side with obstetricians in an interprofessional role (Schramm, Jacks, Prihoda, McComas, & Hernandez, 2016).

Oral health and the importance of dental care during pregnancy have been widely researched and many recommendations regarding the importance of prenatal oral health care for women while pregnant have been reported (Al-Habashneh et al., 2008; George et al., 2012; Schramm et al., 2016). These recommendations cite the importance of education for obstetricians, nurses, general physicians, and other medical professionals;

however, the inclusion of a dental hygienist, as a primary member for positive prenatal care outcomes, is limited (George et al., 2012; Schramm et al., 2016).

Given the proven connection between oral health and prenatal outcomes, the assumption is obstetricians and dental hygienists value the importance of their roles on the interprofessional prenatal care team. To answer this statement, the following research questions were examined: What are dental hygienists' perceptions of their role on the prenatal care team? What are the perceptions of obstetricians towards the role of dental hygienists as part of the prenatal care team?

Overview of Research

Pregnancy offers a unique time in a woman's life when oral health is compromised due to the mother's susceptibility to oral disease resulting in the potential for adverse pregnancy outcomes. Poor maternal oral health can be a predictor of early childhood caries (Chaffee et al., 2014). Education, intervention, prevention, behavior modifications, referral, and follow up with women during prenatal, pregnancy, and postpartum periods of health can be facilitated through interprofessional collaboration with the inclusion of dental hygienists.

Dental hygienists' perceptions of their role in health care. Nationally, dental hygienists are most likely to work in a dental office setting, and only 1% of dental hygienists are employed within a physician's office (Bureau of Labor Statistics, May 2018a). Forty-five percent (45%) of dental hygienists surveyed in Oregon reported that dental hygiene clinician was the most important role of a dental hygienist (Jaecks, 2009). These same dental hygienists were asked to rank dental hygiene roles in the future and while clinician was still ranked highest ($n= 32$, 39%), patient educator and advocate were

ranked higher in the future ($n = 26$ and $n = 14$) than in the present ($n = 22$ and $n = 6$) (Jaecks, 2009). Current dental hygiene curriculum primarily focuses on clinical expertise and not a more broad holistic approach (American Dental Hygienists' Association [ADHA], 2015). State/regional clinical examinations generally evaluate technical clinical skills associated with the removal of calculus deposits located subgingival and supragingival on tooth and root structures (ADHA, 2015). Based on current dental hygiene curriculum, examinations, and current employment trends focused towards clinical skills and settings, it is fair to assume an expanded and broader curriculum could result in a dental hygiene employment shift towards alternative practice. Dental hygienists have a strong knowledge regarding oral health and pregnancy and welcome more education in this area (ADHA, 2015; Commission on Dental Accreditation [CODA], 2018; Schramm et al., 2016).

Forty-three states in the United States support various levels of direct access care provided by dental hygienists (American Dental Hygienists' Association [ADHA], 2019). Direct access care allows dental hygienists to assess patient needs and implement treatment without the presence of a dentist (ADHA, 2019). In addition to direct access care, dental hygienists can practice as mid-level oral health providers under specific licensure, settings, and states (ADHA, 2015). The mid-level oral health provider continues to evolve across state lines where some known titles include Dental Therapist, Advanced Dental Therapist and Dental Hygiene Therapist (ADHA, 2015). A previous mid-level oral health provider title was known as the Advanced Dental Hygiene Practitioner (ADHP). The ADHP model in medical settings was supported by dental directors in California (Smith & Walsh, 2015) and is an example of potential direct

access care provided by dental hygienists. This support of the ADHP model demonstrates an aspiration for some dental hygienists to work outside of the traditional dental office setting and in more medical health care settings.

A study in Michigan validated dental hygienists' ($N= 150$) knowledge, attitudes and behaviors toward treating pregnant patients and dental hygienists' desire for more education on perinatal care and its relation to oral health (Schramm et al., 2016). Michigan dental hygienists who were members of the Michigan Dental Hygiene Association (MDHA) agreed (95.8%) with providing preventive care during pregnancy and agreed (95.8%) there is an association between poor oral health and adverse pregnancy outcomes (Schramm et al. 2016). The majority of MDHA dental hygienists (95.8%, 95.9% and 90.2%) recognized that adverse pregnancy outcomes include low birth weight babies, premature births, and the development of preeclampsia (Schramm et al., 2016). The same Michigan dental hygienists agreed (100%) that oral health is an important part of prenatal care and dental screenings should be included (Schramm et al., 2016). The majority (93.8%) also felt they were trained to treat pregnant women (Schramm et al., 2016). Even though MDHA dental hygienists report positive knowledge, attitudes, and behaviors towards treating pregnant women, collaboration with prenatal care providers (27.1%) was reportedly low (Schramm et al., 2016). Only eleven percent (11.4%) reported they or their employer had a referral program with prenatal care providers (Schramm et al., 2016). Jaecks (2009) reports similar limitations to interprofessional collaboration for dental hygienists ($N= 103$).

Overall, dental hygienists view their role in interprofessional collaborative settings as valuable (Jaecks, 2009). Yet, exposure to interprofessional collaboration

(IPC) is limited (Jaecks, 2009). Jaecks (2009) reported numerous barriers to IPC for surveyed dental hygienists which included: limited time (72%), willingness of other professionals to collaborate (67%), and needing more professional freedom (51%).

Interprofessional collaboration requires excellent communication skills and even though dental hygienists surveyed in Oregon ($N=103$) reported numerous barriers to IPC, they viewed their communication skills positively (Jaecks, 2009). Further research and evaluation assists in shaping education models and interprofessional collaboration opportunities for dental hygienists and other health care providers.

Obstetrician perceptions of oral health and pregnancy association. In a 2005 cross-sectional study of women who had given birth in Iowa from August 2001 to March 2002 ($N=625$), nearly half ($n=309$, 49%) of women reported a dental visit during pregnancy and 43% reported awareness of the oral systemic link between oral health and pregnancy outcomes (Al Habashneh et al., 2005). Yet, 61% percent of women did not feel oral health problems could affect the outcome of pregnancy (Al Habashneh et al., 2005). Women who did not report a dental visit during pregnancy indicated they were not having a dental problem, they chose to delay a visit until after delivery, they did not prioritize a dental visit during pregnancy, or they did not think or were not told a dental visit during pregnancy was important (Al Habashneh et al., 2005). Al Habashneh et al. (2005) found respondents who had knowledge of the oral systemic link (43%) received most of their information from books, pamphlets, and magazines (85%) compared to health care providers (32%) (Al Habashneh et al., 2005).

A survey of gynecologists, who care for all women's health care issues (Kaplan, 2018), in United Arab Emirates ($N=108$), found most gynecologists (95%, $n=103$)

recognized an oral health and pregnancy connection and most gynecologists (85.2%, $n=92$) recommended a dental visit during pregnancy (Hashim & Akbar, 2014). However, 59% still view dental radiographs and local anesthesia as unsafe for pregnant women (Hashim & Akbar, 2014). A similar study aimed to assess how obstetrician-gynecologists (OB-GYN) address oral health during pregnancy ($n= 351$) (Morgan, Goldenberg, & Schulkin, 2009). The majority of OB-GYNs surveyed agreed routine dental care during pregnancy is important (84%) and gingival/periodontal inflammation can affect the outcome of pregnancy (84%) (Morgan et al., 2009). Over half (66%) of the same OB-GYNs agree the treatment of periodontal disease can have positive effects on the outcome of pregnancy (Morgan et al., 2009). However, these OB-GYNs do not ask pregnant patients about dental visits (73%) or oral health (54%), do not provide oral health information (69%), and over a third (38%) do not advise oral health care during pregnancy (Morgan et al., 2009). Morgan et al. (2009) also found 80% of OB-GYNs stating they had not thought about referring pregnant patients to an oral health care provider. Other studies demonstrate similar findings that prenatal health care providers ($N=147$) are aware of oral health's influence on pregnancy (77.6%) (Dev, Madhuri, Lahari, & Kanchumurthy, 2016). Yet, 54.4% of the same prenatal health care providers never perform an oral examination and 45.6% never discuss woman's oral health status during prenatal care appointments (Dev et al., 2016). Prenatal health care providers are aware of an oral systemic link between pregnancy and oral health but do not address it (Dev et al., 2016; Hashim & Akbar, 2014; and Morgan et al., 2009). Despite oral health and maternal guidelines and consensus, these studies demonstrate a lack of education, lack of action, and misconceptions concerning oral health during pregnancy.

Collaboration between the American Dental Association (ADA) and the American College of Obstetricians and Gynecologists (ACOG) resulted in a national statement and guidelines on oral health care during pregnancy directed towards health care professionals (Oral Health Care During Pregnancy Expert Workgroup, 2012). The expert workgroup called for prenatal health care professionals to assess pregnant women's oral health, advise pregnant women about oral health, collaborate with oral health professionals, provide support services, and improve health services in the community (Oral Health Care During Pregnancy Expert Workgroup, 2012). However, prenatal health care providers are not always aware of current statements and guidelines (Curtis, Silk, Savageu, 2013). A 2013 survey of obstetrics and gynecology residency program directors ($n = 97$) reported 44.8% of program directors were aware of current pregnancy and oral health guidelines and only 29.2% said their programs expose residents to these documents (Curtis et al., 2013). Program directors aware of current guidelines (66.7% vs. 31.7%) were twice as likely ($p < 0.001$) to offer at least one hour of pregnancy and oral health education (Curtis et al., 2013). In comparison to program directors not aware of current guidelines (68.3% vs. 33.3%) who were twice as likely ($p < 0.001$) to have zero hours of education (Curtis et al., 2013).

Obstetrician barriers to providing oral health care. Barriers to providing oral health care can be a lack of oral health training and lack of time to address oral health care during prenatal visits (George et al., 2012). According to a 2003 survey by the American Congress of Obstetricians and Gynecologists, obstetricians and gynecologists saw an average of 92 patients per week, equating to approximately two patients per hour (American Congress of Obstetricians and Gynecologists, 2003). Through a systemic

review, George et al. (2012), evaluated the knowledge, attitudes, and behaviors of dentists, obstetricians, general practitioners, and midwives from four countries including the United States, Jordan, Brazil and Australia. The results demonstrated confusion and lack of perinatal and oral health knowledge between all health care providers assessed (e.g. dentists, general practitioners, midwives, and obstetricians). Obstetricians demonstrated a knowledge and positive attitude towards oral health and pregnancy but were not familiar with pregnancy and oral health guidelines and did not feel qualified to diagnose periodontal disease (George et al., 2012). There was also divide amongst obstetricians on whether oral health examinations should be an important part of prenatal care even though the majority thought routine dental care during pregnancy was important (George et al., 2012).

The Association of American Medical Colleges (AAMC), in collaboration with American Dental Education Association (ADEA), evaluated and reported on the lack of oral health education present in medical school curriculum (Association of American Medical Colleges, 2008). Following this report, AAMC recommended and created examples of oral health learning objectives for medical students that included dental public health, dental caries, periodontal disease, and oral-systemic link (Association of American Medical Colleges, 2008). However, the Liaison Committee on Medical Education (LCME) standards for medical school accreditation does not cite specific oral health competencies or curricular objectives (Liaison Committee on Medical Education, 2018). Integration of oral health objectives into medical school curriculum is the responsibility of each medical program's faculty and administration who may not have received oral health education as part of their own medical school education (Association

of American Medical Colleges, 2008). Of 97 surveyed obstetrics and gynecology residency programs, most programs (61.9%) dedicated no time to prenatal oral health education (Curtis et al., 2013). The programs that did report offering pregnancy and oral health education provided one to two hours (32%), and only 6.2% provided three to four hours (Curtis et al., 2013). Lack of knowledge, feeling undertrained and undereducated to diagnose oral health disease coupled with limited appointment time at prenatal visits, preexisting medical conditions and high-risk pregnancy places oral health care as a low or non-existent priority for obstetricians (George et al., 2012).

Pregnancy and oral health. The importance of oral health before, during, and after pregnancy is evident when the connections between pregnancy gingivitis, periodontal disease, preterm low birth weight babies and low birth weight babies, and preeclampsia are reviewed and assessed.

Pregnancy gingivitis. Over the course of two years, three studies (Carrillo-de-Albornoz et al., 2010; Carrillo-de-Albornoz et al., 2012; Figuero et al., 2010), utilized data from the same group of pregnant ($n=48$) and non-pregnant ($n=28$) women to analyze pregnancy gingivitis. The results of each study discovered connections between gingivitis and pregnancy in various capacities. Even though the subgingival microbial profiles of pregnant women did not change during the course of pregnancy, a difference in periodontal pathogens after delivery was noted, indicating a change in gingival health during pregnancy, and pregnant women who were positive for certain pathogens showed greater gingival inflammation (Carrillo-de-Albornoz et al., 2010). The amount of plaque and the presence of specific bacteria, *P. gingivalis*, were associated with gingival inflammation during pregnancy (Carrillo-de-Albornoz et al., 2012). While, gingival

inflammation during pregnancy is exacerbated, no direct correlation with sex hormones, IL-1B or PGE2 levels were found (Figuro et al., 2010). Through a meta-analysis of 12 studies assessing gingival inflammation, an increase in gingival inflammation was associated with pregnancy and more specifically uncovered a peak of gingival inflammation during the second and third terms of pregnancy (Figuro et al., 2013). Compared to non-pregnant women, pregnant women reported a higher gingival inflammation and bleeding on probing (Figuro et al., 2013). These studies demonstrate a strong correlation between pregnancy and gingivitis on many levels.

Periodontal disease and preeclampsia. Preeclampsia is a serious complication of pregnancy that causes high blood pressure during pregnancy, during delivery, or shortly after delivery (Jin, 2017). This complication can cause problems with the kidneys, liver, and sometimes eyes and brain and can cause poor growth of the fetus in utero (Jin, 2017). Screening for preeclampsia is as simple as measuring blood pressure, but treatment is as extreme as delivery (Jin, 2017). If it is too early to deliver, women are monitored and possibly given medications to treat high blood pressure (Jin, 2017).

Multiple confounding factors make it difficult to determine if preeclampsia is affected by periodontal disease however both are caused by inflammatory response (Kunnen et al., 2010). More studies have reported a positive correlation between preeclampsia and periodontal disease compared to studies that found no association (Ha, Jun, Ko, Paik, & Bae, 2014; Kunnen et al., 2010; Macones et al., 2010). Severe preeclampsia and fetal growth restriction were indicated in preterm births in both periodontal treatment and control groups (Macones et al., 2010). A significant relationship between periodontal disease and preeclampsia has been noted, but treatment

of periodontal disease during pregnancy has not resulted in a positive relationship (Kunnen et al., 2010; Macones et al., 2010). However, Ha Jun et al. (2014) noted a variance of homecare methods between the periodontitis group and the control group (no periodontitis) in a hospital-based prospective cohort study completed between March 2009 and June 2013. The study sample ($N=283$) included pregnant women who were non-smokers and comprised of women with periodontitis ($n=67$) and women without periodontitis ($n=216$) (Ha et al., 2014). Periodontitis was defined as clinical periodontal attachment loss of 4.0 mm or greater on 2 or more sites (Ha et al., 2014). Thirteen women were diagnosed with preeclampsia by their obstetrician ($n=13$) (Ha et al., 2014). Participants in both the control (no periodontitis) and periodontitis group were interviewed about health behaviors including experience of dental scaling and regular use of interdental brushes or floss before and during pregnancy. The control group used interdental brushes or floss 18.5% more than the periodontitis group ($p = 0.006$) and periodontitis was significantly associated with preeclampsia (OR = 4.51, 95% confidence interval of 1.13-17.96) (Ha et al., 2014). Since there is a significant relationship between periodontal disease and preeclampsia and the control group used interdental brushes or floss at a higher rate, it may be suggested that oral health behaviors have a positive correlation to the prevention of preeclampsia. Dental health education may facilitate positive oral health behaviors before and during pregnancy and create a positive outcome by reducing periodontal disease and preeclampsia (Ha et al., 2014).

Periodontal disease and preterm low birth weight (PTLBW) and low birth weight (LBW). In 2015, as cited by Martin, Hamilton, Osterman, Driscoll, & Mathews, 2017, the Centers for Disease Control and Prevention (CDC) reported the preterm birth

rate at 9.63%. Preterm births include all babies born before 37 weeks gestation, and low birth weight babies were at 8.07 % in 2015 (Martin et al., 2017). Even though preterm low birth weight (PTLBW) and low birth weight (LBW) babies represent a small percentage of births in the United States, the percentages are significant as babies born preterm and/or at low birth weight are more likely to experience morbidity or death (Martin et al., 2017). Preterm low birth weight has been researched and correlated to periodontal disease, inflammation and destruction of supporting oral structures, in pregnant women and throughout the course of research there has been conflicting evidence in determining if the correlation is causal or associative (Bogges & Edelstein, 2006).

A systematic review of thirteen randomized-controlled clinical trials evaluated periodontal treatment during pregnancy and the effect on preterm birth and/or low birth weight demonstrates this conflicting evidence (Chambrone et al., 2011). Eight of the thirteen studies reviewed demonstrated periodontal treatment during pregnancy might reduce the incidence of preterm birth and/or low birth weight. However, the overall review of all thirteen studies demonstrated periodontal treatment during pregnancy has no significant effect on preterm birth and/or low birth weight babies (Chambrone et al., 2011). Whereas a study published in 2012 examined post-partum women ($N=1,206$) and noted an association with maternal periodontitis and very low birth weight and LBW (Guimarães et al., 2012).

Maternal periodontal disease could be an independent risk factor for low birth weight babies, according to a case-control study of previously pregnant women ($N=88$) in Yazd, Iran (Haerian-Ardakani et al., 2013). Women's periodontal status was evaluated

up to three days after delivery through bleeding on probing, presence of supra-gingival calculus, and Community Periodontal Index for Treatment Needs (CPITN), and mother and infant medical data were gathered from medical records and by interview (Haerian-Ardakani et al., 2013). Half of participating mothers delivered LBW babies and those mothers had less healthy gingival areas ($p=0.042$) and more deep pockets ($p=0.0006$) (Haerian-Ardakani et al., 2013). Uriza, Velosa-Porras, Roa, Lara, Silva, Ruiz, and Arregoces (2018), completed a pilot case-control study of pregnant woman ($N=46$), where the cases ($n=23$) were women at risk of preterm delivery and the controls were pregnant women not at risk ($n=23$). Patients with chronic periodontal disease and those at higher risk for preterm delivery both had increased inflammatory mediators (PGE2) and increased cytokines (IL-2, IL-6, IL-10) present (Uriza et al., 2018). This indicated a possible link between periodontal disease and preterm delivery. In another contrasting study, the progression of periodontal disease during pregnancy showed no significant increased risk for delivering PTLBW or LBW (Michalowicz et al., 2009). However, the authors noted the importance and safety of treating periodontal disease during pregnancy (Michalowicz et al., 2009). Research of the oral systemic link between periodontal disease and PTLBW and/or LBW is emerging and the addition of periodontal treatment before and during pregnancy has potential positive pregnancy outcomes.

Periodontal treatment during pregnancy. Even though research has been conflicting in determining an association between periodontal disease and PTLBW and LBW, recent research has demonstrated a lack of adverse pregnancy outcomes or serious medical outcomes when nonsurgical periodontal therapy (NSPT) is completed during pregnancy (Michalowicz et al., 2006; Michalowicz et al., 2008; Michalowicz et al., 2009;

Michalowicz, Gustafsson, Thumbigere-Math, & Buhlin, 2013; Offenbacher et al., 2006; Offenbacher et al., 2008).

Preterm birth occurred nearly identical in the treatment ($n= 49$, 12.0%) and control ($n= 52$, 12.8%) groups in a randomized study (Michalowicz et al., 2006). A similar study reported essential dental treatment, including NSPT, and the use of topical and local anesthesia, commonly used during periodontal treatment, initiated during pregnancy at 13 to 21 weeks was not associated with an increase of serious medical events or adverse pregnancy outcomes (Michalowicz et al., 2008). Both studies demonstrate the safety of periodontal disease treatment during gestation. However, not all research points towards positive outcomes.

Macones et al. (2010) completed a multicenter, randomized clinical trial utilizing pregnant women ($N=757$). Subjects were randomly assigned to the active group (non-surgical periodontal treatment) ($n=378$) and the control group (supragingival polishing) ($n=379$) (Macones et al., 2010). As previously noted in other studies, NSPT demonstrated no benefit to preterm birth (Chambrone et al., 2011; Macones et al., 2010; Michalowicz et al., 2006; Michalowicz et al., 2009). However, Macones et al. (2010) noted an increase in spontaneous preterm births in the active group, NSPT, (5.3% <35 weeks, 10.6% <37 weeks) which other studies had not experienced. If the association between periodontal treatment and increased preterm risk is true, current recommendations and perceived risk could require modifications. Further research is necessary to determine if the association between periodontal treatment and increased preterm risk was a one-time occurrence or a truth worth addressing.

The association between periodontal disease and adverse pregnancy outcomes is multifaceted and research is ongoing. Even though research has been unable to definitively associate the two directly, current research and evidence based guidelines recommend and encourage periodontal treatment during pregnancy with minimal to no major adverse pregnancy risk (Michalowicz et al., 2006; Michalowicz et al., 2008; Michalowicz et al., 2009; Michalowicz et al., 2013). Radiographs and local anesthesia are safe throughout pregnancy and collaboration between oral health care providers and prenatal care health providers is critical to a holistic prenatal care approach (New York State Department of Health, August 2006; Oral Health Care During Pregnancy Expert Workgroup, 2012).

Infants and oral health. During pregnancy, a mother's oral health may not only affect her overall health and her unborn child's health but could also impact her child's oral health following delivery. A randomly controlled study examined ($n= 50$) pregnant women's saliva and decayed, missing, and filled teeth (DMF) during their pregnancy, while a control group of non-pregnant women ($n=50$) were also examined (Kamate, Vibhute, Baad, Belfaumi, Kadashetti, & Bommanavar, 2019). The results found an increase in DMF during the second and third trimesters and postpartum for pregnant woman compared to the control group ($p<0.01$) (Kamate et al., 2019). Demonstrating an increased risk of carious development during pregnancy compared to non-pregnant women. A notable percent (13.7%) of children aged 2-8 years in the United States have untreated dental caries, and as children age (5 -19 years) the average percentage of untreated dental caries reaches 18.03% (Centers for Disease Control and Prevention, 2017; National Center for Health Statistics, 2017). Dental caries develops over time and

is a major public health problem; affecting eating, sleeping, and resulting in chronic pain and systemic infection, and absence from work or school (World Health Organization [WHO], 2017a). Prevention of dental caries at the earliest stages in life could disrupt the cumulative nature of the disease. However, infant oral health is complicated by influences in feeding practices, family behavior, and bacterial exposure (World Health Organization [WHO], 2017b).

Feeding Practices. A systematic review and meta-analysis concluded breastfeeding up to 12 months does not increase caries risk and might protect children against dental caries (Tham et al., 2015). Whereas, breastfeeding past 12 months may increase the risk of dental caries in children (Tham et al., 2015). Among children breast fed beyond 12 months, those fed nocturnally or more frequently had an increase caries risk (Tham et al., 2015).

Non-breastfed infants can safely use formula milk until age one without increase of dental caries (WHO, 2017b). However, infants who require low-lactose or lactose-free formula, nutrient enriched post-discharge formula and soy formula should be monitored closely by health care providers and parents should be advised to implement good weaning and oral hygiene practices due to sugar content in these infant formula products (WHO, 2017b).

Complementary feeding, introduction of foods and drinks in addition to breastfeeding or formula milk at six months of age, can affect oral health immediately and in the future (WHO, 2017b). The introduction of sugar into an infant's diet has no advantage and the replacement of sucrose and fructose by fruit juices or natural sweeteners such as honey have equal negative effects on oral health (WHO, 2017b). The

WHO strongly recommends no more than 10% of an adult or child's diet should contain free sugars and additional oral health benefits can be gained by decreasing free sugars to 5% of dietary consumption (WHO, 2017b). Free sugars are defined as any monosaccharides and disaccharides added by the manufacturer, cook, or consumer and also include natural sugars present in honey, syrups, fruit juices, and fruit juice concentrate (WHO, 2017b).

Family Behavior. Parent's oral health habits, especially the mother, influence the oral health of their children (WHO, 2017b). The presence of bacterial infection in children is necessary for dental decay to occur (Harris, Nicoll, Adair, & Pine, 2004). However, is it not a sufficient factor for dental caries development, other dietary and oral health care habits are contributing factors (Harris et al., 2004).

Upon review of 77 studies, Harris et al. (2004) noted the importance of dietary intake including magnesium, iron, and calcium. However, these dietary factors were of low impact to oral health compared to sugar consumption and its correlation to dental caries. Twenty of the 28 dietary factors recorded evaluated the amount, frequency, and type of sugar consumption in relation to dental caries, signifying the importance of reduced sugar intake in relation to dental caries (Harris et al., 2004).

Consistent oral health care habits begin at home. Parental habits influence the child's oral health habits (WHO, 2017b). A longitudinal, perspective study initiated in November 2012 and completed in March 2014 evaluated parental perceptions and habits in relation to their own oral health and their abilities to care for their children's oral health. Parents ($N=1,323$) consisted of mostly mothers ($n=1238$) and also included fathers ($n=79$), grandmothers as legal guardians ($n=4$) and other legal guardians ($n=2$)

(Daly et al., 2016). Parents who received at least annual dental care visit perceived their oral health care habits for their child more positively than parents who received less than one annual dental care visit or no dental care at all (Daly et al., 2016). A parent's perception of their ability to care for their child's oral health needs reflected in the parent's daily habits. Parents who utilized fluoridated toothpaste, brushed the child's teeth/gums at least once per day, and let the child consume only water after brushing and prior to bedtime, reported a more positive perception for the infants' teeth and/or gums (Daly et al., 2016). Daly et al. (2016) demonstrated how parental habits and perceptions towards oral health affected the oral health care habits provided for their child. Even though a positive perception of oral health lead to positive oral health care for the child, Daly et al. (2016) also noted parents' perception of general medical health was valued more than their children's oral health. Oral health education with guidance on maintaining oral health of family members and their children and the relation between all systems of the body, the oral systemic link, could help improve the perceived importance of oral health (Daly et al., 2016; WHO, 2017b).

Early Childhood Caries. Early childhood caries (ECC) is defined as “the presence of one or more decayed..., missing (due to caries) or filled tooth surfaces in any primary [baby] tooth in a preschool-age child between birth and 71 months of age [under 6 years old]” (American Dental Association, 2017, para. 1). Importantly, ECC is a preventable, transmittable, and chronic disease of childhood; and evidence is strongest linking maternal oral health and a child's experience with tooth decay (Boggess & Edelstein, 2006). A recent study assessed salivary bacteria for both *mutans streptococci* (MS) and *lactobacilli* (LB) of women during pregnancy and postpartum until children

were 36 months of age (Chaffee et al., 2014). After delivery, children's salivary bacteria were also assessed and compared to that of their mother's. After assessing salivary bacteria it was determined that a salivary challenge, increased salivary bacterial levels, of a mother were associated with childhood oral infections and also predicts an increase in ECC (Chaffee et al., 2014). Conversely, a systematic review in 2004 ($N=77$) including cross sectional, cohort, case-control, and interventional studies demonstrated a positive correlation between transfer of saliva between mother and infant through nurturing habits (e.g. cleaning pacifier with own mouth, kissing a child directly on the mouth, and pre-tasting food) thought to increase immunological resistance to MS compared to infants with rare transfer of saliva contact (Harris et al., 2004). Harris et al. (2004) further noted the presence of MS and LB in children who are free of dental caries. However, the same systematic review found the presence of MS and LB necessary for ECC to occur, and the earlier the MS infection of the oral cavity occurred the higher risk of caries in deciduous dentition (baby teeth) (Harris et al., 2004).

Despite these contrasting results, a bacterial infection is necessary for ECC to occur, bacteria can be transmitted from mother to child, and early bacterial exposure and infection can increase caries risk in children (Bogges & Edelstein, 2006; Chaffee et al., 2014; Harris et al., 2004; Nakai et al., 2016; World Health Organization, 2017b). Pregnancy provides a teachable moment to improve a mother's oral caries status and in turn reduce the caries risk of infants and young children (Bogges & Edelstein, 2006; Nakai et al., 2016).

The baby oral health program (bOHP) demonstrates the effectiveness of preventing caries in infants through education of their mothers (Medeiros, Otero,

Frencken, Bronkhorst, & Leal, 2015). Mothers and infants who effectively participated in bOHP ($n=87$) and mothers and infants who did not fully participate ($n=107$) were divided into separate groups, G1 and G2 respectively, and caries data was gathered two to five years after participation began (Medeiros et al., 2015). The mean decayed, missing, and filled surface (DMF) scores of G1 were 0.25 and G2 DMF scores were 4.12 ($p<0.001$) with an odds ratio of 48.56 of children in G2 developing caries compared to G1 (Medeiros et al., 2015). Since a direct correlation between oral health education and decreased caries development was noted, it is fair to assume regular education of mothers and young children by oral health care providers, dental hygienists included, can decrease caries.

Interprofessional collaboration (IPC) between obstetricians and dental hygienists. Association of State and Territorial Dental Directors (ASTDD) Best Practice Approach: Perinatal Oral Health recommends a strategic framework for improving prenatal oral health (Association of State and Territorial Dental Directors, 2012). A dental hygienist is well positioned to facilitate within scope of practice IPC to achieve improved prenatal oral health for mother and infant. Commission on Dental Accreditation (CODA) establishes, maintains, and applies accreditation standards for dental hygiene education programs. Dental hygiene program curriculum must include at least two full-time academic years of instruction at the postsecondary college-level (CODA, 2018). Educational program standards include instruction, admissions, curriculum, patient care competencies, ethics and professionalism, critical thinking, and curriculum management plan (CODA, 2018). Course curriculum must include four evidence-based areas of general education, biomedical sciences, dental sciences and

dental hygiene science (CODA, 2018). Within these four content areas, dental hygiene curriculum must integrate sufficient depth and scope to properly educate and train dental hygienists to successfully care for patients and contribute to health care.

The CODA 2-8d (2018) dental hygiene science curriculum standards include:

oral health education and preventive counseling, health promotion, patient management, clinical dental hygiene, provisions of services for and management of patients with special needs, community dental/oral health, medical and dental emergencies, legal and ethical aspects of dental hygiene practice, infection and hazard control management, and the provisions of oral health care services to patients with bloodborne infectious disease. (p. 22)

These CODA standards could equip dental hygienists to complete portions of all six ASTDD recommended strategic framework levels.

The ASTDD (2012) levels include:

assess and monitor perinatal oral health, enhance infrastructure and build partnerships, inform and empower the public to mobilize support, ensure adequate oral health workforce and systems, promote and support research and evidence-based practices, and integrate oral health into the patient-centered medical home (p. 6-9).

Addressing oral health alongside prenatal care could move toward Triple Aim goals of improved patient care, improved population health, and reduced per-capita costs (Snyder, 2015).

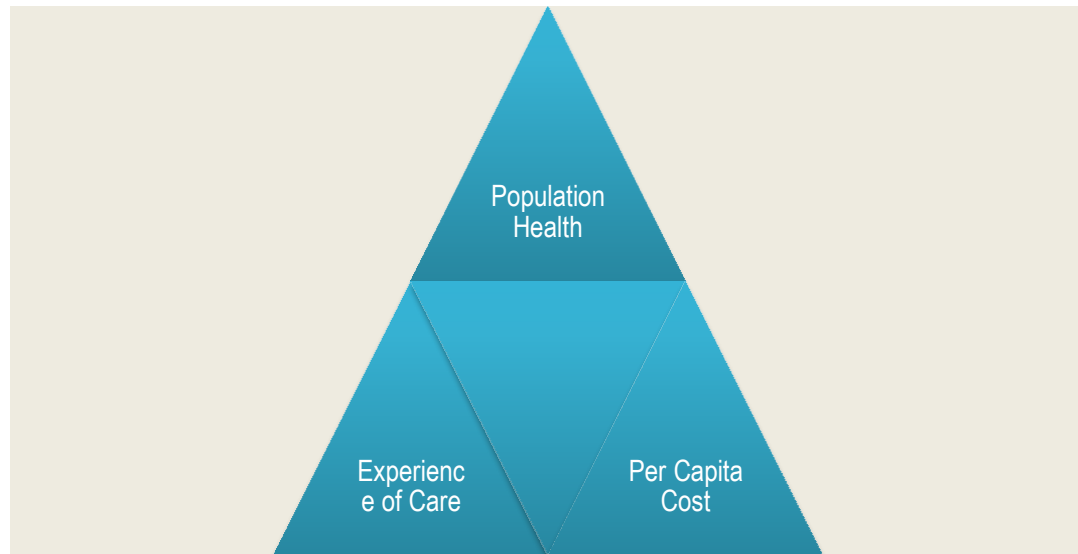


Figure 1: An overview of the IHI Triple Aim

Institute for Healthcare Improvement (IHI) Triple Aim is a national program aimed to create change in the United States health care system (Institute for Healthcare Improvement, 2015 & Sydney, 2015). IHI Triple Aim, the improvement of patient care, improvement of population health, and reduced per-capita costs (see Figure 1), could help influence improvements in oral health care through IPC in settings serving pregnant women and children. Triple Aim focuses on systemic change and improvements in health care systems. Beginning primary, preventive, and secondary, early treatment, services in the earliest stages of life could help decrease cost per capita over an individual's lifetime. The large cost of treating early childhood caries, \$7,200 per case for one child under the age of 6, is often shouldered by Medicaid and Children's Health Insurance Program (CHIP) (Snyder, 2015). These programs are intended to assist underserved populations who need these services most. However, long term stability and

preservation of these programs relies on a decrease in overall costs. Implementing IPC between dental hygienists and obstetricians could decrease dental treatment costs for women and children by improving preventive care (Snyder, 2015). Dental hygienists are expertly trained, educated, and licensed to implement primary, preventive, and secondary, early treatment services to address both mother and infant oral health care needs.

The University of North Carolina (UNC) implemented an IPC prenatal oral health program between medical and dental students during the academic 2012-13 year (Jackson et al., 2015). Medical students and residents targeted pregnant women who did not have a dental home or had not seen a dentist in six to twelve months and referred these women to dental students for oral health care needs (Jackson et al., 2015). The scope of dental services provided to these women included exams and radiographs, preventive treatment, restorative treatment, periodontal treatment, extractions, and endodontic treatment (Jackson et al., 2015). Dental hygiene students were not included in the initial IPC program (Jackson et al., 2015). However, the interprofessional value of dental hygienists was realized and dental hygiene students have been included in future IPC programs (Jackson et al., 2015).

The state of Colorado presents a unique opportunity for interprofessional collaboration (IPC) between dental hygienists and obstetricians, since dental hygienists can work in unsupervised settings (State of Colorado, July 1, 2015). Unsupervised dental hygiene in Colorado constitutes practicing without a dentist present (State of Colorado, July 1, 2015). Colorado dental hygienists practicing unsupervised can complete dental debridement, root planing and tooth polishing, remove infected gingival tissue during

root planing, place dental sealants, review patient health history, perform extra- and intra-oral inspection, complete dental and periodontal charting, take dental radiographs, administer topical anesthetic, prescribe, administer and dispense fluoride, fluoride varnish and antimicrobial rinses, and perform dental hygiene assessment, dental hygiene diagnosis, and dental hygiene treatment planning (State of Colorado, July 1, 2015).

Dental hygienists practicing in Colorado must graduate from a CODA accredited dental hygiene program, successfully complete the written National Board Dental Hygiene Examination, successfully complete a regional or state clinical examination, and meet licensing requirements set forth by the state in order to obtain a registered dental hygiene license. Licensure protects the public and ensures practitioners are qualified and well educated. In addition to licensure, Colorado dental hygienists are required to sustain 30 hours of continuing education every two years.

The Registered Dental Hygienist employment population in Colorado is between 2,730 and 5,430 (Bureau of Labor Statistics, May 2017a). In comparison, the employment of obstetricians and gynecologists in Colorado is between 210 and 570 (Bureau of Labor Statistics, May 2017b). There is a much larger workforce of dental hygienists compared to obstetricians and gynecologists that could help improve oral health in prenatal care settings through IPC.

Beneficial role of Dental hygienists' in interprofessional health care teams.

Minimal literature is available in evaluating the beneficial role dental hygienists play in interprofessional health care teams. However, the current research demonstrates a positive impact from dental hygienist involvement.

According to a tertiary research review focused on rural interprofessional collaborations in Canada, dental hygienists are oral health professionals who can provide significant interprofessional collaborations in public health services (Grant & Kanji, 2017). In addition, dental hygiene students report a positive attitude towards interprofessional education, which could better prepare them for IPC following graduation (Grant & Kanji, 2017; Navickis & Mathieson, 2016).

Interprofessional education fosters IPC. Rothmund, O'Kelley-Wetmore, Jones & Smith (2017), evaluated the effect of interprofessional education between dental hygiene and physician assistant students. Results suggested improved attitudes towards interprofessional collaboration ($p < 0.05$), positive professional identity ($p < 0.05$), roles and responsibilities ($p < 0.05$), and interprofessional communication ($p < 0.05$) (Rothmund et al., 2017).

A pilot project utilized small focus groups to determine educational needs of health care professionals and the role of the dental hygienist on a feeding team working with children with special health care needs (CSHCN) (Jones & Boyd, 2011). The initial assessment demonstrated interest and need for an oral health component to feeding team training and education and improving access to oral health care (Jones & Boyd, 2011). Jones and Boyd (2011) evaluated the in-service program through a Likert scale survey and specifically evaluated the feeding team members' ($N=22$) perceptions towards dental hygienists' involvement with feeding teams. Nineteen of the participants (86%) agreed dental hygienists play a valuable interprofessional role with feeding teams (Jones & Boyd, 2011). Further evaluation demonstrated a positive perception and added perceived benefits to CSHCN patients and feeding team members with the contribution of dental

hygienists in a multidisciplinary and interprofessional role (Jones & Boyd, 2011). The addition of multiple viewpoints, expertise, and experiences enhance patient outcomes and positive experiences (Grant & Kanji, 2017). Dental hygienists have demonstrated their important role in multidisciplinary and interprofessional settings and further research could facilitate more understanding and recognition of this valuable role.

Summary

Previous research demonstrates an oral health connection between pregnancy gingivitis, periodontal disease, preterm low birthweight babies and low birthweight babies, preeclampsia, and early childhood caries. These connections validate the importance of oral health care before, during, and after pregnancy. Recent research and recommended guidelines have determined the safety of oral health care services including preventive services and dental and periodontal treatment. Despite well researched and proven connections between oral health and pregnancy outcomes and the safety of dental care during pregnancy, obstetricians lack education, time, and training to address oral health with women and often do not discuss oral health or refer patients for oral health care as part of their prenatal care.

Interprofessional collaboration between dental hygienists and other health care providers has demonstrated positive outcomes and help achieve IHI Triple AIM goals of improving patient care, improving population health, and reducing per-capita costs.

Methodology

Research Method or Design

This research used a non-experimental, mixed-methods, single test study design to examine dental hygienists' and obstetricians' attitudes towards and perceptions of dental hygienists as part of the prenatal care team. Data was collected by survey of obstetricians and dental hygienists in Colorado. Surveys were sent electronically through SurveyMonkey®. Seeking the perceptions of dental hygienists and obstetricians required a qualitative interpretation and judgment of current perceptions of the value of dental hygienists on the prenatal team.

Quantitative data was gathered with the use of 23 Likert-type survey and 5 demographic questions (See Appendix B) for each group, dental hygienists and obstetricians. Qualitative data was gathered using two open-ended questions (See Appendix B). The rationale for the mixed methods design is to provide evaluation of dental hygienists' perceptions of their own abilities and knowledge as well as obstetricians' perceptions of dental hygienists' abilities and knowledge and to gain insight into the attitudes each respective health care provider has towards IPC between dental hygienists and obstetricians. The ultimate goal of this research was to determine if a connection exists between knowledge and perceptions of oral health and prenatal care, knowledge of dental hygiene abilities in Colorado, and perceptions of dental hygienists as a member in the prenatal care team. A correlation of knowledge and perceptions between dental hygienists and obstetricians was not evaluated as planned due to a low response rate from obstetricians.

Procedures

Human subjects protection/informed consent. The Principal Investigator (PI) obtained informed consent in addition to Institutional Review Board (IRB) approval prior to implementation of the study. Minimal risk was involved for participating licensed dental hygienists and obstetricians and participation was voluntary. Withdrawal from participation was permissible at any time during the study. If a participant choose to discontinue, no consequence or impact occurred. Consent to participate was assumed by participant, licensed dental hygienists and obstetricians, completion of survey. Information regarding this study was stored in the PI's personal, password protected computer to insure anonymity.

Sample source, plan, sample size, description of setting. This study utilized a convenient sampling method composed of licensed obstetricians and licensed dental hygienists in Colorado. The Registered Dental Hygienist employment population in Colorado, as of May 2018, is between 2,730 and 5,430 (Bureau of Labor Statistics, May 2018a). Employment of obstetricians and gynecologists, as of May 2018, in Colorado is between 210 and 570 (Bureau of Labor Statistics, May 2018b). In order to properly represent each group, more dental hygienists were sampled in comparison to obstetricians.

Colorado Dental Hygienists Association (CODHA) and Denver Health and Hospitality Authority (DHHA) aided in the electronic distribution of a single test study through email to their association members. The PI composed a cover letter (see Appendix A) which included a SurveyMonkey® link that was forwarded through email

and posted to social media platforms by CODHA and DHHA. The use of SurveyMonkey® ensured participants could not complete more than one survey.

Study participants were invited to provide contact information, through a Google forms link separate from the survey instrument in order to maintain anonymity, to be entered into a drawing for a \$50 gift card. The gift card offered incentive for completing the survey instrument and aimed to increase response rate.

Variables. This study used research questions rather than test a hypothesis. Therefore, there are neither dependent nor independent variables of study.

Instruments. Quantitative and qualitative data were gathered in the form of a Likert scale and open-ended question survey instrument developed by the PI (See Appendix B). No survey previously existed. This survey was validated through content validity by a panel of experts, which included clinical dental hygienists, undergraduate and graduate level educators, pediatric occupational therapist, health care program directors, and researchers. The survey instrument used a 5-point Likert scale ranging from “strongly agree” (5) to “strongly disagree” (1) and open-ended questions and was divided into three subscales: knowledge/perceptions of oral health and prenatal care (subscale 1), knowledge of Colorado licensed dental hygiene scope of practice (subscale 2), and perceptions of dental hygienists’ interprofessional role in the prenatal care team (subscale 3). Demographic data included licensed dental hygienist or licensed obstetrician, experience (years practicing), collaboration with a dental hygienist/obstetrician, highest level of education, type of practice environment, age, and gender. Once completed, the data was analyzed using Microsoft Excel and SPSS software.

Equipment. Computer software programs used in this study include SurveyMonkey®, Microsoft Excel 2011 version 14.7.2, and IBM SPSS version 2.4. SurveyMonkey® was used to collect data, and Microsoft Excel and SPSS were used to analyze data.

Steps to implementation. After EWU IRB approval, the steps to implementation were as follows.

Step 1. After EWU IRB approval was obtained, the PI communicated with CODHA and DHHA and coordinated electronic distribution of the survey instrument (Appendix B) via a SurveyMonkey® link included in a cover letter (Appendix A). Electronic distribution included email, and social media platforms utilized by CODHA and DHHA and their respective members with a three-week completion timeframe.

Step 2. The PI coordinated an electronic reminder to be sent to Colorado dental hygienists and obstetricians through their respective associations at week 2 of the completion time frame.

Step 3. The PI began analyzing data collected with the survey instrument.

Step 4. The PI collaborated with a statistician, Boyd Foster, to review analyzed results for better understanding. Results were reviewed and an explanation provided to assess the validity of the study.

Statistical Analysis. Preliminary descriptive statistical analyses such as frequencies, percentages, means, standard deviations, and ranges were completed to provide an overview of survey data including demographics and all three subscales: knowledge/perceptions of oral health and prenatal care (subscale 1), knowledge of Colorado licensed dental hygiene scope of practice (subscale 2), and perceptions of

dental hygienists' interprofessional role in the prenatal care team (subscale 3). Survey participants were categorized by demographics (licensed dental hygienist or licensed obstetrician, interprofessional collaboration, experience, highest level of education, type of practice, age, and gender).

Levene's test for equality of variances and an independent Sample t- Test was utilized to examine significant differences between demographics and subscale 1, 2, and 3.

Summary

This research design and implementation ensured all participants remained anonymous. The PI coordinated electronic administration of a 24-item Likert survey via SurveyMonkey® to evaluate obstetricians' and dental hygienists' perceptions towards the role of dental hygienists as part of the prenatal care team.

Descriptive statistics and Independent Sample-T test were utilized to analyze the results of gathered data.

Results

Description of Sample

A convenience sample of Colorado licensed dental hygienists and obstetricians were selected and electronically invited to participate in this research. There were 111 surveys completed ($N=111$). Of the 111 completed surveys, three surveys were excluded from statistical analysis resulting in ($N=108$) participants. One participant responded no to being a Colorado licensed dental hygienist and a Colorado licensed obstetrician. Another participant did not respond yes or no to being a Colorado licensed dental hygienist or Colorado licensed obstetrician and a third participant answered yes to being both a Colorado licensed dental hygienist and Colorado licensed obstetrician. Dental hygienists ($n= 106$) make up the majority of the study sample. While obstetricians ($n= 2$) comprised a smaller study sample which is not representative of the population. Therefore, the analysis and results of this study focused solely on Colorado licensed dental hygienists ($N= 106$). CODHA membership is comprised of 443 CO licensed dental hygienists, resulting in a response rate of 28.44%. The participants ($N= 106$) in this study presented with a range of experience, practice environment, education, and age (see Table 1). The majority (97.2%) of participants were women ($n= 103$) and over half (54.3%) have a bachelor's level of education ($n= 57$). Private practice accounted for most practice settings (58.1%) while some participants ($n= 6$) reported working in more than one type of practice setting. Age and years licensed demonstrated no majority. However, 77.4% of participants reported no collaborative work with an obstetrician ($n= 82$).

Table 1

Colorado licensed dental hygienists (N=106)

Characteristic	Study Sample		
Years licensed	23.6%	0-5 years	(n=25)
	17.0%	6-10 years	(n= 18)
	14.2%	11-15 years	(n=15)
	7.5%	16-20 years	(n= 8)
	37.7%	21+ years	(n= 40)
Worked in collaboration with an obstetrician	22.6%	Yes	(n= 24)
	77.4%	No	(n=82)
Type of practice environment*	58.1%	Private	(n=67)
	27.6%	Public	(n= 33)
	8.6%	Other	(n= 12)
	3.8%	Private + Public	(n=4)
	1.9%	Private + Other	(n= 2)
Highest level of education*	31.4%	Associate	(n= 33)
	54.3%	Bachelors	(n= 57)
	11.4%	Masters	(n=12)
	2.9%	Doctorate	(n= 3)
Age*	16%	21-30 years	(n=17)
	28%	31-40 years	(n= 30)
	20%	41-50 years	(n= 21)
	35%	50+ years	(n= 37)
Gender	97.2%	Female	(n= 103)
	2.8%	Male	(n=3)

*Indicates N=105, in each of these demographic categories there was one missing data point.

Statistical Analysis

Descriptive Statistics including frequencies, percentages, means, standard deviations, and ranges were completed to provide an overview of survey data from all three subscales: knowledge/perceptions of oral health and prenatal care (subscale 1), knowledge of Colorado licensed dental hygiene scope of practice (subscale 2), and perceptions of dental hygienists' interprofessional role in the prenatal care team (subscale 3).

Subscale 1 (see Table 2) gathered participant knowledge and perceptions of oral health and prenatal care. A 5-point Likert scale ranging from "strongly agree" (5) to

“strongly disagree” (1) was utilized. Eighty-seven percent (87%) of participants had a score of 4 or higher in subscale 1 and 26 participants gave a 5 to all 6 questions.

However, subscale 1 responses ranged from 2.5 to 5 with a mean of 4.4638 (see Table 5).

Nearly eighteen percent (17.9%) of participants disagreed or strongly disagreed dental radiographs should be included as part of prenatal care and 34% were neutral (neither agree nor disagree) with radiographs as part of prenatal care. In comparison to 100% of participants agreeing or strongly agreeing that routine preventive oral health care, health care screening, and oral health care education should be part of prenatal care.

The second and third statements in subscale 1, dental radiographs should be part of prenatal care and dental treatment (restorations, root canals, crowns, extractions, etc.) should be part of prenatal care, had the lowest mean scores ($M= 3.58$ and $M= 3.87$) respectively (see Table 2). These statements also had the highest standard deviation ($SD= 1.129$ and $SD= 0.997$ respectively) and the highest variance ($s^2=1.275$ and $s^2=0.954$ respectively) (see Table 2).

Table 2

Subscale 1- Knowledge/perceptions of oral health and prenatal care

	N		Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Range	Minimum	Maximum
	Valid	Missing									
Routine preventive oral health care, oral health care screening, and oral health care education should be part of prenatal care.	106	0	4.93	0.024	5	5	0.25	0.062	1	4	5
Dental radiographs should be part of prenatal care.	106	0	3.58	0.11	3	3	1.129	1.275	4	1	5
Dental treatment (restorations, root canals, crowns, extractions, etc.) should be part of prenatal care.	106	0	3.87	0.095	4	4	0.977	0.954	4	1	5
Periodontal treatment should be part of prenatal care.	106	0	4.73	0.055	5	5	0.561	0.315	3	2	5
Poor oral health can have adverse effects on pregnancy outcomes.	106	0	4.85	0.044	5	5	0.453	0.206	3	2	5
Poor oral health of a mother can have adverse oral health effects on infant(s).	106	0	4.83	0.045	5	5	0.467	0.219	3	2	5

Note: Std. = Standard

Subscale 2 (see Table 3) focused on current Colorado dental hygiene scope of practice and what participants' perceptions or knowledge of the practice act is.

Statements were taken directly from the Colorado practice act under unsupervised settings. In Colorado, dental hygienists practicing unsupervised do not have a dentist present on site which can allow for countless practice scenarios. A 5-point Likert scale ranging from "strongly agree" (5) to "strongly disagree" (1) was again employed.

Ninety-seven-point two percent (97.2%) of participants strongly agree or agree Colorado licensed dental hygienists can work in unsupervised settings, without a dentist present. The overall mean of subscale 2 is 4.7529 (see Table 5) with 50 participants giving a 5 for all 9 questions. Resulting in a mode of 5 (see Table 5). Subscale 2 has an overall range of 2.9 to 5.0, standard deviation of 0.36783, variance of 0.135, and a mean of 4.7529 (see Table 5). Colorado dental hygienists had a notable variance of 1.431 to the statement “In unsupervised settings, Colorado licensed dental hygienists can safely remove infected gingival tissues during root planning.” The same statement had a lower mean ($M= 4.14$) and higher standard deviation ($SD= 1.196$) than any other statement regarding Colorado dental hygiene scope of practice.

Table 3

Subscale 2-Knowledge of Colorado dental hygiene scope of practice

	N		Mean	Median	Mode	Std. Deviation	Variance	Range	Minimum	Maximum
	Valid	Missing								
Colorado licensed dental hygienists can work in unsupervised settings, without a dentist present.	106	0	4.75	5	5	0.582	0.339	4	1	5
<u>In unsupervised settings:</u>										
Colorado licensed dental hygienists can safely complete dental debridement, root planing and tooth polishing.	105	1	4.86	5	5	0.426	0.181	3	2	5
Colorado licensed dental hygienists can safely remove infected gingival tissues during root planning.	105	1	4.14	5	5	1.196	1.431	4	1	5
Colorado licensed dental hygienists can safely place dental sealants.	106	0	4.73	5	5	0.711	0.505	4	1	5
Colorado licensed dental hygienists can safely review patient health history and	106	0	4.9	5	5	0.306	0.094	1	4	5

perform extra- and intra-oral inspections.

Colorado licensed dental hygienists can safely complete dental and periodontal charting.	106	0	4.89	5	5	0.398	0.158	3	2	5
Colorado licensed dental hygienists can safely take dental radiographs.	106	0	4.79	5	5	0.628	0.395	3	2	5
Colorado licensed dental hygienists can safely administer topical anesthetic.	105	1	4.82	5	5	0.515	0.265	3	2	5
Colorado licensed dental hygienists can safely apply, prescribe, administer and dispense fluoride, fluoride varnish and antimicrobial.	106	0	4.75	5	5	0.663	0.439	4	1	5
Colorado licensed dental hygienists can safely perform dental hygiene assessment, dental hygiene diagnosis, and dental hygiene treatment planning.	106	0	4.9	5	5	0.306	0.094	1	4	5

Note: Std. = Standard

Subscale 3 (see Table 4) evaluates the perceptions of dental hygienists interprofessional role in the prenatal care team by using a 5-point Likert scale ranging from “strongly agree” (5) to “strongly disagree” (1). Overall, a low variance ($s^2=0.14$) and insignificant standard deviation ($SD= 0.37577$) (see Table 5). A range of 2.00 with 3.00 being the minimum and 5.00 being the maximum was noted with a mean score of 4.7864 (see Table 5). Overall, dental hygienists responded positively to perceptions of dental hygienists interprofessional role in the prenatal care team (see Table 4 and 5).

Table 4

Subscale 3-Perceptions of dental hygienists interprofessional role in the prenatal care team

	N		Mean	Std. Error of Mean	Median	Mode	Std. Deviation	Variance	Range	Minimum	Maximum
	Valid	Missing									
The dental hygienist plays a valuable role in the prenatal care team.	106	0	4.77	0.045	5	5	0.464	0.22	2	3	5
Dental hygienists play a valuable role in integrating oral health into existing prenatal programs.	106	0	4.76	0.058	5	5	0.594	0.35	3	2	5
Dental hygienists play a valuable role in working with health professionals and community networks to adopt, endorse, and promote prenatal oral health guidelines.	106	0	4.75	0.053	5	5	0.549	0.3	3	2	5
Dental hygienists play a valuable role in promoting prenatal oral health programs.	105	1	4.73	0.055	5	5	0.559	0.31	3	2	5
Dental hygienists play a valuable role in improving existing prenatal oral health systems.	105	1	4.66	0.065	5	5	0.663	0.44	3	2	5
An oral health component to prenatal care is beneficial to mother and child.	105	1	4.92	0.026	5	5	0.267	0.07	1	4	5
An oral health component to prenatal care could be implemented by a dental hygienist.	105	1	4.89	0.031	5	5	0.32	0.1	1	4	5

Note: Std. = Standard

Table 5

Subscale 1, 2, and 3 statistics

Subscale	N		Mean	Median	Mode	Std. Deviation	Variance	Range	Minimum	Maximum
	Valid	Missing								
1	106	0	4	4.5	5	0.47028	0.221	2.5	2.5	5
2	104	2	5	4.9	5	0.36787	0.135	2.1	2.9	5
3	103	3	5	5	5	0.37577	0.141	2	3	5

Note: Std. = Standard

Independent Samples t-Test was used to determine if there were significant differences between two groups based on a demographic factor: Colorado dental hygienists who have collaborated with obstetricians versus those who have not, more education versus less, more years of licensure versus less, older versus younger, and public practice experience versus none. Levene's test for equality of variances was used, and in most/all cases, the variances were not equal. Therefore, a 2-tailed significance values not assuming equal variances was utilized.

Years licensed includes dental hygienists who have been licensed for 15 years or less ($n=58$) and those who have been licensed 16 years or more ($n= 48$). This provides two equal groups for analysis. An associates degree is the entry level of education for dental hygiene licensure in the United States. Thus, level of education was recoded into Associates degree ($n= 33$) and Bachelors degree or higher ($n= 72$). Age was collapsed into 21 to 40 years of age ($n=47$) and 41 years of age or older ($n= 58$). Again, this provided two nearly equal groups for analysis. Type of practice setting was recoded to no public experience ($n= 63$) versus some public experience ($n= 33$). Participants who

indicated “other” ($n= 10$) types of practice on the survey were not included in this variable.

Collaborate with an obstetrician variable. The majority of respondents in all subscales 1, 2, and 3 have not collaborated with an obstetrician ($n=82$, $n= 80$, $n= 80$ respectively) (see Table 6). The mean scores for have collaborated with an obstetrician are consistently higher than the mean scores for have not collaborated with an obstetrician. The have not collaborated with an obstetrician groups have a higher standard deviation than the have collaborated with an obstetrician groups (see Table 6). There is also a much larger standard deviation for the have not groups ($SD= 0.39876$ and $SD= 0.40514$) than the have groups ($SD= 0.19556$ and $SD= 0.19200$) in subscale 2 and 3 (see Table 6).

Table 6

		N	Mean	Std. Deviation	Std. Error Mean
Subscale 1 knowledge	Have Not	82	4.3862	0.46766	0.05164
	Have	24	4.7292	0.38010	0.07759
Subscale 2 scope	Have Not	80	4.7150	0.39876	0.04458
	Have	24	4.8792	0.19556	0.03992
Subscale 3 perception	Have Not	80	4.7446	0.40514	0.04530
	Have	23	4.9317	0.19200	0.04003

Note: Std. = Standard

Levene’s test for equality of variances demonstrated subscale 2 and subscale 3 did not vary equally. Therefore, equality of variance cannot be assumed when determining differences between dental hygienist who have and have not worked with an obstetrician.

There was a significant difference ($p < 0.05$), when equal variances are not assumed, for all three subscales between Colorado dental hygienists who have worked with an obstetrician and those who have not. Subscale 1 ($p = 0.001$), subscale 2 ($p = 0.008$), and subscale 3 ($p = 0.003$). Having practiced with an obstetrician appears to make a significant difference in all subscale scores.

Table 7

Independent Samples t-Test: DH who have and who have not worked with an OB

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Subscale 1 knowledge	Equal variances assumed	1.142	0.288	-3.286	104	0.001*	- 0.34299	0.10438
	Equal variances not assumed			-3.680	45.367	0.001*	- 0.34299	0.09320
Subscale 2 scope	Equal variances assumed	5.333	0.023*	-1.943	102	0.055	- 0.16417	0.08449
	Equal variances not assumed			-2.743	79.950	0.008*	- 0.16417	0.05984
Subscale 3 perception	Equal variances assumed	11.555	0.001*	-2.140	101	0.035	- 0.18703	0.08739
	Equal variances not assumed			-3.094	78.537	0.003*	- 0.18703	0.06045

Note: Std. = Standard, Sig.= Significance

* $p < 0.05$ indicating significance

Years licensed variable was collapsed into two nearly equal groups, ≤ 15 years licensed ($n=58$) and 16+ years licensed ($n= 48$). The mean scores across each subscale

appear similar in regard to experience (see Table 8). There is also no significant standard deviation seen in any subscale or group (see Table 8).

Table 8

Years licensed

		N	Mean	Std. Deviation	Std. Error Mean
Subscale 1 knowledge	≤ 15 years licensed	58	4.5144	0.39525	0.05190
	16+ years licensed	48	4.4028	0.54560	0.07875
Subscale 2 scope	≤ 15 years licensed	58	4.7034	0.42135	0.05533
	16+ years licensed	46	4.8152	0.27886	0.04112
Subscale 3 perception	≤ 15 years licensed	56	4.7526	0.41268	0.05515
	16+ years licensed	47	4.8267	0.32622	0.04758

Note: Std. = Standard

Subscale 1 has a significant difference in variances ($p= 0.045$) (see Table 9).

Therefore, the values for equal variances not assumed were utilized. The independent samples t-test shows no significant differences in any subscales or length of licensure ($p= 0.226$, $p= 0.124$, and $p= 0.321$) (see Table 9). Years of experience does not appear to impact any of the subscale scores.

Table 9

Independent Samples t- Test: Years licensed

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Subscale 1 knowledge	Equal variances assumed	4.128	0.045*	1.219	104	0.226	0.11159	0.09155
	Equal variances not assumed			1.183	83.677	0.240	0.11159	0.09431
Subscale 2 scope	Equal variances assumed	3.194	0.077	-1.549	102	0.124	-0.11177	0.07214
	Equal variances not assumed			-1.621	99.070	0.108	-0.11177	0.06893
Subscale 3 perception	Equal variances assumed	2.179	0.143	-0.998	101	0.321	-0.07420	0.07434
	Equal variances not assumed			-1.019	100.666	0.311	-0.07420	0.07284

Note: Std. = Standard, Sig.=Significance

* $p < 0.05$ indicating significance

Level of education variable was collapsed into two groups, Associates ($n= 33$) and Bachelors or higher ($n= 72$). The majority of respondents ($n= 53$) reported a Bachelors level of education. The mean and standard deviation are similar in each group across the three subscales (see Table 10).

Table 10

<i>Level of education</i>		N	Mean	Std. Deviation	Std. Error Mean
Subscale 1 knowledge	Associates	33	4.4394	0.47657	0.08296
	Bachelors or higher	72	4.4745	0.47361	0.05582
Subscale 2 scope	Associates	32	4.6500	0.50609	0.08947
	Bachelors or higher	72	4.7986	0.27857	0.03283
Subscale 3 perception	Associates	31	4.8157	0.33237	0.05969
	Bachelors or higher	71	4.7787	0.39515	0.04690

Note: Std. = Standard

Subscale 2 varies unequally in the two groups ($F = 10.791$ and $p = 0.001$) (see Table 8). Therefore, equal variances are not assumed. Even though there is no significant difference between the groups, significance is approached for subscale 2 ($p = 0.127$) (see Table 11).

Table 11

Independent Samples t-Test: Level of education

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Subscale 1 knowledge	Equal variances assumed	0.200	0.656	-0.352	103	0.725	-0.03514	0.09975
	Equal variances not assumed			-0.351	61.818	0.726	-0.03514	0.09999
Subscale 2 scope	Equal variances assumed	10.791	0.001*	-1.926	102	0.057	-0.14861	0.07715
	Equal variances not assumed			-1.559	39.598	0.127	-0.14861	0.09530
Subscale 3 perception	Equal variances assumed	0.956	0.331	0.455	100	0.650	0.03700	0.08125
	Equal variances not assumed			0.487	67.446	0.628	0.03700	0.07591

Note: Std. = Standard, Sig.= Significance

* $p < 0.05$ indicating significance

Age variables were recoded into 2 groups, 21-40 years old and 41+ years old. The mean and standard deviation are similar across both groups and all three subscales (see Table 12).

Table 12

<i>Age</i>					
		N	Mean	Std. Deviation	Std. Error Mean
Subscale 1 knowledge	21-40	47	4.4645	0.38689	0.05643
	41+	58	4.4569	0.53308	0.07000
Subscale 2 scope	21-40	47	4.7064	0.36973	0.05393
	41+	56	4.7875	0.36733	0.04909
Subscale 3 perception	21-40	46	4.7578	0.35234	0.05195
	41+	56	4.8061	0.39798	0.05318

Note: Std. = Standard

Equal variances were not assumed in subscale 2 and 3 ($p= 0.382$ and 0.821).

Independent sample t-test was ran and no significant differences between these groups were noted ($p= 0.932$, $p= 0.269$, and $p= 0.517$) (see Table 13). Age does not appear to impact any of the subscale scores.

Table 13

Independent Samples t-Test: Age

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Subscale 1 knowledge	Equal variances assumed	3.411	0.068	0.082	103	0.935	0.00764	0.09291
	Equal variances not assumed			0.085	101.857	0.932	0.00764	0.08991
Subscale 2 scope	Equal variances assumed	0.771	0.382	-1.113	101	0.268	-0.08112	0.07288
	Equal variances not assumed			-1.112	97.704	0.269	-0.08112	0.07292
Subscale 3 perception	Equal variances assumed	0.051	0.821	-0.643	100	0.522	-0.04836	0.07524
	Equal variances not assumed			-0.650	99.411	0.517	-0.04836	0.07434

Note: Std. = Standard, Sig.=Significance

* $p < 0.05$ indicating significance

Public health variable was recoded into any dental hygienist with only private practice experience ($n=63$) and those with at least some public practice experience ($n=33$). Participants who indicated “other” in their response and neither a private nor public practice setting were excluded from this variable ($n=10$). The majority of participants had no public practice indicated ($n=63$) and these individuals had an overall higher standard deviation in subscale 1 ($SD=0.48498$), subscale 2 ($SD=0.40320$), and subscale 3 ($SD=0.43161$) (see Table 14). Those with no public practice indicated appear to be more varied in their responses. Respondents who indicated public practice settings

reported a higher mean score in all 3 subscales respectively ($M=4.6667$, $M=4.7970$, $M=4.8884$) (see Table 14).

Table 14

<i>Public health</i>		N	Mean	Std. Deviation	Std. Error Mean
Subscale 1 knowledge	private, no public indicated	63	4.3307	0.48498	0.06110
	public, at least some	33	4.6667	0.37268	0.06487
Subscale 2 scope	private, no public indicated	61	4.7328	0.40320	0.05163
	public, at least some	33	4.7970	0.27327	0.04757
Subscale 3 perception	private, no public indicated	61	4.7354	0.43161	0.05526
	public, at least some	32	4.8884	0.22290	0.03940

Note: Std. = Standard

Subscale 3 has a significant difference in variances ($p= 0.001$) (see Table 15). However, subscale 1 and 2 do not. Therefore, the values for equal variances not assumed were utilized when determining differences between dental hygienists who indicated public practice and those who did not. There was a significant difference ($p < 0.05$), when equal variances are not assumed, for subscale 1 ($p=0.000$) and 3 ($p=0.027$) between Colorado dental hygienists who indicated public practice and those who did not. Subscale 1 ($p=0.000$) and subscale 3 ($p=0.027$) (see Table 15). Indicated experience in public practice setting appears to make a significant difference in subscale 1 knowledge and subscale 3 perception.

Table 15

Independent Samples t-Test Public practice indicated

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Subscale 1 knowledge	Equal variances assumed	1.889	0.173	-3.475	94	0.001	-0.33598	0.09668
	Equal variances not assumed			-3.770	81.040	0.000*	-0.33598	0.08912
Subscale 2 scope	Equal variances assumed	1.997	0.161	-0.817	92	0.416	-0.06418	0.07851
	Equal variances not assumed			-0.914	87.230	0.363	-0.06418	0.07020
Subscale 3 perception	Equal variances assumed	11.993	0.001*	-1.875	91	0.064	-0.15303	0.08160
	Equal variances not assumed			-2.255	90.995	0.027*	-0.15303	0.06787

Note: Std. = Standard, Sig.=Significance

* $p < 0.05$ indicating significance

Qualitative analysis. Two open-ended questions were included in subscale 3 to explore themes and ideas from participants in relation to collaboration between dental hygienists and obstetricians. The questions are as follows: “How would collaboration between dental hygienists and obstetricians benefit patients?” (collaboration benefit) and “How do you envision obstetricians and dental hygienists working together?” (envision collaboration).

Eighty ($n= 80$) participants responded to the first question, collaboration benefit and seventy-nine ($n= 79$) participants responded to the second question, envision collaboration.

Collaboration benefit. Thematic analysis of the qualitative data was completed by two experts, a statistician and PI. Patterns of meaning and themes identified and coded in order to uncover themes within participant answers. The four main themes for collaboration benefit included: improved oral health, whole health/whole person, education/knowledge/experience for the patient, and education/knowledge/experience for the provider. Responses often contained multiple themes and demonstrated dental hygienists' knowledge and passion for oral health care, prenatal care, and interprofessional collaboration (see Tables 16 and 17).

1. Improved oral health

- a. These comments were focused on mother and fetus in the present for early intervention of dental conditions.
 - i. This could reduce risk of premature birth and other risks to the unborn child/children.
- b. For mother and baby in the future
 - i. The education, knowledge, and experiences received from the oral health care provider and understanding the link of oral health and whole health, will lead to mom and children being more likely to maintain positive oral health care habits and oral health care visits in the future.

- c. This would potentially increase dental access to care, if obstetricians could work with oral health care providers and vice versa.
 - d. This could result in good oral health habits before, during, and after pregnancy.
2. Whole health/whole person
- a. These comments were around linking obstetrician to oral health care providers by integration or collaboration (and including the education/knowledge category below). Patients understand the link between at least two aspects of health and how different body systems affect each other.
 - b. Providing seamless care for the patient.
 - c. Overall health improves with collaboration or passing of knowledge between all health care providers for an individual; resulting in improved health outcomes.
3. Education/knowledge/experience for the patient
- a. This is the largest category and links to many others. This links to the increased likelihood of mother and child keeping up dental visits, mother learning how to care for a child's oral health, knowing and understanding risks, increased compliance, parental awareness, improved dental habits in the future.
 - b. It also links to the whole health category where patients would understand how health care providers collaborate with one another to achieve optimal health for patients.

- c. Professional alignment and/or collaboration shows patient how important oral health and prenatal care are together.
4. Education/knowledge/experience for the provider
- a. Dental hygienists could learn more, communicate better, learn from collaborating, have the ability to educate or collaborate with obstetricians, and observe how to best handle patient concerns.
 - b. Assistance in creation of collaborative policies and treatment plans.
 - c. Obstetricians and oral health care providers could work together and provide care for women before becoming pregnant.
 - d. Overall health improves with collaboration and passing of knowledge between all health care providers for an individual; resulting in improved health outcomes.

Table 16

Collaboration benefit themes

	Theme (n)	No theme	Total	Percent
Improved oral health	23	57	80	30.00%
Whole health/ whole body	31	49	80	41.25%
Education/ knowledge/ experience for the PATIENT	45	35	80	50.00%
Education/ knowledge/ experience for the PROVIDER	23	57	80	40.35%
Other/ undefined	8	73	80	1.27%

Table 17

<i>Collaboration benefit quotes</i>	
Theme	Direct quotes
Improved oral health	“It could possible decrease the amount of disease present in pregnant patients as well as increase oral health literacy among first time mothers and lead to more treatment, and increased oral health awareness of parents and children, possibly leading to a decrease in early childhood caries rate, and maternal caries, periodontal disease incidence rates.”
Whole health/ whole body	“Mouth body connection is real. Helping expectant mothers with oral hygiene and bacteria control results in healthier people.” “Patients need to know the health of their body overall and how it all connects. This will benefit the patient in several ways. It is wise to have a team work together and collaborate for a patient’s case and overall health.”
Education/ knowledge/ experience for the PATIENT	“Often people consider us [dental hygienists] not as much of an expert on things because we are not a doctor or even a dentist. Having the backing of an OB or Midwife to help encourage their patient's to receive oral care during their pregnancy would greatly help spread the information to the importance of good oral health. If an OB or Midwife had a practice they had a good working relationship with and knew they could trust, that door could be open to not only help the patients but potentially grow the dental practice with new patients who may not have previously received dental care until they are informed of the importance of it to their baby.”
Education/ knowledge/ experience for the PROVIDER	“It would help each professional know of any issues or problem with the oral health or pregnancy. The professionals would also be able to create a collaborative treatment plan, both supporting the other viewpoints and professional opinions. It would relieve any miscommunication between providers and patients and would enable providers to speak directly to each other about the care the pregnant women is receiving.”

Envision collaboration. Again, thematic analysis of the qualitative data was completed by two experts and patterns of meaning and themes were identified and coded in order to uncover themes within participant answers. Responses focused mostly on models of referral and direct integration of dental hygienists in prenatal settings. A third focus was on less specific health care models and directed more towards education of dental hygienists and obstetricians and improvements in policies. The three main themes included: models: referrals, models: co-location/direct integration, and education/policies/work together (see Tables 18 and 19).

1. Models: referrals

- a. a better system, collaboration, or perhaps auto generate dental referrals from the obstetrician to oral health care provider.
- b. Many respondents note patients will likely keep obstetrician appointments, which creates an opportunity for obstetricians to recommend women have oral health exams or automatically refer to an oral health provider. Obstetricians can emphasize oral health importance.

2. Models: co-location/direct integration

- a. Many of these answers surround having a dental hygienist on the obstetrician team or in the obstetrician office to do dental exams, provide care and be a normal part of the obstetrician visit. Dental hygienists could refer for more advanced issues.
- b. Besides a dental hygienist on staff, other suggestions were a dental hygienist visiting once a week in obstetrician setting, or full co-location of dental and medical providers under one roof.

3. Education/policies/work together

- a. More networking between the professions, providing workshops for obstetricians and/or for the moms at maternity classes or during home visits. Obstetricians could observe at dental offices. Overall, mutual support and information sharing.

Table 18

<i>Envision collaboration themes</i>				
	Theme (n)	No theme	Total	Percent
Models: Referral	30	49	79	37.97%
Models: Co-location/ direct integration	30	49	79	37.97%
Education/ policies/ work together	35	44	79	44.30%
Other/ undefined	6	73	79	7.59%

Table 19

<i>Envision collaboration quotes</i>	
Theme	Direct quotes
Models: Referral	“Crossover forms/ standardized procedures for information to be gathered at Obgyn [sic] and dental offices regarding pregnancy. And/or standardized form to be completed at dental offices and sent with expectant mothers to take to their Obgyn relaying oral health matters/treatment. Continued education for both medical parties interrelating the two.”
Models: Co-location/direct integration	“Having a dental hygienist involved in a OBGYN practice would be great. Here in Colorado where we can have our own practice there could be referrals from the OBGYN office.”
Education/policies/work together	“Hygienists should provide their expertise to the obstetricians as well as the reverse, resulting in the patient getting a collaborative, cohesive message from both health care providers.”

Discussion

Summary of Major Findings

This research study aimed to answer two research questions: What are the perceptions of obstetricians towards the role of dental hygienists as part of the prenatal care team? and What are dental hygienists' perceptions of their role on the prenatal care team? The perceptions of obstetricians were not examined since the response rate ($n=2$) was not representative of the population. Whereas, the perceptions of dental hygienists were well represented ($N=106$) with a response rate of 28.44%, and the research question was answered.

Overall, Colorado dental hygienists reported a strong positive perception in all subscales: knowledge and perceptions of oral health and prenatal care, knowledge of Colorado dental hygiene scope of practice, and perceptions of dental hygienists interprofessional role in the prenatal care team. Even with the overall positive perception there are outliers worth taking note of.

Dental hygienists perceived dental radiographs and dental treatment more negatively and were less cohesive in their perceptions. They also had a less positive and less unified perception of the removal of infected gingival tissues in unsupervised settings. While, all respondents agreed or strongly agreed with oral health screenings and education during pregnancy.

Interprofessional collaboration with an obstetrician appears to make a significant difference in all three subscale perceptions and public health experience made a significant difference in subscale 1 and 3 perceptions. This suggests that professional

experiences could impact dental hygienists' perceptions and knowledge in regard to oral health care during prenatal care, knowledge of scope of practice, and perceptions of prenatal care roles. Whereas, years of experience and age, do not appear to impact any perceptions. However, the level of education approaches significance for subscale 2 suggesting higher education could impact dental hygienists' perceptions and knowledge of their scope of practice.

Discussion

This study supports recent research that shows dental hygienists have a strong perception of their abilities and knowledge in prenatal care (Schramm et al., 2016). Dental hygienists are valuable additions in prenatal care teams directly and indirectly. Colorado dental hygienists have a unique opportunity to capitalize on these possibilities since their practice act is broad and far reaching in unsupervised settings.

Knowledge/perceptions of oral health and prenatal care. Surveyed Colorado Dental hygienists strongly agree or agree pregnant women should receive preventive oral health care during pregnancy. However, they had more negative perceptions of dental treatment, local anesthesia and dental radiographs during prenatal care. These inaccuracies to the safety of dental radiographs, local anesthesia, and treatment during pregnancy are similar to misconceptions physicians and dentists have reported (George et al., 2012). They are also similar to Schramm et al. (2016), where dental hygienists favored preventive services and reported reservations to radiographs, dental treatment, and periodontal treatment.

Surveyed dental hygienists agreed with current research and guidelines recommending non-surgical periodontal therapy (NSPT) during pregnancy with minimal

to no pregnancy risk (Michalowicz et al., 2006; Michalowicz et al., 2008; Michalowicz et al., 2009; Michalowicz et al., 2013; New York state department of health, August 20016; and Oral Healthcare During Pregnancy Expert Workgroup, 2012). Even though, radiographs and local anesthesia are often essential methods employed during periodontal therapy and the same surveyed dental hygienists perceived these forms of care more negatively. Dental hygienists appear conflicted when oral health care services extend beyond preventive care. Even though current research shows an oral health connection between pregnancy gingivitis, periodontal disease, preterm low birthweight babies, low birthweight babies, preeclampsia, and early childhood caries (Oral Healthcare During Pregnancy Expert Workgroup, 2012). These conflicts can inhibit a dental hygienist's ability to comprehensively provide holistic care to prenatal patients.

Health care providers, as this research illustrates, continue to misunderstand, misinterpret, or are not aware of changes in recommendations. This could be a result of misconceptions and lack of education or information being distributed to oral health care providers in working environments (Amini & Casimassimo, 2010). It is also the responsibility of health care providers to seek out new information and standards of practice, and Colorado dental hygienists have only recently been required to maintain continuing education beginning in 2016 (CODHA, 2015). The inclusion of prenatal and oral health care focused continuing education courses could help eliminate confusion and improve patient care. Updated and improved evidence-based education during formal schooling could also help improve these perceptions towards essential oral health care treatment during prenatal care.

Dental hygiene graduates should be prepared to serve the health and wellness of prenatal patients. This preparation requires continued education in the form of didactic classroom education and improved and added hands-on clinical experiences with prenatal patients. It is crucial that education is evidence-based and not instructor experience based. Dental hygiene instructors may not have practiced current prenatal oral health care recommendations and teaching solely based on their own experiences could result in continued misconceptions and misinformation.

Current CODA standard 2-12 require dental hygiene programs to include education incorporating special needs patients (CODA, 2018). Pregnancy falls under this standard. Current clinical practice education textbooks contain updated and evidence-based information regarding pregnancy (Henry & Goldie, 2016 and Wilkins, 2009). However, this does not always translate into real-life treatment and care. As this research indicates, dental hygienists have fears and reservations associated with treating pregnant patients beyond preventive services. These fears and reservations should not be minimized or dismissed. Education is an imperative tool for changing behaviors though exposure to scenarios and patients is an equally important and critical portion to education. The inclusion of clinical rotations outside of traditional clinical settings can help facilitate this change in behaviors and experiences. Dental hygiene students should have a variety of clinical rotation experiences including obstetrician and gynecological practices, hospitals, and public health settings.

The improved education of dental hygiene graduates helps propel the dental hygiene profession forward and fosters further development of health care access. Improved formal education is crucial, however practicing dental hygienists also need

increased access to prenatal oral health care courses and easy access to published guidelines. Face-to-face and online continuing education courses focused on prenatal oral health care guidelines could reach countless dental hygienists across Colorado and the United States.

Knowledge of Colorado dental hygiene scope of practice. It was noteworthy to assess how knowledgeable Colorado dental hygienists are of their own practice act and the procedures they are legally allowed to implement in unsupervised settings, without a dentist present. Overall scores represent a positive knowledge and perception towards Colorado dental hygiene scope of practice. However, Colorado dental hygienists had a notable variance of 1.431 to the statement “In unsupervised settings, Colorado licensed dental hygienists can safely remove infected gingival tissues during root planning.” The same statement had a lower mean ($M= 4.14$) and higher standard deviation ($SD= 1.196$) than any other statement regarding Colorado dental hygiene scope of practice. An explanation for this lower perception or knowledge is unknown. The current Likert style study does not allow the PI to distinguish if Colorado dental hygienists are unsure of their scope of practice or if they disagree with this scope of practice. A scale of strongly agree to strongly disagree does not supply detailed information in regard to why a Colorado dental hygienist may select disagree versus agree in relation to removal of infected gingival tissues. If Colorado dental hygienists are simply unaware of their scope of practice, education can be utilized to increase awareness and increase full utilization of their practice act. If Colorado dental hygienists disagree that dental hygienists can safely remove infected gingival tissues during root planning in unsupervised settings, further

evaluation as to why they disagree with this practice can provide information for added assessment and possible adjustments to the practice act itself.

Education models to foster further understanding and more use of progressive practice acts like Colorado’s could include formal college courses and continuing education courses focused around unsupervised settings and opportunities available to dental hygienists with all levels of formal education. According to ADHA (n.d.), there are numerous career opportunities outside of private clinical practices settings that include:

Table 20

Dental hygiene career opportunities

Clinician	Private dental practice Community clinics Hospitals University dental clinics Prison facilities Nursing homes Schools
Corporate	Sales representative Product researcher Corporate educators Corporate Administrators
Public Health	Clinician: Rural or inner-city community clinics Indian Health services Head Start programs School sealant programs Administrator: State public health officer Community clinic administrator
Researcher	Colleges and universities Corporations Governmental agencies Nonprofit organizations
Educator	Clinical instructors Classroom instructors Program directors Corporate educators

Administrator	Clinical director Program director Executive director Research administrator Director
Entrepreneur	Practice management company Product development and sales Employment services CE provider or meeting planner Consulting business Founder of a nonprofit Independent clinical practice Professional speaker/writer

Introduction and exposure to various dental hygiene career opportunities can improve access to care for patients and also reinforce the reputation of dental hygienists as fully educated, thoroughly prepared primary care providers.

Perceptions of dental hygienists interprofessional role in the prenatal care team. Surveyed dental hygienists have a positive cohesive perception to their role in the prenatal care team. These findings support current research representing dental hygienists' strong perception of their abilities on the prenatal care team (Schramm, et al., 2016). However, as previously discussed, Colorado dental hygienists waived in their knowledge and perceptions of oral health care procedures during prenatal care such as radiographs and anesthesia. Dental hygienists appear to view themselves as preventive oral health care providers and avoid controversial and misunderstood recommendations during prenatal care.

As previously discussed, changes to educational methods in and out of college settings can improve dental hygienists' knowledge and perceptions to prenatal oral health care. This improvement will better align dental hygienists with their positive perception as part of the prenatal care team.

Colorado dental hygienists reported similar responses to what research suggests is a benefit for oral health care during pregnancy for women and see a collaboration benefit positively. Patient education, knowledge, and experience were mentioned the most by Colorado dental hygienists (50.00%). While respondents also mentioned the oral systemic link and the importance of whole health (41.25%) more than oral health improvements (30.00%). This demonstrates a stronger holistic approach by Colorado dental hygienists and not a more narrow oral health only focus. A broader holistic perception could be a result of the Colorado dental practice act providing autonomy in many settings for dental hygienists. This allows dental hygienists to take a more primary provider role versus a secondary provider role reliant on a dentist or other health care provider.

Surveyed dental hygienists demonstrated their opinions and knowledge towards the prenatal care team as strong and positive. Dental hygienists view themselves working directly with the prenatal care team to create a seamless health care system for pregnant women, and if dental hygienists are not directly integrated in the prenatal care team, they see themselves communicating with obstetricians when providing oral health care services for mutual patients. Dental hygienists see the obstetrician as a prime advocate for oral health care during pregnancy since women see an obstetrician more frequently while pregnant. Obstetricians can automatically initiate referrals for oral health care and stress its importance. Dental hygienists envisioned themselves gaining more knowledge and education but saw obstetricians needing even further education about oral health care during pregnancy. Their assumptions may not be inaccurate since a 2013 survey found

minimal to no oral health and prenatal care focused hours in surveyed obstetrics and gynecological residency programs (Curtis et al., 2013).

Collaboration with an obstetrician. Dental hygienists have limited exposure to interprofessional collaboration (Jaecks, 2009) and this study establishes a similar outcome in association to prenatal care. More than three quarters (77.4%) of Colorado dental hygienists reported not having worked with an obstetrician. While, collaborating with an obstetrician had a significant difference in all subscale perceptions ($p= 0.001$, $p= 0.008$, and $p= 0.003$). Suggesting that interprofessional collaboration with an obstetrician creates higher more positive responses to prenatal oral health care knowledge, more positive knowledge or response to Colorado dental hygiene scope of practice in unsupervised settings and a positive perception towards dental hygienists as part of the prenatal care team.

Current entry level dental hygiene curriculum focuses on clinical settings and skills (ADHA, 2015). A broader oral systemic, holistic curriculum could help benefit dental hygienists and the population as a whole. Improved and updated evidence-based curriculum can help change career expectations and shift from a mostly clinical private practice focus and expectations to a broader range of roles and new models of health care within and beyond dental care.

A systemic change in education curriculum focus can better prepare dental hygienists to be an asset to IHI Triple aim goals: improvement of patient care, improvement of population health, and reduced per-capita costs (Snyder, 2015). In addition to traditional patient-provider relationships, dental hygienists could develop and implement curriculum and research promoting prenatal oral health needs and disparities

and IPC (Association of State and Territorial Dental Directors, 2012). Dental hygienists could facilitate relationships between oral health care providers and prenatal health care providers by working directly in physician offices and clinics. Dental hygienists are skilled and educated in providing patient education, dental hygiene exams of hard (teeth) and soft (gums, cheeks, lips, etc.) tissues, dental caries risk assessment, nutritional counseling, topical fluoride application, oral cancer screenings, and referral to oral health care providers such as general dentists, dental hygienists, orthodontists, or oral surgeons. Procedures of this type can be completed in any health care setting and do not require additional dental equipment and operatories. Increased dental hygiene utilization allows dentists and health care providers to devote more time towards procedures not within the dental hygiene scope of practice.

According to the results of this research, the following framework could be implemented to incorporate dental hygienists directly into prenatal care settings; working with patients before, during, and after pregnancy:

Table 21

Direct integration of dental hygienists in prenatal care settings

Dental hygienists in prenatal care settings can facilitate:	Explanation	Equipment necessary
Education of patients	Home care habits including brushing and flossing. Education and recommendations for habits Importance of oral health for themselves before, during, and after pregnancy and their child after delivery. Importance of a dental home before, during, and after pregnancy. Education of pregnancy risks (preterm, low birth weight, preeclampsia,) associated with oral health (gingivitis, periodontal disease, ECC)	No equipment is necessary. Pamphlets and visual aids could help aid in education. However, they are not required.

Examination of hard (teeth) and soft (gums, cheeks, lips, etc.) tissues	The use of an oral/dental mirror and a head lamp/light to examine and document hard and soft tissue as it exists.	Oral/dental mirror Head lamp/light Medical gloves
Dental caries risk assessment	The use of an oral/dental mirror and a head lamp/light along with disclosing solution and discussions about daily habits and eating habits that can affect caries risk.	Oral/dental mirror Head lamp/light Disclosing solution Medical gloves
Nutritional counseling	Evaluation and discussion about a patient's eating habits. Analysis of food log and recommendations to decrease caries risk for pregnant women and their children.	No equipment necessary. Pamphlets in multiple languages are beneficial but not required.
Topical fluoride application	Application on women and children to safely reduce caries risk.	Topical Fluoride Medical gloves
Oral cancer screening	Examination to look for signs of cancer or precancerous conditions of the mouth, face, and neck to identify cancer early, when there is a greater chance for a cure.	Oral/dental mirror Head lamp/light 2x2 gauze Medical gloves
Referral to other oral health care providers	According to findings during an assessment, a dental hygienist can refer women and/or children to the appropriate oral healthcare provider. A dental hygienist could also help facilitate referrals to providers who are eligible to see patients according to their Medicaid and insurance status.	Referral forms Telephone

Including dental hygienists in prenatal care settings can allow dental hygienists to assess and refer to treat women prior to pregnancy. These preventive early interventions are beneficial to women and also address concerns and fears dental hygienists have with completing radiographs, dental treatment, and anesthesia while women are pregnant. Early involvement in women's health care services allow controversial and concerning procedures to be completed before pregnancy.

Public health experience. Colorado dental hygienists were asked what type of practice setting they have worked in and most respondents reported working in private practice settings ($n=67$). Nationwide, the majority of dental hygienists work in dental office settings (94.61%) while a small percentage (<1%) work in physician offices

(Bureau of Labor Statistics, May 2018a) were interprofessional collaboration would undoubtedly occur. Public practice can include dental office settings and alternative settings. Colorado dental hygienists with no public health experience appeared to be more varied in their responses though those with public practice experience reported a higher perception in all 3 subscales. Public health experience also had a significant difference on subscale 1 knowledge ($p=0.000$) and subscale 3 perceptions ($p=0.027$) but not on subscale 2 scope. This demonstrates a difference between Colorado dental hygienists who have experience in public health and those who have none.

Colorado dental hygienists with public health experience appear to have more positive responses to knowledge about prenatal oral health and also perceive dental hygienists as having a more positive role on the prenatal oral health care team. Colorado dental hygienists with public health experience could have experiences with other health care professionals and patients with prenatal and oral health needs. These experiences and gained knowledge could affect their perceptions in relation to prenatal oral health care and their own perceptions of their role on the prenatal care team. Public health clinics may also be co-located with medical services, which could provide experiences and exposure a dental hygienist in non-public health settings may not encounter. Exposure and experiences in public health settings, such as clinics, hospitals, and long-term care facilities, during formal education will provide dental hygienists knowledge and experiences they may not encounter through on-campus clinical settings. These experiences further prepare dental hygienists and can foster interest in caring for patients who are underserved.

Level of education revealed no significant difference to subscale 1, 2, or 3 perceptions. However, significance is approached for subscale 2 ($p = 0.127$). This approach towards significance is notable. A possible explanation could be dental hygienists with educations beyond an entry level associates degree, may more fully utilize their scope of practice. Therefore, better understanding the scope of practice and having a more positive perception. Without further research it is not possible to completely understand this approach to significance.

Interprofessional collaboration (IPC) including dental hygienists creates a holistic prenatal care approach. Colorado dental hygienists practice assessment, dental hygiene diagnosis, planning, implementation, and evaluation within their scope of practice for all patients, and pregnancy is no different. These skills and knowledge are not just limited to clinical practice settings and can be beneficial in many health care settings, including physician offices.

Research shows confusion when it comes to prenatal care and the safety of oral health care treatment during pregnancy despite defined guidelines and recommendations. Exposure to various settings and interprofessional collaboration along with education can help eliminate confusion and misconceptions to prenatal and oral health care.

Colorado dental hygienists do not feel patients are being referred for oral health care before, during, or after pregnancy and this can have negative effects on women and their children. Increased dental hygiene interprofessional collaboration in all health care settings can allow other health care providers time to focus on procedures outside the Colorado dental hygiene scope of practice. Patients benefit because they are receiving holistic care.

Dental hygienists possess the advanced skills and education to be an integral piece to holistic prenatal care for mother and infant and lessen the patient burden of obstetricians. Dental hygienists could help provide educational materials and one on one interaction in interprofessional and multidisciplinary settings. These interactions with a skilled and educated health care provider, such as a dental hygienist, could facilitate positive parental habits and lead to positive oral health care for their children. The IPC of dental hygienists could improve the patient experience of care, improve the health of a population, and reduce the cost of health care for pregnant women and their infants (Institute for Healthcare Improvement, 2017).

Limitations

The utilization of only email for survey responses could have negatively affected responses from obstetricians. The lack of support from obstetrician associations, organizations, and universities with distribution of the research survey limited the response rate and ultimately negated adequate collection of data from Colorado obstetricians.

Utilizing a Likert style survey to gather data on perceptions and knowledge of the Colorado dental hygiene scope of practice may have had some bias. The PI had to assume what perceptions or knowledge were. Adjusting Likert style questions could have eliminated the need for assumption and offered more clear responses, perceptions, and knowledge. Subscale 2 could have used more neutrally worded statements/questions and a yes/no/I don't know response option instead of a 5-point Likert scale.

Recommendations/Suggestions for Future Research

The PI recommends expanding the obstetrician sample to include midwives. Colorado estimates 110-200 certified nurse midwives and nationally an estimated 6,250 certified nurse midwives are part of the prenatal care team (Bureau of Labor Statistics, 2018c). The principle investigator also recommends completing surveys in person and not electronically for obstetricians and midwives. Electronic surveys are alluring because they save time and money but the response rate for an entire section of the population was nearly null and void. Targeting gatherings or large practices in various settings where prenatal health care providers work could have resulted in a more accurate depiction of the population. A PI could strategically set up quick meetings to introduce possible participants to the research and allow participants to take an electronic survey immediately during or after being introduced to the research topic, its relevance, and importance to their practice.

Subscale 2 – scope could have been crafted with less bias. Since the Colorado dental hygiene scope of practice is established and statements were taken directly from the existing practice act, a Likert scale from strongly disagree to strongly agree was unfocused. Utilizing a yes, no, and I don't know could have provided more precise evaluation of Colorado dental hygienists' knowledge and understanding of their own practice act. As a PI, it is prudent to not make assumptions regarding participants' responses. Adjusting subscale 2 to a yes, no, I don't know response option eliminates the need to assume what participants think or meant.

The PI recommends further research into the relationship between education and understanding scope of practice. Does the level of education affect a dental hygienist's understanding of scope of practice? An associate level degree is required for licensure,

however, dental hygienists may acquire higher levels of education. Therefore, this research separated responses into associate level education and bachelors level or higher education.

Research has reported positive results to interprofessional collaboration with dental hygienists and the PI recommends further research into interprofessional roles of dental hygienists and their role in improving access-to-care in the United States.

The PI also recommends future research including ethnicity demographic to evaluate if patients who share the same ethnicity as their health care provider are more or less accepting of recommendations.

Conclusions

Colorado dental hygienists demonstrated positive perceptions in their knowledge of prenatal and oral health care, their dental hygiene scope of practice in unsupervised settings, and their role as part of the prenatal care team. Additionally, results indicate experience in collaboration with obstetricians had a significant difference on dental hygienists' perceptions and public health experience had a significant difference in responses also. More experience and exposure to scenarios outside of common private practice settings can impact Colorado dental hygienists' perceptions and knowledge. Colorado dental hygienists are in a position to use current evidence-based practice guidelines along with a broad scope of practice to provide oral health care services and advocate for women in prenatal health care settings. Colorado dental hygienists demonstrated a desire to improve interprofessional relationships with obstetricians through referral models, co-location and integration of prenatal and oral health care, and improved oral health knowledge for obstetricians. Improving oral health care and prenatal health care knowledge and behaviors can reduce pregnancy risks that include preterm and low birth weight babies, preeclampsia, and ECC. It is imperative that prenatal health care teams collaborate with oral health care providers to improve the health of pregnant women and their children.

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Appendices

Appendix A

Thesis Survey Cover Letter

Hello Colorado Dental Hygienists and Obstetricians,

My name is Lisa Westhoff, I enrolled as a student in the Master of Science in Dental Hygiene program at Eastern Washington University. I am inviting you to participate in a study titled *Perceptions of the Dental Hygienist's Role on the Prenatal Care Team*.

The purpose of this study is to:

1. Determine the perceptions of obstetricians towards the role of dental hygienists as part of the prenatal care team
2. Determine dental hygienists' perceptions of their role on the prenatal care team.

As part of this research you will be asked to complete a single survey by clicking this link_____. Responses are needed by_____.

Please know that your participation in this study is completely voluntary and your responses are anonymous, as they do not require you to disclose any identifying information. This study is less than minimal risk. The time anticipated to complete this survey is less than 10 minutes, and by clicking on the survey you consent to be part of the research.

Study results will be made available to all participants upon request at lwesthoff@eagles.ewu.edu.

If you have any questions about the research study please contact Professor Lorie Speer RDH, BS, MSDH, thesis chair, at lspeer@ewu.edu or (509) 828-1294. If you have any concerns about your rights as a participant in this research or any complaints you wish to make, you may contact Ruth Galm, Human Protections Administrator, at rgalm@ewu.edu or (509) 359-6567.

Thank you for your time and contribution,

Lisa Westhoff RDH, BSDH, MSDH (C)
lwesthoff@eagles.ewu.edu

Appendix B

Likert Scale Survey	Strongly Agree (5)	Agree (4)	Undecided (3)	Disagree (2)	Strongly Disagree (1)
Oral health and prenatal care knowledge/perceptions					
1. Routine preventive oral health care, oral health care screenings, and oral health care education should be part of prenatal care.					
2. Dental radiographs should be part of prenatal care.					
3. Dental treatment (restorations, root canals, crowns, extractions, etc.) should be part of prenatal care.					
4. Periodontal treatment should be part of prenatal care.					
5. Poor oral health can have adverse effects on pregnancy outcomes.					
6. Poor oral health of a mother can have adverse oral health effects on infant(s).					
Knowledge of Colorado dental hygiene scope of practice					
7. Colorado licensed dental hygienists can work in unsupervised settings, without a dentist present.					
In unsupervised settings, Colorado licensed dental hygienists can safely:					
8. Complete dental debridement, root planing and tooth polishing.					
9. Remove infected gingival tissues during root planing.					
10. Place dental sealants.					
11. Review patient health history and perform extra- and intra-oral inspection.					
12. Complete dental and periodontal charting.					
13. Take dental radiographs.					

14. Administer topical anesthetic.					
15. Apply, prescribe, administer and dispense fluoride, fluoride varnish and antimicrobial rinses.					
16. Perform dental hygiene assessment, dental hygiene diagnosis, and dental hygiene treatment planning.					
Perceptions of the dental hygienist's interprofessional role in the prenatal care team					
17. The dental hygienist plays a valuable role in the prenatal care team.					
18. Dental hygienists play a valuable role in integrating oral health into existing prenatal programs.					
19. Dental hygienists play a valuable role in working with health professionals and community networks to adopt, endorse, and promote prenatal oral health guidelines.					
20. Dental hygienists play a valuable role in promoting prenatal oral health programs.					
21. Dental hygienists play a valuable role in improving existing prenatal oral health systems.					
22. An oral health component to prenatal care is beneficial to mother and child.					
23. An oral health component to prenatal care could be implemented by a dental hygienist.					
24. How would collaboration between dental hygienists and obstetricians benefit patients?					

25. How do you envision obstetricians and dental hygienists working together?						
Demographics – Dental hygienists						
26. I am a Colorado licensed dental hygienist.	Yes				No (if you selected no, please jump ahead to question #33 on the next page)	
27. If yes, how many years have you been licensed?	0-5	6-10	11-15	16-20	21+	
28. As a dental hygienist, have you worked in collaboration with an obstetrician?	Yes			No		
29. Type of practice environment	Private	Public		Other (fill in the blank)		
30. Highest level of education	Associate	Bachelors	Masters	Doctorate		
31. Age	Under 20	21-30	31-40	41-50	50+	
32. Gender	Female	Male	Non-gender identifying	Transgender or other (fill in the blank)		
Demographics - Obstetricians						
33. I am a Colorado licensed obstetrician.	Yes				No (if you selected no, please jump ahead to the next page)	
34. If yes, how many years have you been licensed?	0-5	6-10	11-15	16-20	21+	
35. As an obstetrician, have you worked in collaboration with a dental hygienist?	Yes			No		
36. Type of practice environment	Private	Public		Other (fill in the blank)		
37. Highest level of education	Associate	Bachelors	Masters	Doctorate		
38. Age	Under 20	21-30	31-40	41-50	50+	
39. Gender	Female	Male	Non-gender identifying	Transgender or other (fill in the blank)		

Curriculum Vita

Lisa Westhoff

Registered Dental Hygienist

Address

1060 Chipeta Ave
Grand Junction, CO 81501

Phone (719) 688-5472

email lisawesthoff@me.com

Education

- 2019** **MS in Dental Hygiene**
The Department of Health Sciences
Eastern Washington University, Spokane, WA
Thesis title: "Perceptions of Dental Hygienists' on the Prenatal Care Team"
Thesis Chair: Lori Spear
- 2016** **BS in Dental Hygiene**
Eastern Washington University
The Department of Health Sciences
Eastern Washington University, Spokane, WA
Summa Cum Laude
- 2007** **AAS in Dental Hygiene**
The Department of Dental Hygiene
Colorado Northwestern Community College, Rangely, CO
President's Honors List

Licensure/ Certification

2007 – Present Colorado State Dental Hygiene License

2005 – Present American Heart Association BLS for Healthcare Providers

Employment

2013 - Present Registered Dental Hygienist with Ryan Davis DDS, Grand Junction, CO

2013 – Present	Registered Dental Hygienist with Public Health School Dental and Sealant Program, Garfield County, CO
2008 - 2012	Registered Dental Hygienist with Crested Oak Dentistry, Don Brown DDS, and Fine and Naranja Family Dentistry, Grand Junction, CO
2010 – 2011	OSHA Coordinator, Don Brown DDS, Grand Junction, CO
2007 - 2008	Registered Dental Hygienist with Don Aust, DDS Family Dentistry, Grand Junction, CO
2007	Registered Dental Hygienist with G.J. Smiles for Cosmetic, Reconstructive, and Family Dentistry, Grand Junction, CO

Course Work

Graduate

2017 - 2019	Thesis
2018	Practicum
	Seminar on Healthcare Policy and Finance
2017	Seminar on Administration, Management, & Organization
	Clinical Teaching Strategies
	Principle of Dental Hygiene Course Design
	Research Methodology & Writing
	Introduction to Thesis
	Components of Program Development
	Healthcare Education & Instructional Methods
2016	Advanced Dental Hygiene Practice + Lab
	Healthcare Leadership
	Seminar on Public Health and Promotion
	Research, Biostatistics & Other Ways

Undergraduate

2016	Education & Health Promotion Practicum
	Dental Hygiene Capstone
	Applied Statistics and Evidence-based Decision Making for the Health Sciences
	Principles of Dental Public Health
2015	Relationship, Ethics, and Communication in Healthcare
	Foundations of Dental Hygiene Education
	Principles and Policies of Oral Healthcare Management
	Collaborative Composition: Analysis, Research, & Documentation
	Survey of Theatre History
	Myth, Folklore, & Healthcare
	Career Strategies
	Contemporary Issues in Dental Hygiene
2014	Oral Health Promotion
	Research Methods
2007	Community Dental Health I
	Ethics & Practice Management
	Community Dental Health II
	Clinical Practice III
	Clinical Theory III
	National Boards Prep
2006	Preventive Dentistry & Special
	General & Oral Pathology
	Periodontics II

Clinical Theory II

Clinical Practice II

CPR for Professionals Renewal

Dental Materials

Clinic II Lecture

Dental Materials

Dental & Medical Emergencies

Dental Hygiene Clinic Lecture

Periodontics I

Clinical Practice of Dental Hygiene I

Applied Pharmacology

Local Anesthesia

Nitrous Oxide & Oxygen Sedation

Immunology Aspects of Periodontal Disease

2005 Pre-Clinical Dental Hygiene Lecture II

CPR for Professionals

Current Issues & Ethics in Dental Hygiene

Pre-Clinical Dental Hygiene Lecture

Pre-Clinical Dental Hygiene Care

Dental Anatomy & Hystology

Dental Radiology

Head & Neck Anatomy

Applications in Dental Hygiene

	Human Nutrition
	Introduction to Chemistry II + Lab
	Human Anatomy & Physiology II + Lab
	Microbiology
2004	Human Anatomy & Physiology I + Lab
	Seminar: Medical Terminology
	Introduction to Chemistry I + Lab
	Science of Biology
2003	Introduction to Statistics
	Principles of Speech
	Introduction to Sociology I
	Introduction to Literature I
	General Psychology

Research Experience

2017 – 2019	Perceptions of Dental Hygienists' Role on the Prenatal Care Team
2014	Prophylactic Therapy and Bisphosphonate-related Osteonecrosis of the Jaw. Non-clinical

Academic Teaching/Education Experience

2019	Career Strategies, EWU, Spokane WA
2018	Community Dental Health, CNCC, Rangely, CO
2018	Community Dental Health II, CNCC, Rangely, CO
2018	Revising, Analyzing, Researching, and Updating CNCC Dental Hygiene Program Manual, Rangely, CO
2018	Creation of Clinical Dental Hygiene consent forms: Fluoride Varnish Application, Non-Surgical Periodontal Therapy, Refusal

	for Non-Surgical Periodontal Therapy, Refusal of diagnostic radiographs; CNCC, Rangely, CO
2017	Pre-Clinical Dental Hygiene Care, CNCC, Rangely, CO
2017	Pre-Clinical Dental Hygiene Lecture, CNCC, Rangely, CO
2017	Oral Health and Pregnancy Presentation/Lecture, Grand Junction, CO
2016	Career Opportunities for Dental Hygienists CNCC, Rangely, CO
2011	OSHA presentation to staff, Don Brown DDS
2007	Oral Healthcare instruction to nursing home staff, Rangely, CO

Professional Organizations

2015 – Present	Secretary of the House of Delegates for Colorado Dental Hygienists Association (CDHA)
2007 – Present	Active Member and official positions held in Western Slope Dental Hygienist Society (WSDHS)
2015 - Present	WSDHS Treasurer and Secretary
2013 - 2014	WSDHS President
2011 - 2012	WSDHS Secretary
2007 – Present	Colorado Dental Hygienist's Association
2015	Delegate to the CDHA House of Delegates
2014	Delegate to the CDHA House of Delegates
2012	Delegate to the CDHA House of Delegates
2007 – Present	American Dental Hygienist's Association
2019	Colorado Delegate to the ADHA House of Delegates
2018	Colorado Delegate to the ADHA House of Delegates
2005 – 2007	Student American Dental Hygienist's Association
2004 – Present	P.E.O. (Philanthropic Educational Organization) active member
2015 – 2016	P.E.O. Secretary

Honors and Awards

2016	Summa Cum Laude Eastern Washington University
2016	ADEA/Crest Oral-B Laboratories Scholarship for Dental Hygiene Students Pursuing Academic Careers

2005 – 2007	CNCC President’s Honors List
2006	Collegiate National Cross-country Competition in El Paso, TX
2004 – 2005	PCC President’s Honors List
2002 – 2004	LCC President’s Honors List

Community Service

2019	Colorado Mission of Mercy, Oral Healthcare Services, Glenwood Springs, CO
2015 – Present	Volunteer at GJ Homeward Bound. Preparing and serving meals, Grand Junction, CO
2016 – 2018	Volunteer for PLACE. Community based organization advocating for neighborhood improvements in Mesa County.
2006 – 2007	Clinical rotations at Public Health facilities in CO and UT
2006 – 2007	Dental screenings and education in elementary schools, Lamar, CO