



American
Dental
Hygienists'
Association

Journal of Dental Hygiene

August 2022 • Volume 96 • Number 4

- United States Dental Health Care Workers' Mental Health During the COVID-19 Pandemic
- COVID-19 Practices of Idaho Dental Hygienists
- Examining the Influence of Academic Degree Level on Health Care Providers' Perception of Interprofessional Collaboration: A pilot study
- Prenatal and Pediatric Oral Health Education Among Dental Hygiene Programs in the United States
- Brief Motivational Interviewing: Evaluation of a skills-based education program
- Implementing Environmental Sustainability Educational Intervention in Dental Hygiene Instruction

Journal of Dental Hygiene

August 2022 • Volume 96 • Number 4

Statement of Purpose

The *Journal of Dental Hygiene* is the refereed, scientific publication of the American Dental Hygienists' Association. The *JDH* promotes the publication of original research related to the profession, education, and practice of dental hygiene and supports the development and dissemination of a dental hygiene body of knowledge through scientific inquiry in basic, applied and clinical research.

Subscriptions

The *Journal of Dental Hygiene* is electronically published bi-monthly by the American Dental Hygienists' Association, 444 N. Michigan Avenue, Chicago, IL 60611. Copyright 2018 by the American Dental Hygienists' Association. Reproduction in whole or part without written permission is prohibited. Subscription rates for non-members are one year, \$150.

Submissions

Author guidelines and the manuscript submission process can be found at: http://www.adha.org/resources-docs/7833_JDH_Author_Guidelines.pdf

2021 - 2022 ADHA Officers

President

Dawn Ann Dean, RDH, MSDH

Treasurer

Jeanna Secrist, RDH

President Elect

Becky Smith, CRDH, EdD

Immediate Past President

Sharlee Burch, RDH, MPH, EdD

Vice President

Erin Haley-Hitz, RDH, BSDH, MS

ADHA/JDH Staff

Managing Editor

Catherine K. Draper, RDH, MS
cathyd@adha.net

Director of Education and Research

JoAnn R. Gurenlian,
RDH, PhD, AFAAOM
joanng@adha.net

Emeriti Editors

Mary Alice Gaston, RDH, MS
Rebecca S. Wilder, RDH, MS

Layout/Design

Dorreen Petersen Davis, MS

Chief Executive Officer

Ann Battrell, MSDH
annb@adha.net

2022-2024 JDH Editorial Advisory Board

Cynthia C. Amyot, EdD, RDH
Denise M. Claiborne, PhD, RDH
Priscilla Flynn, PhD, MPH, RDH
Tami Grzesikowski, MEd, RDH

Harold Henson, PhD, MEd, RDH
Michelle Hurlbutt, DHSc, MSDH, RDH
Lisa F. Harper Mallonee, MPH, RD/LD, RDH
Jodi Olmsted, PhD, RDH
Dorothy J. Rowe, PhD, MS, RDH

Danielle Rulli, DHSc, MS, RDH
Ann Eshenaur Spolarich, PhD, RDH
Cheryl Westphal Theile, EdD, MS, RDH
Pamela Zarkowski, JD, MPH, RDH

JDH Reviewers at Large

Celeste M. Abraham, DDS, MS
Cynthia C. Amyot, RDH, EdD
Roland R. Arnold, PhD
Hadeel M. Ayoub, RDH, PhD
Katy Batani, RDH, MS
Kathryn Bell, EdD, RDH
Kristy Menage Bernie, RDH, MS
Leciel Bono, RDH, MS
Linda D. Boyd, RDH, RD, EdD
Brenda Bradshaw, RDH, MS
Jennifer L. Brame, RDH, EdD, MS
Ann Bruhn, BSDH, MS
Aubree Chismark, RDH, MS
Sharon Compton, RDH, PhD
Amy E. Coplen, RDH, MS
Elizabeth T. Couch, RDH, MS
Jennifer Cullen, RDH, MS
Susan J. Daniel, RDH, MS, PhD
Melissa Efurd, RDH, MSDH, EdD
Kathy Eklund, RDH, MHP

Deborah E. Fleming, RDH, MS
Maria Perno Goldie, RDH, MS
Ellen B. Grimes, RDH, MA, MPA, EdD
Lesley Harbison, RDH, MS
Virginia Hardgraves, PhD, MSDH, RDH
Penny Hatzimanolakis, RDH, BDSc, MSc
Melanie J. Hayes, BOH, BHSc, PhD
Kathleen Hodges, RDH, MS
Alice M. Horowitz, RDH, PhD
Madison Howey, BSc(DH), MEd
Zul Kanji, EdD, RDH
Rachel Kearney, RDH, MS
Kimi Khabra, MSc(DH), BSc(DH), Dip(DH)
Janet Kinney, RDH, MS
Elizabeth C. Kornegay, CDA, RDH, MSDH
Emily Ludwig, RDH, MS
Deborah Lyle, RDH, BS, MS
Deborah S. Manne, RDH, RN, MSN, OCN
Hannah L. Maxey, RDH, MPH, PhD
Martha McComas, RDH, MS

Frances McConaughy, RDH, MS
Tanya Villalpando Mitchell, RDH, MS
Christine Nathe, RDH, MS
Jessica Parker, RDH, MS
Brian Partido, PhD, MSDH, RDH
Lori Rainchuso, RDH, DHSc
Lorraine Raukman, RDH, MS
Marilynn Rothen, RDH, MS
Lattice Sams, RDH, MS
Tammy R. Sanderson, RDH, MS
Deanne Shuman, BSDH, MS PhD
Melanie Simmer-Beck, RDH, PhD
Jessica Suedbeck, RDH, MS
Julie Sutton, RDH, MS
Darlene, Swigart, RDH, MS
Sheryl L. Ernest Syme, RDH, MS
Terri Tilliss, RDH, PhD
Lynn Tolle, BSDH, MS
Bethany Valachi, PT, MS, CEAS
Marsha A. Voelker, CDA, RDH, MS

Inside this Issue

Guest Editorial

- 4** **Mental Health Issues in Health Care Providers**
Danielle Rulli, RDH, MS, DHSc

Guest Commentary

- 6** **Worried Sick: Anxiety, depression, and the impact on dental health care workers**
Maria L. Geisinger, DDS, MS, Stacey L. Dershewitz, JD, PsyD

Research

- 9** **United States Dental Health Care Workers' Mental Health During the COVID-19 Pandemic**
Laura A. Eldridge, MS; Cameron G. Estrich, MPH, PhD; JoAnn R. Gurenlian, RDH, MS, PhD, AFAAOM; Ann Battrell, MSDH; Ann Lynch, BA; Marko Vujicic, PhD; Rachel Morrissey, MA; Stacey Dershewitz, JD, PsyD; Maria L. Geisinger, DDS, MS; Marcelo W.B. Araujo, DDS, MS, PhD
- 20** **COVID-19 Practices of Idaho Dental Hygienists**
Crystal L. Kanderis Lane, RDH, MS; JoAnn R. Gurenlian, RDH, MS, PhD, AFAAOM
- 28** **Examining the Influence of Academic Degree Level on Health Care Providers' Perception of Interprofessional Collaboration: A pilot study**
Megan R. Bilbee, RDH, MS; Danielle Rulli, RDH, MS, DHSc; Stefanie M. VanDuine, RDH, MS; Elizabeth K. Kuzma, DNP, FNP-BC; Jennifer L. Cullen, RDH, BSDH, MPH
- 37** **Prenatal and Pediatric Oral Health Education Among Dental Hygiene Programs in the United States**
Denise M. Claiborne, PhD, RDH; Shillpa Naavaal, BDS, MS, MPH

Innovations in Dental Hygiene Education

- 46** **Brief Motivational Interviewing: Evaluation of a skills-based education program**
Michelle C. Arnett, MS, RDH; Michael D. Evans, MS; Cynthia L. Stull, DHSc, MDH, RDH
- 57** **Implementing Environmental Sustainability Educational Intervention in Dental Hygiene Instruction**
Wai-Sum Leung, MS, RDH; Laura Dubbs, PhD; Tiffanie White, MEd, CDA, RDH; Elizabeth C. Kornegay, MS, RDH

Guest Editorial

Mental Health Issues in Health Care Providers



Danielle Rulli,
RDH, MS, DHSc

Mental health and burnout have been a growing concern for health care clinicians for decades, yet it has only been recently that actionable steps have been taken to address the omnipresent elephant in the room. In 2017, the National Academy of Medicine (NAM) created the Clinician Well-being Collaborative as response to epidemic levels of mental health issues including burnout, depression and suicide being experienced by clinicians across all health care disciplines.¹⁻² In 2014 it was suggested that the much-celebrated Triple Aim of health care could not be successful without a fourth aim that included improving the work life of clinicians and staff.³ Why, after so many decades is it still somewhat of a novel concept that those providing care need care and support for their own wellness? More importantly, why is there so little in the literature regarding wellness and burnout among oral health providers?

Perhaps more important than the lack of research on the mental health and well-being of oral health providers, is the lack of attention given to the mental health and well-being of women in the oral health care professions, particularly in dental hygiene. While the number of men in dental hygiene has been slowly increasing, the vast majority of clinicians and educators are women. Without fail, the literature in other health disciplines points to women suffering more from burnout and depression regardless of their professional role. Health care providers and educators who are women with children are more likely to suffer burnout and depression, yet we as a profession have not adequately addressed this issue. It is not just a problem for dental hygiene in the United States. Our dental hygiene colleagues in Canada have brought the subject into the open and have already begun addressing these concerns head on. It's time we do the same.

I am not implying that there is no joy or resilience in dental hygiene. On the contrary, there is much to be celebrated in our profession! In what other health profession do most patients leave with smiles on their faces, looking forward to their next appointment? Generally, we receive personal fulfillment from delivering personalized patient care, a reason many of us chose this profession. However, no one knows better than we do how physically and mentally demanding the profession actually is. We must present ourselves as sunny, smiling providers of oral health care to anywhere from eight to sixteen patients a day. And for many of us, we are expected to do so while being hungry and desperately needing to use the restroom. Some of us keep on smiling, while suffering with musculoskeletal pain. We hear distressing information from our patients or need to have difficult conversations with them. Some of us experience pressures about production. Many dental hygienists are the main breadwinners for their family. Missing work due to illness or childcare can put an enormous amount of mental and financial stress on clinicians. We may also receive unwanted attention from our patients or even our employers. The accumulation of these stressors can take a significant, but silent toll on our mental health and wellbeing.

If there is anything positive to be said about the COVID-19 pandemic, it is that the mental health crisis in dentistry and dental hygiene was brought fully into focus. We could no longer remain unaware of the problem, and it swiftly gained significant attention. Gurenlian et al., found that COVID-19 has led to an 8% decrease in dental hygiene employment, with childcare issues noted as one of the drivers for leaving the workforce.⁴ Again, as a predominately female profession, this should not have been a surprise, yet it underscores how

the pandemic exacerbated the already existing contributors to poor mental health and burnout. Personal safety was also a concern. What if we brought the virus home to our loved ones? What if we got sick? What about the physical and mental tolls the increased levels of PPE had on providers? Headaches and exhaustion were common daily side effects and being physically unwell began to impact mental wellbeing.

Dental hygiene educators were particularly impacted by the pandemic with high levels of burnout.⁵ Ever-changing protocols, challenges in sourcing PPE, supporting student learning when patient care was shut down, all while juggling their own families and responsibilities, took a significant toll on the mental health of our educators. Both faculty and students mourned the loss of community that we all know is an integral part of dental hygiene education. Our educators were thrust into unknown roles they were not prepared to take on as the pandemic took a toll on the mental health and wellbeing of their students. Students in turn, did not have access to internet or computers, had family illnesses and deaths, and encountered food and housing insecurities. During the days of isolation, the faculty were their support lifeline. But, who supported the faculty's mental health and wellbeing?

Healthy work environments do not happen by chance. We can no longer be complacent about mental health, anxiety and burnout in the dental hygiene profession. The COVID-19 pandemic has given momentum to dismantling the stigmas and taboos surrounding the mental health status of all health care providers. It is time to seize the opportunity and join with our dental colleagues and the other health professions to address mental health and wellbeing head-on. Our professional colleagues, our students, and our patients are counting on us.

Danielle Rulli, RDH, MS, DHSc is a member of the *Journal of Dental Hygiene* Editorial Advisory Board and a clinical associate professor and Director, Graduate Dental

Hygiene Program, Department of Periodontics and Oral Medicine, University of Michigan School of Dentistry, Ann Arbor, MI, USA. Dr. Rulli continues to practice dental hygiene as a member of the Department of Periodontics and Oral Medicine's faculty practice and has published on burnout in dental hygiene education.

References

1. Dzau VJ, Kirch DG, Nasca TJ. To care is human—collectively confronting the clinician-burnout crisis. *N Engl J Med*. 2018 Jan 25; 378(4):312-14.
2. Melnyk BM, Kelly SA, Stephens J, et al. Interventions to improve mental health, well-being, physical health, and lifestyle behaviors in physicians and nurses: a systematic review. *Am J Health Promot*. 2020 Nov; 34(8):929-41.
3. Bodenheimer T, Sinsky C. From triple to quadruple aim: care of the patient requires care of the provider. *Ann Fam Med*. Nov-Dec 2014; 12(6): 573-6.
4. Gurenlian JR, Morrissey R, Estrich CG, et al. Employment patterns of dental hygienists in the United States during the COVID-19 pandemic. *J Dent Hyg*. 2021 Feb;(95(1):17-24.
5. Arnett MC, Ramaswamy V, Evans MD, Rulli D. Impact of Covid-19 on dental hygiene educators: a national survey. *J Dent Educ*. 2022 Jan 14; 1-11.

Guest Commentary

Worried Sick: Anxiety, depression, and the impact on dental health care workers

Maria L. Geisinger, DDS, MS; Stacey L. Dershewitz, JD, PsyD

“Given the severe impacts of mental health disorders on dental health care workers and the potential for related maladaptive behaviors, dental health care workers must evaluate the impact of such disorders on the dental community and patients.”

Dental health care workers (DHCWs) encounter myriad stressors in their day-to-day work including financial pressures, tightly booked schedules, paperwork demands, practice management issues, reimbursement concerns, uncooperative patients, and physical demands inherent to oral health care delivery.^{1,2} These pressures are often accompanied by personal characteristics, such as perfectionism and prioritization of others’ needs, leaving DHCWs vulnerable to distress, mental health disorders, and burnout.³ This stress endemic,^{4,5} owing to prolonged exposure to internal and external stressors, can take a heavy physical and emotional toll on DHCWs.

Studies suggest that the COVID-19 pandemic has exacerbated mental health disorders.⁶⁻⁸ Given the severe impacts of mental health disorders on DHCWs and the potential for related maladaptive behaviors, DHCWs must evaluate the impact of such disorders on the dental community and patients, explore methods to improve recognition of mental health disorders, and implement protocols for enhanced communication, prevention, screening, and referral.

Understanding Mental Health

Stress is the reaction of the brain and body to a demand. Stress can push us to learn and grow personally or professionally or become the impetus for making beneficial changes in our lives.⁹ But there are negative impacts to prolonged or unusually intense stress. Distress is characterized by low mood, difficulty relaxing, and subjective feelings of being tense. If left untreated, distress can progress and impair physical well-being and personal and professional functioning.^{2,9} Both distress and depression have been associated with decreased function of the limbic system and prefrontal cortex as well as systemic vascular inflammation and elevated serum cytokine levels.^{10,11} Furthermore, anxiety and depression often overlap; 20% through 70% of patients with depression also meet the lifetime criteria for an anxiety disorder, and anxiety disorders

have been implicated in the underlying etiology of depression in many cases.^{12,13} The interaction of stress and anxiety suggests a bidirectional relationship; psychological stress can lead to depression in susceptible people, and depression may exacerbate anxiety disorders and stress.

Signs and symptoms of depression and anxiety include the following:¹⁴

- Excessive worry
- Distress or impairment in social, occupational, or other important areas of functioning
- Feeling restless
- Fatigue or sleep disturbances
- Difficulty concentrating
- Significant changes to mood (irritability, decreased enjoyment)
- Somatic pain
- Suicidal thoughts or thoughts about death and injury

Recognition of Mental Health Disorders in the Dental Office

Given the prevalence and potential impact of anxiety and depression, increasing awareness of the signs of these mental health disorders among DHCWs is imperative. Readily available tools that can allow DHCWs to screen people for anxiety and depression can be used easily, and in-office screening may be beneficial for both patients and providers, particularly in light of reports that oral health is affected adversely in people with mental illness.^{9,15-17} It is also critically important that DHCWs look inward and identify potential signs and symptoms of mental health disorders within the profession, promote healthy work environments, and reduce the impact of stress on the profession.

Anxiety and depression symptoms have differed between dentists and dental hygienists throughout the pandemic, independent of other factors, including sex, type of practice, time in practice, and geographic area. Differences may be related to diverse information sources and messaging targeted at these

different groups, particularly on social media, which underscores the need for open communication among the dental team and cohesive and effective messaging for DHCWs.¹⁸

Impact of Stress on Personal and Professional Functioning: The Stress-Distress-Burnout Continuum

DHCWs experience common societal stressors and occupation-specific stressors, both of which have been compounded by the ongoing pandemic. Chronic unresolved stress in DHCWs can erode well-being and lead to feelings of distress, leading to long-term stress and burnout. A significant number of dental hygienists reported that COVID-19 was an impetus for permanently exiting the profession,¹⁹ which may be related to distress.

If left untreated, distress can progress and impair personal and professional functioning. Physical and emotional health may suffer, including negative impact on immune, cardiovascular, digestive, attentional, and reproductive systems. Mood disorders, such as anxiety and depressive disorders, may develop and DHCWs may experience difficulties in relationships and interpersonal functioning.^{5,9} Furthermore, DHCWs under distress may show impaired professional functioning.^{5,19-22} Professional burnout may develop, characterized by physical or emotional exhaustion, negative or indifferent attitudes, and feelings of personal and professional dissatisfaction.¹⁹⁻²²

Call to Action

As members of the dental profession, we are committed to improving the oral and overall health of our patients and communities. As such, improved awareness regarding the prevalence of mental health disorders, the risk factors for such disorders, and their potential oral manifestations is critical to our mission. Furthermore, as health care professionals, it is also important that we acknowledge that our mental health affects our ability to care for others optimally. Thus, creating professional environments that allow for open communication about mental health among members of the dental team can reduce the stigma around mental health diagnoses and treatment for DHCWs. Experiencing stress, anxiety, and depression as a DHCW can be an isolating experience, and we cannot dismiss those who exhibit severe signs of anxiety and depression as outliers. However, it is apparent that suboptimal mental health is common among DHCWs and can be affected by external forces, such as the COVID-19 pandemic. Adoption of the following concrete steps is suggested to improve identification and prevention of mental health disorders for DHCWs and reduce stigmas associated with seeking mental health care: 1) beginning in training programs, instruction to recognize the signs and symptoms of stress, distress, and burnout; 2) greater focus on

developing and monitoring self-care plans for DHCWs; 3) ongoing continuing education offerings focused on DHCW self-care; 4) peer support programs to discuss self-care and mental health care; 5) easily accessible information through local, state, and national dental organizations to connect with mental health care providers; 6) systematic efforts to elucidate treatment barriers among DHCWs.

Conclusions

The COVID-19 pandemic has highlighted the importance of both physical and mental well-being of health care providers and the workplace stressors that seriously can affect mental health among DHCWs. The current environment should serve as a call to action to improve support for mental health among all members of the dental team.

Disclosures

Drs. Geisinger and Dershewitz have no conflicts of interest to report. Commentaries represent the opinions of the authors and not necessarily those of the American Dental Association.

The article was reprinted with permission from *The Journal of the American Dental Association (JADA)* and published in *The Journal of the American Dental Association (JADA)* Vol 153, Issue 8, Maria L. Geisinger, DDS, MS; Stacey L. Dershewitz, JD, PsyD, Worried sick: Anxiety, depression, and the impact on dental health care workers, pp 734-736, ©2022 American Dental Association (ADA). Reprinted with permission from the ADA. All rights reserved.

Maria L. Geisinger, DDS, MS is a professor and the Director of Advanced Education in Periodontology, Department of Periodontology, School of Dentistry, University of Alabama at Birmingham, Birmingham, AL, USA.

Stacey L. Dershewitz, JD, PsyD is a clinical assistant professor, Department of Professional Psychology and the Associate Director, Center Clinic, George Washington University, Washington, DC, USA.

Corresponding author: Maria L. Geisinger, DDS, MS; miagdds@uab.edu

References

1. Basudan S, Binanzan N, Alhassan A. Depression, anxiety and stress in dental students. *Int J Med Educ.* 2017 May;8:179-86.
2. Rada RE, Johnson-Leong C. Stress, burnout, anxiety, and depression among dentists. *J Am Dent Assoc.* 2004 Jun;135(6):788-94.
3. Westerman GH, Grandy TG, Erskine CG. Personality types of dentists. *Am J Dent.* 1991 Dec;4(6):298-302.

4. Lee CY, Wu JH, Du JK. Work stress and occupational burnout among dental staff in a medical center. *J Dent Sci*. 2019 Sep;14(3):295–301.
5. Miron C, Colosi HA. Work stress, health behaviours and coping strategies of dentists from Cluj-Napoca, Romania. *Int Dent J*. 2018 Jun;68(3):152–161.
6. Cullen W, Gulati G, Kelly BD. Mental health in the COVID-19 pandemic. *QJM*. 2020 May;113(5):311-12.
7. Taylor S. *The psychology of pandemics: preparing for the next global outbreak of infectious disease*. Newcastle: Cambridge Scholars Publishing; 2019. 179p.
8. Wang C, Pan R, Wan X, et al. Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *Int J Environ Res Public Health*. 2020 mar 6;17(5):1729.
9. Lingawi HS, Afifi IK. COVID-19 associated stress among dental students. *Open Dent J*. 2020 Nov;14:554-62.
10. Lu XT, Zhao YX, Zhang Y, Jiang F. Psychological stress, vascular inflammation and atherogenesis: potential roles of circulating cytokines. *J Cardiovasc Pharmacol*. 2013 Jul;62(1):6-12.
11. Krishnan V, Nestler EJ. The molecular neurobiology of depression. *Nature*. 2008 Oct;455(7215):894-902.
12. Kessler RC, Sampson NA, Berglund P, et al. Anxious and non-anxious major depressive disorder in the World Health Organization World Mental Health Surveys. *Epidemiol Psychiatr Sci*. 2015 Jun;24(3):210-6.
13. Kalin NH. The critical relationship between anxiety and depression. *Am J Psych*. 2020 May;177(5):365-7.
14. Delgado-Angulo EK, Sabbah W, Suominen AL, et al. The association of depression and anxiety with dental caries and periodontal disease among Finnish adults. *Community Dent Oral Epidemiol*. 2015 Dec;43(6):540-9.
15. Kisley S, Sawyer E, Siskind D, Lalloo R. The oral health of people with anxiety and depressive disorders: a systematic review and meta-analysis. *J Affect Disord*. 2016 Aug;220:119-32.
16. Warren KR, Postolache TT, Groer ME, et al. Role of chronic stress and depression in periodontal diseases. *Periodontol 2000*. 2014 Feb;64(1):127–38.
17. Vahratian A, Blumberg SJ, Terlizzi EP, Schiller JS. Symptoms of anxiety or depressive disorder and use of mental health care among adults during the COVID-19 pandemic: United States, August 2020-February 2021. *MMWR Morb Mortal Wkly Rep*. 2021 Apr;70:490-4.
18. Al-Amad SH, Hussein A. Anxiety among dental professionals and its association with their dependency on social media for health information: insights from the COVID-19 pandemic. *BMC Psychol*. 2021Jan;9(1):9.
19. Gurenlian JR, Morrissey R, Estrich CG, et al. Employment patterns of dental hygienists in United States during the COVID-19 pandemic. *J Dent Hyg*. 2021Feb;95(1):17–24.
20. Ahola K, Hakanen J. Job strain, burnout, and depressive symptoms: a prospective study among dentists. *J Affect Disord*. 2007 Dec;104(1-3):103–10.
21. Yansane A, Tokede O, Walji MF, et al. Burnout, engagement, and dental errors among US dentists. *J Patient Saf*. 2021 Sep;17(8):e1050–e1056.
22. Kulkarni S, Dagli N, Duraiswamy P, et al. Stress and professional burnout among newly graduated dentists. *J Int Soc Prev Community Dent*. 2016 Nov;6(6):535–41.

Research

United States Dental Health Care Workers' Mental Health During the COVID-19 Pandemic

Laura A. Eldridge, MS; Cameron G. Estrich, MPH, PhD; JoAnn R. Gurenlian, RDH, MS, PhD, AFAAOM; Ann Battrell, MSDH; Ann Lynch, BA; Marko Vujicic, PhD; Rachel Morrissey, MA; Stacey Dershewitz, JD, PsyD; Maria L. Geisinger, DDS, MS; Marcelo W.B. Araujo, DDS, MS, PhD

Abstract

Background: This study was designed to assess the prevalence of anxiety and depression symptoms and understand factors influencing mental health among dental health care workers (DHCWs) during the COVID-19 pandemic.

Methods: Beginning in June 2020, 8,902 DHCWs participated monthly in an anonymous longitudinal, web-based survey (response rate, 6.7%). The Patient Health Questionnaire-4 was used to estimate rates of anxiety and depression symptoms. Changes in mental health over time and differences by demographic and practice characteristics, COVID-19 community transmission level, and COVID-19 vaccination status were tested using χ^2 tests and multilevel multivariable logistic regression.

Results: Anxiety symptom rates peaked in November 2020 (28% of dental hygienists, 17% of dentists) and declined to 12% for both professions in May 2021. Depression symptom rates were highest in December 2020 (17% of dental hygienists, 10% of dentists) and declined to 8% in May 2021. Controlling for gender, age, race or ethnicity, and COVID-19 community transmission level, the authors found that dentists had significantly lower odds of anxiety symptoms (adjusted odds ratio [aOR], 0.82; 95% CI, 0.70 to 0.95) and depression symptoms (aOR, 0.79; 95% CI, 0.67 to 0.93) than dental hygienists. Compared with vaccinated respondents, those who were unvaccinated but planning on getting vaccinated had significantly higher rates of anxiety (aOR, 1.57; 95% CI, 1.08 to 2.30) and depression (aOR, 1.57; 95% CI, 1.07 to 2.29) symptoms.

Conclusions: DHCWs' mental health fluctuated during the pandemic. Anxiety and depression in DHCWs were associated with demographic and professional characteristics as well as perceived risk of COVID-19.

Practical Implications: Mental health support should be made available for DHCWs.

This clinical trial was registered at ClinicalTrials.gov. The registration numbers are NCT04423770 and NCT04542915.

Introduction

On March 11, 2020, the World Health Organization declared a pandemic of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the causative virus for COVID-19.¹ Health care delivery of all types was disrupted during this pandemic, and it was hypothesized that dental health care workers (DHCWs) were at particularly high risk of contracting COVID-19, because SARS-CoV-2 is transmitted primarily via close person-to-person airborne transmission. In addition to working directly with patients, DHCWs also are exposed to aerosolized oral fluids, including blood and saliva, which also can contain SARS-CoV-2.^{2,3} In response to this perceived risk, on March 16, 2020, the American Dental Association (ADA) and the American Dental Hygienists' Association (ADHA) recommended that

DHCWs in the United States (US) should postpone elective dental procedures and focus on urgent and emergent oral health care.⁴ Shortly thereafter, a national poll of dental practices found that 19% of private practices were closed to all patients and 76% were open only to emergency patients.⁵ Dental practices in the US began reopening in May 2020. Thus, from June 2020 through June 2021, more than 90% of practices were back to providing elective care, and at least 33% were open at normal business levels.⁵

Concern and uncertainty during the COVID-19 pandemic have led to increased mental health concerns worldwide. In June 2020, it was reported that 25.5% of US adults experienced symptoms consistent with an anxiety disorder and 24.3% with a depressive disorder.⁶ These rates

increased over time, with 41.5% of adults reporting symptoms of anxiety or depression in February 2021.⁷ Compared with the general public, health care workers may be at increased risk of COVID-19 exposure and may witness more instances of COVID-19 morbidity and mortality; previous research has reported heightened rates of mental health problems among health care workers during the COVID-19 pandemic.^{8,9} Dental health care workers work in close proximity with patients who cannot, by nature of the care provided, wear face coverings or other personal protective equipment (PPE). These work-related activities may present a heightened sense of exposure and infection risk. Furthermore, the uncertainty that DHCWs experienced during a period of rapidly changing practice situations with shifting infection prevention and control policies may have affected their mental health. At least 80% of dentists surveyed outside the US felt anxious owing to concerns about COVID-19 infection, with additional concerns about their professional futures.^{10,11} Meanwhile, research including dentists in the United Kingdom (UK) found that 71% had anxiety-related symptoms and 60% had depression-related symptoms.¹² A multinational survey identified 49.1% of dental auxiliary staff members compared with 29.3% of dentists had symptoms of at least moderate anxiety.¹³ In Germany, 25.2% of dental nurses and 18.2% of dentists had symptoms of at least moderate anxiety, and 31.1% of dental nurses and 28.9% of dentists had symptoms of at least moderate depression.^{14,15}

There is a gap in the existing literature on prevalence of anxiety and depression symptoms in DHCWs in the US prior to the COVID-19 pandemic, preventing the comparison of mental health status both before and during the pandemic. The purpose of this study was to assess the prevalence of anxiety and depression symptoms and understand factors influencing mental health among DHCWs in the US during the COVID-19 pandemic. Of particular interest was determining whether mental health changed over the course of the pandemic, and if so, at which times. Furthermore, this investigation also tested the associations of demographic or professional characteristics, level of COVID-19 community transmission, and COVID-19 vaccination status with the mental health of DHCWs.

Methods

This clinical trial was registered at ClinicalTrials.gov; registration numbers NCT04423770 and NCT04542915. An anonymous web-based survey (Qualtrics XM Platform; Qualtrics, Provo, UT, USA) was administered monthly to a cohort of dentists beginning June 8, 2020, and a cohort of dental hygienists beginning September 29, 2020. Dentists were eligible

to participate if they held a license to practice dentistry in the United States, were at least 18 years old, were in private practice or public health, and indicated a willingness to participate in the previous ADA-generated survey⁵ related to COVID-19. Dental hygienists were eligible to participate if they were licensed as a dental hygienist in the US, were at least 18 years old, and were employed as a dental hygienist as of March 1, 2020. The research protocols and surveys were approved by the ADA Institutional Review Board. Potential respondents read and signed an electronic informed consent before responding to the survey. Further details of the study population and questionnaires are described in previous articles.^{16,17}

The survey included questions about respondents' gender, race or ethnicity, age, geographic location, dental practice type, dental practice setting, infection prevention and control practices while practicing dentistry, COVID-19 vaccination statuses, and COVID-19 tests or diagnoses. Dental hygienists were not surveyed about the specifics of the dental specialty in which they were employed, so comparisons were limited to general dentistry compared with those working in any dental specialty practice. The survey included the validated Patient Health Questionnaire-4¹⁸ (PHQ-4) to screen respondents for symptoms of depression (using Patient Health Questionnaire-2¹⁹) or anxiety symptoms (using Generalized Anxiety Disorder-2¹⁹). Scores of 3 or greater on the Patient Health Questionnaire-2 indicate depressive disorder symptoms and have 83% sensitivity and 92% specificity for major depression.²⁰ Scores of 3 or greater on Generalized Anxiety Disorder-2 indicate anxiety disorder symptoms, with 86% sensitivity and 83% specificity for generalized anxiety disorder and greater than 50% sensitivity and specificity for panic disorder, social anxiety disorder, posttraumatic stress disorder, or any anxiety disorder.²¹ In both cases, higher scores are indications for further mental health evaluation rather than a definitive diagnosis.¹⁹ To test whether COVID-19 risk was positively correlated with mental health concerns, the COVID-19 case rate per 100,000 people in each US state and territory was obtained from the Centers for Disease Control and Prevention (CDC) for the 7 days before each survey and categorized the level of community transmission using the CDC's criteria: low to moderate (<50 cases per 100,000), substantial (50-99.99 cases per 100,000), and high (≥ 100 cases per 100,000) levels of community transmission.²² Initial analysis indicated no statistically significant difference in rates of anxiety or depression symptoms between low to moderate or substantial levels of community transmission, therefore these categories were combined into a single category before defining a regression model. Furthermore, the rates of anxiety and depression symptoms in DHCWs who reported at least one dose of COVID-19 vaccine were contrasted with the rates

in unvaccinated DHCWs. Vaccination status was added to the survey as of February 1, 2021, however it was modeled separately to avoid constricting the periods of the other regression models.

Statistical software (SAS, Version 9.4; SAS Institute, Cary, NC, USA) was used for the statistical analysis. Statistical significance was set at alpha of .05 and χ^2 tests were used to test associations between respondent characteristics and anxiety or depression symptoms. To achieve sufficient power to estimate the effect of time on mental health, consecutive months were grouped with similar rates of depression and anxiety symptoms, creating 4 periods of 3 months each. Multivariable multilevel logistic regression models were used to estimate odds of mental health symptoms, with survey results nested within each respondent to account for the same respondents answering surveys over time. To evaluate whether mental health significantly differed by dental profession type, models were restricted to the ages (≥ 26 years) and months (September 2020-May 2021) for which data were available from both dentists and dental hygienists. No interaction term between independent variables was significant in regression models. Multivariable regression models using purposeful model selection were used. Respondents were allowed to skip questions; over the year of this study, 4.4% (n=1,465) of the observations lacked data on the PHQ-4. There was no pattern in missing PHQ-4 data (all regression models, $p > .05$), indicating the data were missing at random. Under that assumption, available case analysis was used.

Results

The survey response rate was 6.7%. Survey respondents' mean (standard deviation) age was 47.2 (12.8) years. Dental hygienists' ages ranged from 18 through 77 years, and dentist respondent ages ranged from 26 through 84 years. The sample was 15.6% (n=1,386) male and 76.2% (n=6,781) female (Table I). By profession, 59.9% (n=1,316) of the dentists were men and 38.9% (n=854) were women, and 1.0% (n=70) of the dental hygienists were men and 88.4% (n=5,927) were women. Most of the sample was non-Hispanic White (70.2%, n=6,249), with 4.1% (n=366) describing themselves as non-Hispanic Asian, 4.8% (n=428) as Hispanic, 1.7% (n=147) as non-Hispanic Black, and 4.8% (n=427) as another race or ethnicity. Most respondents worked in general dentistry (57.2%,

n=5,095), however all dental specialties were represented in the sample. Most respondents worked in a private practice dental setting (71.0%, n=6,318), while the remainder worked in a public health dental setting. The 8,902 respondents could be surveyed up to 12 times, for a total of 33,197 observations.

Overall, rates of anxiety and depression symptoms varied over time and were higher for anxiety than depression (Figure 1). Rates of anxiety symptoms were highest in November and December 2020. Rates declined over the study period for both professional types,

Table I. Sample demographics (n= 8,902)

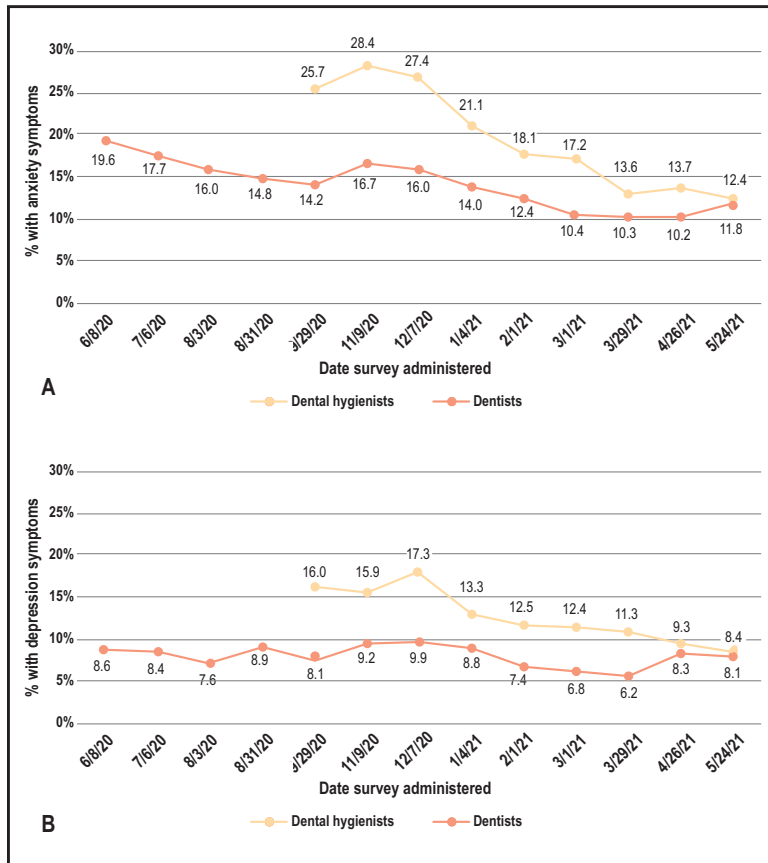
Characteristic	Dentists* n(%)	Dental hygienists** n(%)
Gender		
Male	1,316 (59.9)	70 (1.0)
Female	854 (38.9)	5,927 (88.4)
Other	14 (0.6)	47 (0.7)
Missing data	12 (0.6)	662 (9.9)
Age Group, Y		
18-25	0 (0.0)	194 (2.9)
26-39	305 (13.9)	2,138 (31.9)
40-65	1,454 (66.2)	3,421 (51.0)
≥ 66	272 (12.4)	186 (2.8)
Missing data	165 (7.5)	767 (11.4)
Race or Ethnicity		
Non-Hispanic White	1,752 (79.7)	4,497 (67.1)
Non-Hispanic Asian	163 (7.4)	203 (3.0)
Hispanic	105 (4.8)	323 (4.8)
Non-Hispanic Black	24 (1.1)	123 (1.8)
Other	126 (5.7)	301 (4.5)
Missing data	26 (1.3)	1,259 (18.8)
Primary Practice Type		
General dentistry***	1,819 (82.8)	3,276 (48.9)
Specialty	351 (16.0)	943 (14.1)
Missing data	26 (1.3)	2,487 (37.1)
Primary Practice Setting		
Private***	2,099 (95.5)	4,219 (62.9)
Public	80 (3.6)	213 (3.2)
Missing data	17 (0.8)	2,274 (33.9)
COVID-19 Vaccination Status		
Fully vaccinated***	1,402 (63.8)	2,015 (30.1)
1 vaccine dose	56 (2.6)	199 (3.0)
Not vaccinated	103 (4.7)	664 (9.9)
Missing data	635 (28.9)	3,828 (57.1)

* n = 2,196; 24.7% of total responses

** n = 6,706; 75.3% of total responses

*** Percentages do not add up to 100 due to rounding

Figure 1. Anxiety (A) and depression (B) symptoms by dental profession from June 8, 2020, through May 24, 2021 (n = 8,902; dentists = 2,196; dental hygienists = 6,706).



with a rebound increase in anxiety symptom rates observed for dentists in May 2021. At the end of the reporting period, rates were similar for dentists (11.8%) and dental hygienists (12.4%) (Figure 1). As with anxiety symptoms, dental hygienists had higher rates of depression symptoms than dentists at each surveyed time point (Figure 1). Depression symptom rates were highest in December 2020. Dental hygienists' depression rates declined thereafter, whereas the rates for dentists remained relatively steady, resulting in relatively similar rates for both groups at the end of the study period (Figure 1). Over the course of the entire survey, 17.7% of DHCWs reported anxiety symptoms, 10.7% reported depression symptoms, and 8.3% reported symptoms of both.

Rates of anxiety symptoms differed significantly by gender, age group, race or ethnicity, primary practice type, and DHCW professional role (χ^2 P s < .05) (Table II). Most demographic and professional groups experienced heightened rates of anxiety symptoms from September through December 2020 (Table II). The highest rates of anxiety and depression symptoms in non-Hispanic Black DHCWs occurred from March through May 2021 (Table II). Similarly, although all other age groups experienced the highest rates of depression symptoms from September through December 2020, DHCWs aged 18 through 25 years also reported a high rate of depression symptoms from March

through May 2021 (Table II). There were also significant differences in depression symptom rates by gender, age group, and professional role (Table II).

Even when controlling for gender, age group, race or ethnicity, period, and COVID-19 community transmission level, dentists had statistically significantly lower odds of anxiety and depression symptoms than dental hygienists (Tables III and IV). There was evidence of multicollinearity between COVID-19 community transmission level and period (condition index of 21.1, much larger than the eigenvalue of 0.01), and were modeled separately (Tables III and IV). In multivariable models, dental practice type and practice setting were not associated statistically significantly with anxiety or depression symptoms and were excluded them from the final models (Tables III and IV). Compared with August through December 2020, DHCWs had significantly lower odds of anxiety and depression symptoms in all subsequent months (Tables III and IV). DHCWs living in states and during periods with high levels of COVID-19 community transmission had significantly higher odds of anxiety (adjusted odds ratio [aOR], 1.37; 95% CI, 1.21 to 1.55) and depression (aOR, 1.25; 95% CI, 1.09 to 1.44) symptoms than those living with lower transmission.

From January through March 2021, DHCWs who were unvaccinated but intended to be vaccinated experienced significantly higher rates of anxiety (20.6%) and depression (14.0%) symptoms than DHCWs who were partially vaccinated (14.9% anxiety, 9.2% depression) or fully vaccinated (14.1% anxiety, 9.2% depression) or those who did not intend to be vaccinated (12.6% anxiety, 11.3% depression) (p < .05). Controlling for gender, age group, primary practice type, primary practice setting, professional role, and either period or COVID-19 community transmission level, DHCWs who were planning to be vaccinated but were not yet vaccinated had significantly increased odds of anxiety symptoms (aOR including period, 1.73 [95% CI, 1.22 to 2.46]; a OR including COVID-19 transmission level, 1.71 [95% CI, 1.20 to 2.44]) than DHCWs who had received at least 1 dose of COVID-19 vaccine. Similarly, controlling for gender, age group, primary practice type, primary practice setting, professional role, and either period or COVID-19 community transmission level, those who were planning to be vaccinated but were not yet vaccinated had significantly increased odds of depression symptoms (aOR including period, 1.57 [95% CI, 1.08 to 2.30]; aOR including COVID-19

Table II. Proportion of sample with anxiety and depression symptoms (n=8,902)

Characteristic	Anxiety symptoms per survey period (%)				χ^2 p-value for anxiety symptoms	Depression symptoms per survey period (%)				χ^2 p-value for depression symptoms
	6/8/20-8/31/20	9/29/20-12/7/20	1/4/21-3/1/21	3/28/21-5/24/21		6/8/20-8/31/20	9/29/20-12/7/20	1/4/21-3/1/21	3/28/21-5/24/21	
Gender										
Male	13.4	12.4	10.6	8.8	< .0001	6.9	7.5	6.3	6.8	< .0001
Female	23.8	25.7	18.2	13.5		10.9	15.4	12.1	9.5	
Other	7.1	17.7	12.5	20.0		0.0	15.9	9.4	4.0	
Age Group, Y										
18-25	NA*	30.9	20.0	17.7	< .0001	NA	25.7	13.3	23.5	< .0001
26-39	24.6	28.5	21.8	15.6		11.7	17.7	14.9	10.8	
40-65	17.3	21.1	15.0	11.8		8.5	12.3	9.5	8.5	
≥66	10.3	11.5	9.7	7.4		5.3	6.6	6.5	6.0	
Race and Ethnicity										
Non-Hispanic White	17.1	22.3	15.4	12.3	< .0001	8.3	13.2	9.9	8.7	< .0001
Non-Hispanic Asian	14.0	18.6	10.9	8.5		7.3	11.8	8.0	6.4	
Hispanic	19.3	23.2	15.8	8.6		5.4	15.0	13.0	7.1	
Non-Hispanic Black	13.6	13.9	11.5	15.1		9.1	8.9	4.4	11.4	
Other	25.3	30.9	25.4	16.4		14.7	21.0	16.4	12.8	
Primary Practice Type										
General dentistry	17.2	21.2	15.2	11.3	< .0001	8.4	13.0	10.1	8.1	.27
Specialty	18.2	23.6	13.3	10.9		8.6	13.7	7.5	8.3	
Primary Practice Setting										
Private	17.0	21.7	15.0	11.3	.99	8.3	13.1	9.8	8.2	.62
Public	27.0	23.2	15.1	13.1		12.2	13.2	8.8	7.5	
Professional Role										
Dental hygienist	NA	26.5	19.0	13.2	< .0001	NA	16.1	12.8	9.8	< .0001
Dentist	17.4	15.7	12.4	10.8		8.5	9.1	7.7	7.5	
COVID-19 Vaccination Status										
Fully vaccinated	NR**	NR	14.1	14.2	< .0001	NR	NR	9.2	10.1	.047
1 dose	NR	NR	14.9	16.8		NR	NR	9.2	9.1	
Planning to be vaccinated	NR	NR	20.6	14.0		NR	NR	14.0	8.9	
Unvaccinated	NR	NR	12.6	9.9		NR	NR	11.3	6.5	

*NA: not applicable **NR: not recorded

Table III. Odds of anxiety symptoms in dental health care workers, September 28, 2020 - June 2, 2021 (n = 7,534)*

Characteristic	OR† (95% CI)	p-value	OR (95% CI) Adjusting for demographics, professional role, and survey period	p-value	OR (95% CI) Adjusting for demographics, professional role, and COVID-19 transmission level	p-value
Gender						
Male	[Reference]	< .0001	[Reference]	< .0001	[Reference]	< .0001
Female	2.32 (2.06 to 2.60)	< .0001	1.75 (1.48 to 2.06)	< .0001	1.74 (1.48 to 2.05)	< .0001
Age Group, Y						
26-39	1.92 (1.65 to 2.23)	< .0001	1.33 (1.14 to 1.55)	< .0001	1.36 (1.17 to 1.58)	< .0001
40-65	[Reference]	< .0001	[Reference]	< .0001	[Reference]	< .0001
≥ 66	0.48 (0.35 to 0.66)	< .0001	0.73 (0.58 to 0.94)	.01	0.74 (0.58 to 0.94)	.01
Race and Ethnicity						
Non-Hispanic White	[Reference]	.0001	[Reference]	< .0001	[Reference]	< .0001
Non-Hispanic Asian	0.65 (0.46 to 0.92)	.02	0.76 (0.57 to 1.01)	.06	0.79 (0.60 to 1.05)	.11
Hispanic	1.10 (0.80 to 1.52)	.58	1.03 (0.77 to 1.37)	.85	1.04 (0.78 to 1.37)	.84
Non-Hispanic Black	0.65 (0.34 to 1.27)	.21	0.29 (0.14 to 0.62)	< .0001	0.29 (0.14 to 0.62)	< .0001
Other	1.79 (1.32 to 2.42)	< .0001	1.94 (1.50 to 2.51)	< .0001	1.95 (1.51 to 2.52)	< .0001
Primary Practice Type						
General dentistry	[Reference]	< .0001	[Reference]	NA**	[Reference]	NA
Specialty	1.37 (1.17 to 1.60)	< .0001	**		-	
Primary Practice Setting						
Private	[Reference]	.45	-	NA	-	NA
Public	0.79 (0.42 to 1.47)	.45	-		-	
Professional Role						
Dental hygienist	[Reference]	< .0001	[Reference]	< .0001	[Reference]	< .0001
Dentist	0.51 (0.46 to 0.56)	< .0001	0.80 (0.68 to 0.93)	< .0001	0.82 (0.70 to 0.95)	< .0001
Period						
8/28/20-12/7/20	[Reference]	< .0001	[Reference]	< .0001	-	
1/4/21-3/1/21	0.56 (0.50 to 0.62)	< .0001	0.65 (0.57 to 0.71)	< .0001	-	NA
3/28/21-5/24/21	0.37 (0.32 to 0.42)	< .0001	0.49 (0.42 to 0.57)	< .0001	-	
COVID-19 Transmission Level						
Low to substantial	[Reference]	< .0001	-	NA	[Reference]	< .0001
High	1.44 (1.27 to 1.63)	< .0001	-		1.37 (1.21 to 1.55)	< .0001

* Dentists = 1,824; Dental hygienists = 5,710 ** No OR for this model in this category *** NA: not applicable

transmission level, 1.57 [95% CI, 1.07 to 2.29]) than fully or partially vaccinated DHCWs.

Discussion

Despite expectations that DHCWs would experience heightened mental health problems owing to COVID-19 occupational infection concerns, in this investigation, at every time point their rates of anxiety and depression symptoms

were lower than in the reported rates in the overall US adult population.^{7,23,24} As in the general population of US adults, rates of mental health concerns increased in fall and early winter 2020⁷ and then improved in spring 2021.²⁴

Similar to previous reports both before and during the COVID-19 pandemic,^{7,23} rates of anxiety and depression symptoms were lowest in the oldest age groups. As has also been commonly found in other studies,^{7,23,25} women

Table IV. Odds of depression symptoms in dental health care workers, September 28, 2020 - June 2, 2021 (n= 7,534)*

Characteristic	OR (95% CI)	p-value	OR (95% CI) Adjusting for demographics, professional role, and survey period	p-value	OR (95% CI) Adjusting for demographics, professional role, and COVID-19 transmission level	p-value
Gender						
Male	[Reference]	< .0001	[Reference]	< .0001	[Reference]	< .0001
Female	2.67 (2.21 to 3.24)	< .0001	1.55 (1.30 to 1.84)	< .0001	1.56 (1.30 to 1.85)	< .0001
Age Group, Y						
26-39	1.92 (1.61 to 2.28)	< .0001	1.25 (1.07 to 1.47)	.01	1.27 (1.09 to 1.49)	< .0001
40-65	[Reference]	< .0001	[Reference]	< .0001	[Reference]	< .0001
≥ 66	0.53 (0.37 to 0.75)	< .0001	0.81 (0.62 to 1.04)	.10	0.81 (0.62 to 1.04)	.10
Race and Ethnicity						
Non-Hispanic White	[Reference]	.01	[Reference]	< .0001	[Reference]	< .0001
Non-Hispanic Asian	0.77 (0.53 to 1.14)	.19	0.81 (0.60 to 1.10)	.16	0.83 (0.61 to 1.12)	.21
Hispanic	1.22 (0.85 to 1.76)	.28	1.16 (0.87 to 1.55)	.33	1.16 (0.87 to 1.55)	.32
Non-Hispanic Black	0.71 (0.34 to 1.60)	.44	0.33 (0.14 to 0.77)	.01	0.33 (0.14 to 0.78)	.01
Other	1.68 (1.19 to 2.36)	< .0001	1.82 (1.40 to 2.37)	< .0001	1.83 (1.41 to 2.39)	< .0001
Primary Practice Type						
General dentistry	[Reference]	.051	—**	NA***	—	NA
Specialty	1.2 (0.99 to 1.44)	.051	—		—	
Primary Practice Setting						
Private	[Reference]	.47	—	NA	—	NA
Public	0.77 (0.37 to 1.57)	.47	—		—	
Professional Role						
Dental hygienist	[Reference]	< .0001	[Reference]	< .0001	[Reference]	< .0001
Dentist	0.52 (0.46 to 0.59)	< .0001	0.77 (0.66 to 0.90)	< .0001	0.79 (0.67 to 0.93)	< .0001
Period						
8/28/20-12/7/20	[Reference]	< .0001	[Reference]	< .0001	—	NA
1/4/21-3/1/21	0.63 (0.55 to 0.72)	< .0001	0.79 (0.68 to 0.91)	< .0001	—	
3/28/21-5/24/21	0.50 (0.43 to 0.59)	< .0001	0.68 (0.57 to 0.79)	< .0001	—	
COVID-19 Transmission Level						
Low to substantial	[Reference]	< .0001	—	NA	[Reference]	< .0001
High	1.32 (1.15 to 1.51)	< .0001	—		1.25 (1.09 to 1.44)	< .0001

* Dentists = 1,824; Dental hygienists = 5,710 ** No OR for this model in this category *** NA: not applicable

reported higher rates of anxiety and depression than men. Unlike a survey of mental health among dentists in the United Kingdom (UK),¹² no differences in rates of anxiety or depression symptoms among US DHCWs were identified by practice setting (that is, private practice versus public health). This discrepancy may be due to differences in dental health care delivery systems and payers between the UK and the US or may be a reflection on the different times of data collection. In results consistent with another report,²⁵ no significant differences in mental health concerns were identified between DHCWs in general dentistry and those practicing specialties.

In Germany, differences in mental health by professional type were seen during the pandemic, with dental nurses exhibiting more anxiety and depression symptoms than dentists.^{14,15} Similarly, in the current study, even controlling for other factors related to mental health outcomes such as age and gender, dentists had significantly lower odds of anxiety or depression symptoms than dental hygienists. There are several potential underlying explanations for these differences. Dentists may have felt more in control of infection prevention and control procedures in their primary dental practice, which may have provided a protective buffer against anxiety or work-related stress. In addition, whereas dentists may own their practices, fewer dental hygienists operate independently, most work as employees. Thus, elevated rates of anxiety and depression symptoms among dental hygienists could correlate with concerns of availability of PPE, being unemployed or furloughed,²⁶ managing childcare issues, bringing infection home to family members, and properly following national guidance without the control to dictate policies within their primary practice environment.²⁷ The narrowing of the gap in anxiety and depression rates between dentists and dental hygienists through May 2021 may indicate that as DHCWs continued to be provided information about national guidance, they were able to deliver care at volumes that approached prepandemic rates, and as data about low COVID-19 infection rates among DHCWs were reported, their mental health may have been influenced positively. Strategies that enable dental hygienists to be informed, empowered, and included in decision-making processes in dental settings may reduce psychological distress and improve working conditions within the dental team.

Perceptions of COVID-19 risk have shown an influence on anxiety and depression symptoms in other surveys of DHCWs.^{11,28} In this study, DHCWs experienced higher rates of anxiety and depression symptoms during high levels of community transmission of COVID-19, and those who wanted to be vaccinated but were not yet vaccinated reported higher levels of anxiety and depression symptoms than those already

vaccinated and those not intending to be vaccinated. These findings imply that external factors associated with perceived occupational risks have a significant impact on anxiety and depression symptom rates among DHCWs. Ensuring that DHCWs have the necessary resources to safely practice dentistry, including PPE, vaccination, and adherence to CDC guidance, may reduce psychological distress. The ADA and the ADHA have expanded resources available to support dentists' and dental hygienists' mental and emotional health.^{29,30}

There are limitations to these findings. There were high rates of missing data regarding dental hygienists' personal and professional characteristics, which may introduce nonresponse bias. The survey response rate of 6.7% also may indicate nonresponse bias. There may be survivorship bias in that adverse mental health decreases the likelihood of continued survey participation³¹ or social desirability bias against reporting mental health concerns that affects one professional group disproportionately to the other. Unmeasured factors such as overall household income and expenses, financial difficulties, known stressors (for example, childcare or eldercare) during the pandemic, or level of patient contact also may influence mental health and account for the measured differences between dentists and dental hygienists. Furthermore, the PHQ-4 is meant for mental health screening, not diagnosis, and thus the results of this study do not reflect prevalence of definitive mental health diagnoses.

Conversely, there are also strengths to this research. The sample of dentists was broadly similar to US dentists on all measured variables. How representative the sample of surveyed dental hygienists was of dental hygienists nationally is unknown, but those surveyed represented every level of experience, type of dental practice, measured demographic characteristic, and US state. To the best of the authors' knowledge, this is the first, and perhaps only, study evaluating mental health in a cohort of DHCWs over the course of the COVID-19 pandemic. Results from this study show distinct differences between dentists and dental hygienists that could be used to tailor communication strategies to each group, as well as inform mental health screening and support. This study was uniquely suited to identify points in time at which anxiety and depression particularly troubled DHCWs and align such increased rates of adverse mental health outcomes with local COVID-19 transmission rates. This is also the first study to evaluate the association between COVID-19 vaccination and US DHCW mental health and highlight the potential psychological impact of vaccination on the overall well-being of DHCWs. These findings highlight the importance of monitoring mental health in DHCWs and suggest areas for future research including investigating

the incidence of trauma, self-harm, and related disorders, or exploring why certain demographic or practice groups experienced high rates of anxiety and depression over time.

Conclusions

This analysis assessed time trends and risk factors associated with anxiety and depression symptoms in DHCWs over the course of one year during the COVID-19 pandemic. Although rates for anxiety symptoms were higher than rates for depression symptoms and were also higher among dental hygienists than dentists, overall rates declined in both types of DHCWs by the end of the study. Those who were unvaccinated, but planning to get vaccinated, had significantly higher rates of anxiety and depression symptoms. Good mental health is essential. Resources and research should continue to focus on this important public health topic to ensure that DHCWs and other health care providers are able to perform at their best, ensuring the optimal quality of life and care for their patients.

Acknowledgements

The authors thank Matthew Mikkelsen, manager of education surveys at the ADA Health Policy Institute, for his work on survey administration. The authors are grateful to every dentist and dental hygienist who participated in these surveys and made this research possible.

This article was adapted with permission from *The Journal of the American Dental Association (JADA)* and published in *The Journal of the American Dental Association (JADA)* Vol 153, Issue 8, Laura A. Eldridge, MS; Cameron G. Estrich, MPH, PhD; JoAnn R. Gurenlian, RDH, MS, PhD, AFAAOM; Ann Battrell, MSDH; Ann Lynch, BA; Marko Vujcic, PhD; Rachel Morrissey, MA; Stacey Dershewitz, JD, PsyD; Maria L. Geisinger, DDS, MS; Marcelo W.B. Araujo, DDS, MS, PhD, US dental health care workers' mental health during the COVID-19 pandemic, pp 740-749, ©2022 American Dental Association (ADA). Adapted with permission from the ADA. All rights reserved.

Laura A. Eldridge, MS is a Research Associate, American Dental Association Science and Research Institute, Chicago, IL, USA.

Cameron G. Estrich, MPH, PhD is a Health Research Analyst, Evidence Synthesis and Translation Research, American Dental Association Science and Research Institute, Chicago, IL, USA.

JoAnn R. Gurenlian, RDH, MS, PhD, AFAAOM is the Director of Education and Research, American Dental Hygienists' Association, Chicago, IL, USA.

Ann Battrell, MSDH, is the Chief Executive Officer, American Dental Hygienists' Association, Chicago, IL, USA.

Ann Lynch is the Director of Advocacy, American Dental Hygienists' Association, Chicago, IL, USA.

Marko Vujcic, PhD is the Chief Economist and Vice President, Health Policy Institute, American Dental Association, Chicago, IL, USA.

Rachel W. Morrissey, MA is a Senior Research Analyst, Education, Health Policy Institute, American Dental Association, Chicago, IL, USA.

Stacey L. Dershewitz, JD, PsyD is a clinical assistant professor, Department of Professional Psychology and the Associate Director, Center Clinic, George Washington University, Washington, DC, USA.

Maria L. Geisinger, DDS, MS is a professor and the Director of Advanced Education in Periodontology, Department of Periodontology, School of Dentistry, University of Alabama at Birmingham, Birmingham, AL, USA.

Marcelo W. B. Araujo, DDS, MS, PhD is the Chief Executive Officer, American Dental Association Science and Research Institute, Chicago, IL, USA.

Corresponding author: Laura A. Eldridge, MS;
eldridgel@ada.org

References

1. WHO. Director-General's statement on IHR Emergency Committee on novel coronavirus (2019-nCoV) [Internet]. Geneva; World Health Organization; 2020 [modified 2020 Mar 11; cited 2020 Jul 15]. Available from: <https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020>.
2. CDC. Interim infection prevention and control guidance for dental settings during the COVID-19 response [Internet]. Atlanta (GA): Centers for Disease Control and Prevention; 2022. [modified 2022 Feb 2; cited 2020 Jun 29]. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/hcp/dental-settings.html>
3. To KK, Tsang OT, Yip CC, et al. Consistent detection of 2019 novel coronavirus in saliva. *Clin Infect Dis*. 2020 Jul;71(15):841-3.
4. Burger D. ADA recommending dentists postpone elective procedures [Internet]. Chicago (IL): American Dental Association; 2020 [modified 2020 Mar 20; cited 2022 Mar 28]. Available from: <https://www.ada.org/publications/ada->

- news/2020/march/ada-recommending-dentists-postpone-elective-procedures.
5. ADA HPI. COVID-19 economic impact on dental practices [Internet]. Chicago (IL): American Dental Association; 2021 [cited: 2021 Aug 4]. <https://www.ada.org/en/science-research/health-policy-institute/covid-19-dentists-economic-impact>.
 6. Czeisler MÉ, Lane RI, Petrosky E, et al. Mental health, substance use, and suicidal ideation during the COVID-19 pandemic: United States, June 24-30, 2020. *MMWR Morb Mortal Wkly Rep*. 2020 Aug;69(32):1049-57.
 7. Vahratian A, Blumberg SJ, Terlizzi EP, Schiller JS. Symptoms of anxiety or depressive disorder and use of mental health care among adults during the COVID-19 pandemic: United States, August 2020-February 2021. *MMWR Morb Mortal Wkly Rep*. 2021 Apr;70(13):490-4.
 8. Marvaldi M, Mallet J, Dubertret C, et al. Anxiety, depression, trauma-related, and sleep disorders among healthcare workers during the COVID-19 pandemic: a systematic review and meta-analysis. *Neurosci Biobehav Rev*. 2021 Jul;126:252-64.
 9. Firew T, Sano ED, Lee JW, et al. Protecting the front line: a cross-sectional survey analysis of the occupational factors contributing to healthcare workers' infection and psychological distress during the COVID-19 pandemic in the USA. *BMJ Open*. 2020 Oct;10(10):e042752.
 10. Consolo U, Bellini P, Bencivenni D, et al. Epidemiological aspects and psychological reactions to COVID-19 of dental practitioners in the northern Italy districts of Modena and Reggio Emilia. *Int J Environ Res Public Health*. 2020 May;17(10):3459.
 11. Mahdee AF, Gul SS, Abdulkareem AA, Qasim SSB. Anxiety, practice modification, and economic impact among Iraqi dentists during the COVID-19 outbreak. *Front Med*. 2020 Dec;7:595028.
 12. Ranka MS, Ranka SR. Survey of mental health of dentists in the COVID-19 pandemic in the UK. *J Int Soc Prev Community Dent*. 2021 Jan-Feb;11(1):104.
 13. Al-Amad SH, Hussein A. Anxiety among dental professionals and its association with their dependency on social media for health information: insights from the COVID-19 pandemic. *BMC Psychol*. 2021 Jan;9(1):9.
 14. Mekhemar M, Attia S, Dörfer C, Conrad J. Dental nurses' mental health in Germany: a nationwide survey during the COVID-19 pandemic. *Int J Environ Res Public Health*. 2021 Jul;18(15):8108.
 15. Mekhemar M, Attia S, Dörfer C, Conrad J. The psychological impact of the COVID-19 pandemic on dentists in Germany. *J Clin Med*. 2021 Mar;10(5):1008.
 16. Estrich CG, Mikkelsen M, Morrissey R, et al. Estimating COVID-19 prevalence and infection control practices among US dentists. *J Am Dent Assoc*. 2020 Nov;151(11):815-24.
 17. Estrich CG, Gurenlian JR, Battrell A, et al. COVID-19 prevalence and related practices among dental hygienists in the United States. *J Dent Hyg*. 2021 Feb;95(1):6-16.
 18. Kroenke K, Spitzer RL, Williams JB, Lowe B. An ultra-brief screening scale for anxiety and depression: the PHQ-4. *Psychosomatics*. 2009 Nov-Dec;50(6):613-21.
 19. Löwe B, Wahl I, Rose M, et al. A 4-item measure of depression and anxiety: validation and standardization of the Patient Health Questionnaire-4 (PHQ-4) in the general population. *J Affect Disord Rep*. 2010 Apr;122(1-2):86-95.
 20. Kroenke K, Spitzer RL, Williams JB. The Patient Health Questionnaire-2: validity of a two-item depression screener. *Med Care*. 2003 Nov;41(11):1284-1292.
 21. Kroenke K, Spitzer RL, Williams JB, et al. Anxiety disorders in primary care: prevalence, impairment, comorbidity, and detection. *Ann Intern Med*. 2007 Mar 6;146(5):317-25.
 22. CDC. COVID data tracker [Internet]. Atlanta (GA): Centers for Disease Control and Prevention; 2021 [cited 2021 Sep 2]. Available from: <https://covid.cdc.gov/covid-data-tracker/>
 23. Czeisler MÉ, Wiley JF, Facer-Childs ER, et al. Mental health, substance use, and suicidal ideation during a prolonged COVID-19-related lockdown in a region with low SARS-CoV-2 prevalence. *J Psychiatr Res*. 2021 Aug;140:533-44.
 24. Jia H, Guerin RJ, Barile JP, et al. National and state trends in anxiety and depression severity scores among adults during the COVID-19 pandemic: United States, 2020-2021. *MMWR Morb Mortal Wkly Rep*. 2021 Oct;70(40):1427-32.
 25. Salehiniya H, Abbaszadeh H. Prevalence of corona-associated anxiety and mental health disorder among dentists during the COVID-19 pandemic. *Neuropsychopharmacol Rep*. 2021 Jun;41(2):223-9.
 26. IFDH. 2020 COVID survey [Internet]. Rockville (MD): International Federation of Dental Hygienists; 2020 [cited 2020 Jul 24]. Available from: <http://www.ifdh.org/ifdh-2020-covid-survey.html>.
 27. Gurenlian JR, Morrissey R, Estrich CG, et al. Employment patterns of dental hygienists in the United States during the COVID-19 pandemic. *J Dent Hyg*. 2021 Feb;95(1):17-24.

28. Shacham M, Hamama-Raz Y, Kolerman R, et al. COVID-19 factors and psychological factors associated with elevated psychological distress among dentists and dental hygienists in Israel. *Int J Environ Res Public Health*. 2020 Apr 22;17(8):2900.
29. ADA. New program aims to support dentists' mental wellness [Internet]. Chicago (IL): American Dental Association; 2021 [modified 2021 Mar 29; cited 2021 Aug 6]. Available from: <https://www.ada.org/en/publications/new-dentist-news/2021/march/new-program-aims-to-support-dentists-mental-wellness#:~:text=Action%3A%20Hope%20for%20the%20Day,his%20friends%20die%20by%20suicide>.
30. ADHA. COVID-19 resource center for dental hygienists [Internet]. Chicago (IL); American Dental Hygienists' Association; 2021 [cited: 2021 Sept 24]. Available from: <https://www.adha.org/covid19>.
31. Czeisler M, Wiley J, Czeisler C, et al. Uncovering survivorship bias in longitudinal mental health surveys during the COVID-19 pandemic. *Epidemiol Psychiatr Sci*. 2021 Aug;30:e35.

COVID-19 Practices of Idaho Dental Hygienists

Crystal L. Kanderis Lane, RDH, MS; JoAnn R. Gurenlian, RDH, MS, PhD, AFAAOM

Abstract

Purpose: The COVID-19 pandemic has challenged dental professionals to provide appropriate care while using nationally recognized guidelines to minimize disease transmission. The purpose of this study was to investigate the current practices of dental hygienists in Idaho to better understand how their practices have been impacted by COVID-19 in comparison to national guidelines.

Methods: Practicing dental hygienists licensed in Idaho were invited to participate in a 23-item web-based survey. Items included demographics, guidelines used, procedures employed in response to COVID-19, barriers encountered implementing protocols, and vaccination status. Descriptive statistics were used to analyze the data. A Chi-square test was used to test for association between demographics and national guidance used and vaccination status ($p=.05$).

Results: Of the 1,200 dental hygienists e-mailed, 185 consented to participate for a response rate of 15.4%. Respondents reported that level 3 or higher filtration masks were worn for every patient (72.9%, $n=113$) as were gloves (95.5%, $n=148$) and eye protection with side shields (71.6%, $n=111$). Most respondents indicated that disposable gowns (68.4%, $n=106$) and washable gowns (39.4%, $n=61$) were not available. A majority (56.1%, $n=87$) indicated they had been vaccinated. Respondents who had been employed for >15 years were more likely to have been vaccinated ($\chi^2 = 15.25$, $df = 1$, $p = 0.000$) and were more likely to ask their patients if they had received the COVID-19 vaccine ($\chi^2 = 7.99$, $df = 1$, $p=0.005$).

Conclusion: Infection control practices following national guidance were inconsistent among dental hygienists in Idaho. Further research focusing on factors influencing adherence to national guidance for COVID-19 is needed.

Keywords: COVID-19, dental hygienists, infection control practices, vaccination, pandemic, occupational health

This manuscript supports the NDHRA priority area **Professional development; Occupational health** (determination and assessment of risks).

Submitted for publication: 8/12/21; accepted: 12/9/21

Introduction

COVID-19 has significantly impacted the practice of dentistry, requiring changes focused on overcoming the continual challenges due to COVID-19. Dental health care personnel (DHCP) have had access to national guidelines which help outline the most recommended practices to minimize COVID-19 exposure risk since the early days of the pandemic. The Centers for Disease Control and Prevention (CDC) first established interim guidance for dentistry early in 2020, with ongoing updates throughout the pandemic.¹ The CDC recommendations focused on general guidance stating the need to prioritize necessary care to minimize risk and included: screening and monitoring of patients and DHCP; physical distancing; source control, and standard as well as transmission based precautions.¹ In communities where disease transmission is moderate to high and during aerosol

production procedures, the use of a high level of protection respirator was recommended; respirators could be reused due to supply shortages.¹ As N95 respirators became more readily available, the CDC recommended the single use of N95 respirators for aerosol producing procedures.² In July of 2021, the CDC's guidance regarding aerosol producing procedures was updated, indicating that these procedures should continue to be avoided in patients suspected of COVID-19.³

Professional organizations such as Organization for Safety, Asepsis and Prevention (OSAP), the American Dental Hygienists' Association (ADHA), and American Dental Association (ADA) also constructed more detailed, functional guidelines for DHCPs to incorporate practices for minimizing COVID-19 risks while regulatory bodies such as the Occupational Safety and Health Administration

(OSHA), and the various state boards of dentistry issued statutes related to practicing during the pandemic.⁴⁻⁷ The ADHA offered specific guidelines for each of the sections of the CDC interim guidelines and also included guidance on key important areas: High-Volume Evacuator (HVE) and dental assistant utilization whenever possible; and aerosol producing procedures.⁷ The OSAP created a substantial document and toolkit that summarized all of the professional organization's major recommendations for managing COVID-19 in healthcare practice settings.⁴

A national study conducted by the ADA Health Policy Institute and the ADHA examined the practice tendencies of a sample population of dental hygienists throughout the United States (US) and Puerto Rico (n=4,776) from September 29 and October 8, 2020.⁸ Results from this study showed a slight decrease in employment (7.9%, n=205) with the most commonly cited reasons for voluntary departure from clinical practice were issues with workplace safety/standards (12.7%, n=26) and discomfort working until the pandemic was under control (48.3%, n=100).⁸ Participants were asked regarding their knowledge and level of concern regarding personal protective equipment (PPE) with the majority of participants stating that they had >14 days' worth of PPE.⁸ A key discussion point identified COVID-19 vaccination availability as a possible reason for dental hygienists to rejoin the workforce. At the time of the original study, nothing had been reported in the literature addressing the relationship between vaccinations and dental hygienists in the workforce.⁸

According to the ADA Health Policy Institute, 60.9% of the dentist respondents in the US reported being open and running their practice as customary, and >80% report having eight to >14 days' worth of the CDC recommended PPE.⁹ The Health Policy Institute reported 58.6% of the dental hygienists surveyed were working full-time while 32.3% are working part-time; >77% of reported having eight to >14 days' worth of the CDC recommended PPE.¹⁰

With the development of the three types of COVID-19 vaccines,¹¹ and due to the increasing availability of the vaccines, the CDC officially recommended all healthcare workers to be COVID-19 vaccinated as of May 2021.¹² At the time of this study period, 49.8% of the US population had been fully vaccinated¹³ and nationally 52.2% of dental hygienists had been fully vaccinated,¹⁴ demonstrating dental hygienists have kept pace with the vaccination rate across the country.

While some workplace safety issues, such as availability of vaccinations and PPE, have been addressed, it is unknown how these issues have influenced the practices of dental hygienists in relation to COVID-19. It is also not known whether years

of experience or if full versus part-time employment status impacts dental hygiene practice or COVID-19 vaccination status. Lastly, it is unknown whether COVID-19 vaccination status is associated with inquiring whether patients have received the COVID-19 vaccine. Previous research has been conducted on a national population; little is known about practices in individual states. Therefore, the purpose of this study was to investigate the current practices of dental hygienists in the state of Idaho to better understand how their practices have been impacted by COVID-19.

Methods

A descriptive research design was used to study COVID-19 practices of dental hygienists in Idaho. A web-based survey was administered (Qualtrics, Provo, UT, USA) from April to June 2021. The research protocol and survey were approved by the Idaho State University Human Subjects Committee (IRB-#FY2021-212). Although there were 2,073 dental hygienists licensed in the state of Idaho, there was an available contact list of 1,200 dental hygienists at the time of this study. The dental hygienists in this contact list (n=1,200) received an invitation to participate in the survey; two reminder emails were sent. Individuals were eligible to participate if they were licensed, currently practicing and were at least 18 years of age.

Potential participants read and signed an electronic informed consent before beginning the survey. The 23-item survey was constructed using items similar to a national survey of US dental hygienists conducted previously.^{8,15} The modified survey was reviewed by a group of dental hygiene educators and clinicians for content validity, and by a statistician who evaluated the instrument in relation to the purpose, research questions, content, and to determine the statistical analysis plan. Minor modifications were made based on feedback. Demographic survey questions included age, sex, primary practice setting, employment status, and years of experience as a dental hygienist. Participants were asked to identify which guidelines were used to determine appropriate practices to address COVID-19 in their dental practice setting and which procedures they were employing in response to COVID-19 for both patients and for themselves.

In addition, participants were asked what barriers they encountered over the past month related to implementing COVID-19 national guidelines into their dental hygiene practices, and what things would they like to see available to help them use these guidelines in their daily practice. Finally, respondents were asked if they had been vaccinated against COVID-19, if they were a COVID-19 vaccine administrator or were planning to become one, and whether they routinely ask their patients if they have received the COVID-19 vaccine.

Frequencies and percentages were calculated for all survey items. For categorical variables, differences were tested using χ^2 tests with statistical significance set at a minimum of 0.05. Due to the survey design skip patterns (respondents were able to skip any question or stop answering the survey at any time) not all respondents answered all questions; the percent missing ranged from 0 to 9.0% per question.

Results

Of the 1,200 dental hygienists e-mailed, 185 consented to participate for a response rate of 15.42%. Most (83.8%, n=155) were licensed dental hygienists practicing in Idaho, while the remainder (16.2%, n=30) were practicing outside of the state. For respondents not currently practicing in Idaho the reasons for being out of state included: voluntarily left the state (33.3%, n=10), retired (20.0%, n=6), working in another state (20.0%, n=6), working in a non-clinical position (13.2%, n=4), COVID-19 (3.3%, n=1), laid off/furloughed (3.3%, n=1), permanently let go from position (3.3%, n=1) and missing response (3.3%, n=1). The results that follow pertain only to those respondents practicing within the state of Idaho.

Respondents were predominantly female (99.4%, n=154); one respondent was male (0.6%, n=1). Age and years of practice were closely distributed. The majority (52.3%, n=81) worked full-time (>31 hours per week) while nearly half (47.1%, n=73) worked on a part-time basis (<31 hours per week). Most (78.7%, n=122) worked in a clinical private practice setting. Demographics are shown in Table I

Respondents were asked to indicate what guidelines they consulted to determine appropriate protocols to address COVID-19 in their practice settings. The guidelines chosen most often were the CDC (89.0%, n=138), ADA (87.1%, n=135), and OSHA (78.7%, n=122). A Chi-square test of significance was used to determine if there was a statistical significance based on response to this item by employment status (full-time versus part-time) and years of experience. The Bonferroni adjusted criterion for statistical significance was indicated to adjust for a type 1 error, accounting for the seven tests evaluated; the *p* value was set at 0.007. None of the χ^2 tests were statistically significant for either employment status or years of experience (data not shown).

Protocols utilized for patients and dental team members in response to COVID-19 were surveyed. Most frequent protocols being used for patients included screening questions at the appointment (75.5%, n=117), and face coverings worn in all areas of the practice setting (83.2%, n=129). Most respondents reported they rarely followed-up with patients

Table I. Sample demographics* (n=155)

Characteristic	n	%
Sex		
Female	154	99.4
Male	1	0.6
Age		
20-30	25	16.1
31-40	53	34.2
41-50	36	23.2
51-60	25	16.1
60+	16	10.3
Years practicing dental hygiene		
1-5	28	18.1
6-10	26	16.8
11-15	31	20.0
16-20	24	15.5
21-25	15	9.7
25+	31	20.0
Current employment status		
Full-time (>31 hours per week)	81	52.3
Part-time (<31 hours per week)	73	47.1
Missing	1	0.6
Current primary practice setting		
Clinical private practice	122	78.7
DSO or group practice setting	6	3.9
Federally Qualified Health Center	7	4.5
Public health/community setting	4	2.6
School setting	1	0.6
Dental hygiene/dental/dental assisting education setting	9	5.8
Other (federal prison, speaking/coaching, Indian health clinic, temping in all settings, Veteran Affairs)	5	3.2
Missing data	1	0.6

*Respondents licensed and practicing in Idaho

after appointments to check on symptoms for COVID-19 (89.0%, n=138) and most did not telescreen patients prior to appointments (52.9%, n=82), have patients wait in the car prior to appointments (62.6%, n=97), or ask patients to use

Table II. Patient management practices used in response to COVID-19 (n=155)

Practice	n	%
Telescreening patients prior to appointment		
Yes	67	43.2
No	82	52.9
No response	6	3.9
Have patients wait in car prior to appointment		
Yes	53	34.2
No	97	62.6
Missing	5	3.2
Screening questions at appointment		
Yes	117	75.5
No	35	22.6
No response	3	1.9
Temperature checks		
Yes	92	59.4
No	58	37.4
No response	5	3.2
Follow-up patient checks after appointment		
Yes	10	6.5
No	138	89.0
No response	7	4.5
Pre-procedural rinsing		
Yes	86	55.5
No	65	41.9
No response	4	2.6
Face coverings worn in all areas of practice setting		
Yes	129	83.2
No	23	14.8
No response	3	1.9
Patients wear face coverings in between procedures		
Yes	83	53.5
No	65	41.9
No response	7	4.5
Patients use hand sanitizer prior to beginning appointment		
Yes	56	36.1
No	92	59.4
No response	7	4.5

hand sanitizer prior to beginning an appointment (59.4%, n=92) (Table II). However, respondents were more likely to routinely implement safety practices for dental team members (Table III). Exceptions included regular temperature checks (52.9%, n=82) and maintaining physical distancing (51.6%, n=80) with most reporting that they were more likely to defer performing these precautionary procedures.

Procedures implemented routinely for patient care in response to COVID-19 showed that most participants were donning and doffing PPE between patients (59.4%, n=89) and hand scaling (80.6%, n=125). However, respondents also reported that they were not avoiding ultrasonic scaling (66.5%, n=103) or coronal polishing (88.4%, n=137), and if ultrasonic scaling was deemed essential, they did not use four-handed dentistry and two HVE systems (73.5%, n=114) (Table IV).

When asked what PPE was currently being used in practice, respondents reported that level 3 or higher filtration masks were worn for every patient (72.9%, n=113) as were

Table III. Practices routinely implemented among dental team members in response to COVID-19 (n=155)

Practice	n	%
Temperature checks		
Yes	68	43.9
No	82	52.9
No response	5	3.2
Screening questions		
Yes	70	45.2
No	77	49.7
No response	8	5.2
Face coverings worn in all areas of practice setting		
Yes	126	81.3
No	26	16.8
No response	3	1.9
Frequent hand sanitizing		
Yes	148	95.5
No	6	3.9
No response	1	0.6
Maintaining physical distancing		
Yes	70	45.2
No	80	51.6
No response	5	3.2

Table IV. Patient care procedures routinely implemented in response to COVID-19 (n=155)

Procedures	n	%	Procedures	n	%
Don and doff PPE between patients			Avoid ultrasonic scaling		
Yes	89	59.4	Yes	12	7.7
Sometimes	26	16.8	Sometimes	37	23.9
No	35	22.6	No	103	66.5
No response	5	3.2	No response	3	1.9
Once PPE is donned, remain in operatory			Avoid coronal polishing		
Yes	52	33.5	Yes	8	5.2
Sometimes	39	25.2	Sometimes	6	3.9
No	59	38.1	No	137	88.4
No response	5	3.2	No response	4	2.6
Use HVAC system			Perform hand scaling		
Yes	80	51.6	Yes	125	80.6
Sometimes	22	14.2	Sometimes	17	11.0
No	51	32.9	No	10	6.5
No response	2	1.3	No response	3	1.9
Use HVE for reducing aerosols			Perform selective polishing		
Yes	79	51.0	Yes	51	32.9
Sometimes	34	21.9	Sometimes	20	12.9
No	40	25.8	No	78	50.3
No response	2	1.3	No response	6	3.9
Avoid using air and water syringe simultaneously			If ultrasonic is deemed essential, use four-handed dentistry and two HVE systems		
Yes	37	23.9	Yes	15	9.7
Sometimes	42	27.1	Sometimes	21	13.5
No	71	45.8	No	114	73.5
No response	5	3.2	No response	5	3.2

gloves (95.5%, n=148) and eye protection with side shields (71.6%, n=111). However, respondents indicated that disposable gowns (68.4%, n=106) and washable gowns (39.4%, n=61) were not available. Most (63.2%, n=98) reported that a dental team member had been assigned as an infection control officer for the practice. Types of PPE used are shown in Table V.

Respondents were asked to describe barriers encountered over the last month related to implementing COVID-19 national guidance into dental hygiene practice. Options for responses included: lack of PPE, lack of manager/employer support, lack of time, lack of knowledge of national guidelines, national guidelines are hard to understand, lack of dental team members, patient demands, employer demands. The only barrier that received a majority response as a concern was lack of PPE (49.7%, n=77).

Regarding vaccination status, over half of the respondents (56.1%, n=87) indicated they had been vaccinated for COVID-19 while 40.6% (n=63) were not vaccinated. For those who

were not vaccinated, reasons reported included: already had COVID-19 (4.5%, n=7), did not feel vaccines were safe (6.5%, n=10), waiting to see the side effects (3.2%, n=5), do not trust vaccines (0.6%, n=1), have other medical conditions and concerns about how the vaccine will affect health (1.3%, n=2), pregnant (2.6%, n=4), and not enough long-term research information available (8.4%, n=13). Two individuals (1.3%) indicated they were a COVID-19 vaccine administrator and six (3.9%) reported they are planning to become one. Lastly, only 31.0% (n=48) respondents indicated routinely asking their patients if they have received the COVID-19 vaccine.

Chi-square test of significance was performed to determine if there was a difference between employment status and vaccination status. No significant difference based on employment status was identified ($\chi^2=0.005$, $df=1$, $p=0.95$). However, there was a statistically significant difference in vaccine status between respondents who had been employed for greater than 15 years versus those who had been employed for less than 15 years. Respondents who had been employed for more than 15 years were likely to have been vaccinated ($\chi^2=15.25$, $df=1$, $p=0.000$). Further, there was a statistically significant difference for respondents who were vaccinated in terms of asking whether their patients had received the COVID-19 vaccine. More respondents who were vaccinated asked their patients whether they had received the COVID-19 vaccine ($\chi^2=7.99$, $df=1$, $p=0.005$).

Table V. Current PPE used in practice (n=155)

PPE Utilized	n	%	PPE Utilized	n	%
Hair covering			Disposable gown		
Every patient	32	20.6	Every patient	15	9.7
Daily	23	14.8	Daily	15	9.7
Weekly	4	2.6	Weekly	7	4.5
Not available	87	56.1	Not available	106	68.4
No response	9	5.8	No response	12	7.7
Eye protection with side shields			Washable gown		
Every patient	111	71.6	Every patient	42	27.1
Daily	18	11.6	Daily	42	27.1
Weekly	2	1.3	Weekly	3	1.9
Not available	20	12.9	Not available	61	39.4
No response	4	2.6	No response	7	4.5
Level 3 or higher filtration mask			Shoe coverings		
Every patient	113	72.9	Every patient	2	1.3
Daily	23	14.8	Daily	2	1.3
Weekly	3	1.9	Weekly	1	0.6
Not available	14	9.0	Not available	136	87.7
No response	2	1.3	No response	14	9.0
Face shield with side extension			Gloves		
Every patient	54	34.8	Every patient	148	95.5
Daily	19	12.3	Daily	4	2.6
Weekly	18	11.6	Weekly	---	---
Not available	59	38.1	Not available	---	---
No response	5	3.2	No response	3	1.9

Discussion

COVID-19 has significantly impacted the practice of dental hygiene. Adaptations in clinical practice settings were essential to ensure the safety of the public and DHCPs. The practice trends noted in the national survey indicated that not all national guidance recommendations were being followed.¹⁰ Therefore, this study was undertaken to provide a snapshot of the COVID-19 practices in one state to compare the findings to the national sample.

Employment practices of dental hygienists both nationally and statewide appeared comparable. In the national survey, 90.9% the respondents were employed either full- or part-time, while 99.4% of the respondents in Idaho were employed during the same time period.¹⁰ Most of the respondents worked in clinical practice settings both nationally and in Idaho. However, there were differences found regarding the availability of PPE. While masks, face shields, and gloves appeared to be readily available as reported in the national survey, gowns and face shields with side extensions were not nearly as available in Idaho. This lack of PPE was noted as a major concern by the Idaho respondents, contradicting the national findings.

Although there are multiple national guidance resources available to assist DHCPs manage COVID-19 risks, and most respondents reported using the CDC interim guidance, ADA, and

OSHA documents, findings from this study revealed that many of the guidelines were not being followed. For example, there was a tendency to avoid screening protocols for both patients and DHCPs and many respondents indicated they performed aerosol generating procedures without additional HVE. It is difficult to determine what influencing factors impacted DHCPs decision making related to national guidance. Concerns expressed regarding the availability of PPE did not correlate with the extent of the avoidance of other practices such as patient screening and aerosol generating procedures.

Another significant factor which may be contributing to guideline variations may be the vaccination rate among the respondents and the public. During the study as of July 28, 2021, the US rate of fully vaccinated individuals was 49.8%,¹³ while the rate for those living in Idaho was 37.3%.¹⁶ In comparison, 52.2% of dental hygienists in the US were fully vaccinated¹⁴ whereas 56.1% of the Idaho survey respondents were fully vaccinated. As more individuals become vaccinated, respondents may have had a false sense of security making them feel better protected in clinical practice and less inclined to follow national guidelines. The current study was conducted prior to any CDC guideline relaxation; therefore, it is important to recognize the risks and threat of transmission had not diminished.

Termination of COVID-19 risk mitigation protocols among DHCPs is concerning considering the current infection rates are elevating due to new variants of COVID-19.¹⁷ As of August 2021 there were four known variants of COVID-19, Alpha, Beta,

Gamma, and Delta and five emerging variants Eta, Iota, Kappa, Lambda, and Mu.¹⁸ The greatest concern related to the variants is the high-transmission rate which is gaining momentum even in countries with high vaccination rates.¹⁹ Therefore, crucial transmission components must be maintained including social distancing, facial coverings, vaccines, and other proven public health measures.^{19,20} One example of a public health measure to mitigate risk, in the state of California DHCP were required to be COVID-19 vaccinated by August 23, 2021.²¹ Consequences of non-compliance with the California vaccination requirement are weekly COVID-19 testing and mandated surgical masks in place of other face coverings.²¹ The CDC's response to the rising infection rates due to the variants has been indoor, public mask recommendations for fully vaccinated people.²² Preliminary findings from a study conducted in Chile concluded the Lambda variant may be COVID-19 immunity evasive, underscoring the continuously evolving nature of the virus.²³ Vaccination status should not solely guide DHCPs practices, and national guidelines should continue to be followed.

A notable finding from this study was that more respondents who were vaccinated also asked their patients if they had received the COVID-19 vaccine. It is recommended that the immunization history be taken, and patients be assessed for additional vaccines as part of a thorough medical history review.^{24,25} Comprehensive immunization documentation can be accomplished through patient vaccination questioning. With the availability of dentists and dental hygienists as vaccine administrators, the potential exists for in-office immunization for COVID-19 and other essential vaccines.^{24,25}

There are limitations to this study. The low response rate limits its generalizability. It may be that the response rate reflects COVID-19 fatigue or a lack of desire in addressing topics related to this subject matter. In addition, these results were based on self-reported data, which may be associated with recall or social desirability bias. Future research should examine what factors influence adherence to national guidelines including new variants of COVID-19, vaccination status, and vaccine administration in dental practice settings. In addition, factors affecting adherence should be explored from a qualitative perspective to provide greater understanding of decision making among practitioners.

Conclusion

Infection control practices following national guidance were inconsistent among dental hygienists in Idaho. Lack of PPE was identified as a primary among the participants. Dental hygienists with more years of employment were more likely to be vaccinated and determine the vaccination status

of their patients. Future research should focus on factors influencing adherence to national guidance.

Crystal L. Kanderis Lane, RDH, MS is an assistant professor and the Health and Safety Coordinator, Department of Dental Hygiene, Idaho State University, Pocatello, ID, USA.

JoAnn R. Gurenlian, RDH, MS, PhD, AFAAOM is Director of Education and Research, American Dental Hygienists' Association and Professor Emerita, Department of Dental Hygiene, Idaho State University, Pocatello, ID, USA.

Corresponding author: Crystal L. Kanderis Lane, RDH, MS; kandcrys@isu.edu

References

1. CDC. Interim infection prevention and control guidance for dental settings during the coronavirus disease (COVID-19) pandemic [Internet]. Atlanta (GA): Center for Disease Control and Prevention; 2020 [modified 2020 Dec 4; cited 2021 Jul 28]. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/hcp/dental-settings.html>
2. CDC. Strategies for optimizing the supply of N95 respirators: summary of recent changes [Internet]. Atlanta (GA): Center for Disease Control and Prevention; 2021 [modified 2021 Apr 9; cited 2021 Jul 28]. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/hcp/respirators-strategy/index.html>
3. CDC. Summary of CDC COVID-19 guidance for dental services [Internet]. Atlanta (GA): Center for Disease Control and Prevention; 2020 [modified 2021 Jul 13; cited 2021 Jul 28]. Available from: <https://www.cdc.gov/oralhealth/infectioncontrol/statement-COVID.html>
4. OSAP/CareQuest Institute. Best practices for infection control in dental clinics during the COVID-19 pandemic [Internet]. Atlanta (GA): Organization for Safety, Asepsis and Prevention; 2020 [modified 2021 Jul 21; cited 2021 Jul 28]. Available from: https://cdn.ymaws.com/www.osap.org/resource/resmgr/dentaquest/INC-1353_Best_Practices_for_.pdf
5. OSHA. COVID-19 control and prevention: dentistry workers and employers [Internet]. Washington (DC): United States Department of Labor; 2021 [modified 2021 Jun 10; cited 2021 Jul 28]. Available from: <https://www.osha.gov/coronavirus/control-prevention/dentistry>
6. ADA Center for Professional Success. COVID-19 safely and clinical resources [Internet]. Chicago (IL): American Dental Association; 2021 [cited 2021 Jul 28]. Available from: https://success.ada.org/en/practice-management/patients/safety-and-clinical?utm_source=cpso&utm_

medium=covid-cps-virus-lp&utm_content=fb-safety-clinical&utm_campaign=covid-19

7. ADHA. Interim guidance on returning to work [Internet]. Chicago (IL): American Dental Hygienists' Association; 2020 [modified 2021 Jul 12; cited 2021 Jul 28]. Available from: https://www.adha.org/resources-docs/ADHA_TaskForceReport.pdf
8. Gurenlian JR, Morrissey R, Estrich CG, et al. Employment patterns of dental hygienists in the United States during COVID-19. *J Dent Hyg*. 2021 Feb;95(1):17-24.
9. Health Policy Institute. COVID-19 economic impact on dental practices [Internet]. Chicago (IL): American Dental Association; 2021 [cited 2021 Jul 28]. Available from: <https://www.ada.org/en/science-research/health-policy-institute/covid-19-dentists-economic-impact/private-practice>
10. Health Policy Institute. COVID-19: Impact on dental hygienists [Internet]. Chicago (IL): American Dental Hygienists' Association and American Dental Association; 2021 [cited 2021 Jul 28]. Available from: <https://www.ada.org/en/science-research/health-policy-institute/covid-19-dentists-economic-impact/dental-hygiene>
11. US FDA. COVID-19 vaccines [Internet]. Silver Spring (MD): US Food and Drug Administration; 2021 [modified 2021 Jul 20; cited 2021 Jul 28]. Available from: <https://www.fda.gov/emergency-preparedness-and-response/coronavirus-disease-2019-covid-19/covid-19-vaccines#basics>
12. CDC. COVID-19 Vaccines for Healthcare Personnel [Internet]. Atlanta (GA): Center for Disease Control and Prevention; 2021 [modified 2021 May 27; cited 2021 Jul 28]. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/recommendations/hcp.html>
13. USA Facts. US Coronavirus vaccine tracker: What's the nation's progress on vaccinations? [Internet]. Bellevue (WA): USA Facts; 2021 [modified 2021 Nov 15; cited 2021 Nov 18]. Available from: <https://usafacts.org/visualizations/covid-vaccine-tracker-states>
14. Versaci MB. Impact of COVID-19 on dental hygienists: ongoing research update. [Internet]. Chicago (IL): American Dental Association; 2021 [cited 2021 Jul 28]. Available from: <https://www.ada.org/en/publications/ada-news/2021>
15. Estrich CG, Gurenlian JR, Battrell A, et al. COVID-19 prevalence and related practices among dental hygienists in the United States. *J Dent Hyg* 2021 Feb;95(1):6-16.
16. USA Facts. Idaho coronavirus vaccination progress: How many COVID-19 vaccines has Idaho administered? [Internet]. Bellevue (WA): USA Facts; 2021 [modified 2021 Nov 15; cited 2021 Nov 18]. Available from: <https://usafacts.org/visualizations/covid-vaccine-tracker-states/state/idaho>
17. CDC. COVID-19 integrated country view [Internet]. Atlanta (GA): Center for Disease Control and Prevention; 2021 [cited 2021 Aug 12]. Available from: <https://covid.cdc.gov/covid-data-tracker/#county-view>
18. WHO. Tracking SARS-CoV-2 variants [Internet]. New York (NY): World Health Organization; 2021 [modified 2021 Jul 23; cited 2021 Aug 12]. Available from: <https://www.who.int/en/activities/tracking-SARS-CoV-2-variants/>
19. WHO. Episode #45 delta variant (Transcript) [Internet]. New York (NY): World Health Organization; 2021 [cited 2021 Aug 12]. Available from: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/media-resources/science-in-5/episode-45---delta-variant>
20. Infection Control Today. CDC tightens mask rules for fully vaccinated in COVID-19 hot spots [Internet]. Cranbury (NJ): MJH Life Sciences; 2021 [modified 2021 Jul 27; cited 2021 Aug 12]. Available from: <https://www.infectioncontroltoday.com/view/cdc-expected-to-tighten-masking-rules-for-fully-vaccinated>
21. CDA. Recommendations versus requirements: Managing unvaccinated employees [Internet]. Sacramento (CA): California Dental Association; 2021 [modified 2021 Aug 4; cited 2021 Aug 12]. Available from: <https://www.cda.org/Home/News-and-Events/Newsroom>
22. CDC. Interim public health recommendations for fully vaccinated people [Internet]. Atlanta (GA): Center for Disease Control and Prevention; 2021 [modified 2021 Jul 27; cited 2021 Aug 12]. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/fully-vaccinated-guidance.html>
23. Acevedo ML, Alonso-Palomares L, Bustamante A, et al. Infectivity and immune escape of the new SARS-CoV-2 variant of interest Lambda [Internet]. *medRxiv*; 2021 Jul 1 [cited 2021 Aug 12]. Available from: <https://www.medrxiv.org/content/10.1101/2021.06.28.21259673v1>
24. CDC. Document the vaccination(s) [Internet]. Atlanta (GA): Center for Disease Control and Prevention; 2019 May [cited 2021 Aug 12]. Available from: <https://www.cdc.gov/vaccines/hcp/admin/document-vaccines.html>
25. AAPD. Record-Keeping [Internet]. Ithasca (IL): American Academy of Pediatric Dentistry; 2017 [modified 2021 Jun; cited 2021 Aug 12]. Available from: https://www.aapd.org/globalassets/media/policies_guidelines/bp_recordkeeping.pdf

Research

Examining the Influence of Academic Degree Level on Health Care Providers' Perceptions of Interprofessional Collaboration: A pilot study

Megan R. Bilbee, RDH, MS; Danielle Rulli, RDH, MS, DHSc; Stefanie M. VanDuine, RDH, MS; Elizabeth K. Kuzma, DNP, FNP-BC; Jennifer L. Cullen, RDH, BSDH, MPH

Abstract

Purpose: Health care provider perceptions of interprofessional collaboration (IPC) have been well documented, however barriers to provider participation persist. The purpose of this pilot study was to examine differences in health care providers' perceptions of IPC based on the academic degree level.

Methods: Licensed health care providers with faculty appointments at a four-year university-based setting were invited to participate in an electronic survey. Attitudinal questions in the survey instrument were based on the Theory of Planned Behavior and the Social Cognitive Theory and assessed perceptions, attitudes, norms, and self-efficacy toward IPC. Descriptive statistics were used to analyze the data.

Results: Respondents (n=179) included faculty in medicine (29%), dentistry (23%), nursing (13%), dental hygiene (11%), physical therapy (8%), and pharmacy (7%). Ninety percent of respondents agreed or strongly agreed that IPC is important for improving patient health outcomes. Respondents across all degree levels were significantly more comfortable taking recommendations on patient treatment from another health care provider with a doctoral degree as compared to a health care provider with an associate degree, with mean scores declining from 5.58 to 4.58 ($p=0.000$).

Conclusion: While all respondents valued IPC in improving patient outcomes, their perceptions of other health care providers' level of academic degree may play a role in their willingness to truly collaborate with them. Despite an institution's positive culture of IPC, bias and stereotypes regarding the level of academic degree need to be addressed. Results indicate that while health care providers with lower academic degrees may be valuable contributors to the IPC team, their academic degree could be a barrier to their meaningful inclusion.

Keywords: interprofessional collaboration, health outcomes, academic degree, health care provider stereotypes, willingness to collaborate

This manuscript supports the NDHRA priority area, **Professional development: Education** (evaluation).

Submitted for publication: 6/14/21; accepted: 12/23/21

Introduction

The Patient Protection and Affordable Care Act (ACA) recognizes the integral role of preventive health services and introduced a new health care delivery paradigm that embraced interprofessional collaboration (IPC).^{1,2} Interprofessional collaboration can be described as a partnership between multiple health providers of different professions, in which there is shared decision making.³ An important barrier to the formation of effective interprofessional health care teams are the existing stereotypes and misconceptions among health

care professionals toward professions other than their own.⁴ These stereotypes can interfere with collaboration and affect communication and interactions between providers. In addition, level of education (i.e. level of academic degree) has been found to have an impact on practitioners' perceptions of IPC and professional identity. A study by Miller found that higher educational levels have a positive influence on IPC among graduate prepared nurses.⁵ Level of education has also been shown to influence professional values among nurses. In

a systematic review of the literature examining how level of education affects the professional values of nurses in clinical practice, Sibandze et al. concluded that nurses pursuing a bachelor's or higher degree had a greater awareness and were more likely to apply professional values in practice when compared to nurses with non-academic, certificate or associate degrees.⁶ Baccalaureate degree or higher educated nurses were shown to hold professional values as being a fundamental component of quality nursing practice.⁶ Dental hygienists also have also been shown to play an important role as part of interprofessional teams and place a high professional value on IPC.^{7,8} While academic degree level does not change the scope of practice for a dental hygienist in clinical practice, it is still important to consider barriers to true IPC such as other health care providers' perceptions of the team member's education level.

Evidence shows that health care professional students rate their own profession more positively than other professions.⁹ Health care students and providers are commonly educated about each providers' role within the interprofessional team in order to develop accurate perceptions to facilitate effective communication and collaboration. Since the various health profession faculty members have a large impact on how students practice in the future it may be insightful to explore their attitudes and perceptions regarding IPC, including their willingness to collaborate with health care providers who have a different level of academic degree to their own.

The determinants of IPC include the opportunity, ability, and a provider's willingness to collaborate.¹⁰ This willingness to collaborate is directly related to a health care provider's attitudes and intentions towards team-based patient care and may be challenging to objectively measure.¹¹ However, the determinants of and barriers to IPC can be further examined through the established social cognition models of behavior theory. Assessing a health care practitioner's willingness to participate in IPC through the lens of behavior theories such as Azjen's Theory of Planned Behavior (TPB) and Bandura's Social Cognitive Theory (SCT) can be insightful in understanding which attributes motivate a person to perform or engage in specific behaviors as well as reasonably predict their intention to do so.^{11,12} Specifically, the TPB and SCT suggest that human behaviors are guided by perceptions, attitudes, norms, and behavioral control (self-efficacy).^{11,12} Social Cognitive Theory elaborates further, adding environmental factors to the equation.¹² The purpose of this pilot study at a university-based health care education setting was to examine differences in health care providers' perceptions of IPC based on their level of academic degree.

Methods

This non-experimental cross-sectional survey study was determined to be exempt from the Institutional Review Board (IRB) oversight by the Health Sciences and Behavioral Sciences at the University of Michigan (U-M) (HUM#00162953). To quantify the health care providers' willingness to collaborate, and make predictions regarding their behavior, an original survey was designed using Francis et al. in which questions are structured around the constructs of TPB and SCT.¹³ The electronic survey was validated by the U-M Survey Research Center and piloted with seven health care providers of various health professions. Based on feedback from the pilot, changes were made to improve readability. Survey items included demographic questions, Likert scale and matrix style items that assessed provider perceptions, attitudes, and intentions towards IPC. Targeted survey participants were health care providers with faculty appointments at the University of Michigan who held different levels of academic degrees. An a priori power analysis determined an appropriate sample size of 168 respondents.

An email invitation and link were sent via the U-M Center for Interprofessional Education (IPE) to the deans of the U-M professional schools for dissemination to their faculty. Two reminder email invitations were sent to faculty one and two months after the initial email invitation. Inclusion criteria were licensed health care providers with faculty appointments at the U-M. The data from the survey responses were analyzed with a statistical software program (SPSS v26; IBM, Armonk, NY, USA). Descriptive statistics including frequency distribution, percentages, and measures of central tendency, specifically mean scores, were used to provide an overview of the findings. Inferential statistics such as one-way ANOVAs and paired t-tests were used to test the hypothesis that level of academic degree influences health care providers' perceptions of IPC. Results were considered statistically significant at $p < 0.05$.

Results

A total of 194 faculty accessed the survey via digital link (n=194). Surveys that were less than or equal to 14% complete (n=15) were excluded from analysis. This percentage represents respondents who opened the survey and answered one or less than one question. One hundred seventy-nine responses were included in the data analysis, fulfilling the a priori power analysis of 168 respondents. The response rate could not be calculated because the total population count was not available. Respondents included faculty who were

licensed dentists (23%), physicians (18%), dental hygienists (11%), physical therapists (8%), pharmacists (7%), and registered nurses (6%) (Table I). Nearly 80% of respondents held a doctoral degree, 17% held a master's degree, and 4% held a bachelor's degree.

Perceptions and Attitudes

The TPB and SCT suggest that behaviors are guided by perceptions, attitudes, norms, and behavioral control.^{11,12} Overall, respondents of all degree types had positive perceptions of IPC (Table II). Ninety percent of total respondents agreed or strongly agreed that IPC is important for improving patient health outcomes. Those with doctoral degrees reported higher levels of agreement than those with master's and bachelor's degrees with mean scores of 5.83, 5.71, and 5.29 respectively. Bachelor's degree respondents felt collaborating with a team member with a lower degree (fewer years of education) to be less desirable compared to respondents with doctoral degrees, with mean differences of 1.06 and 1.02 ($p=0.18$, $p=0.020$). In a paired t-test, most respondents were significantly more comfortable taking recommendations on patient care from a health care provider with a doctoral degree as compared to a health care provider with an associate degree, with mean scores declining from 5.58 to 4.58 ($p=0.000$).

Norms

Overall, respondents felt a fairly high degree of social and professional expectation to collaborate with health care providers outside their own profession (Table III). Respondents who held doctoral degrees tended to feel higher expectations to collaborate than respondents who holding bachelor's degrees, although these differences were not significant (5.18 and 4.00, $p=0.067$). Despite respondents feeling a high degree of expectation to collaborate, only one-fourth of the respondents reported feeling pressure to collaborate.

Environmental Factors

When asked about work environment, 80% of the respondents reported working in an interprofessional environment (Table IV). Most (71%) felt they had administrative support to collaborate with health care providers from other disciplines. Respondents who held doctoral degrees were significantly more likely to agree that the complexity of their work makes it necessary for them to collaborate, when compared to respondents with master's degrees (5.49 and 4.54, $p=0.000$).

Self-Efficacy

Nearly all respondents (98%) felt confident in their ability to contribute to the interprofessional team (Table V). Respondents with doctoral degrees felt significantly more confident collaborating with providers from different disciplines and with providers who held lower academic degrees (5.69 and 4.80, $p=0.003$; 5.65 and 4.80, $p=0.005$). Overall, respondents of all degree levels believed their own level of academic degree and professional role was valuable to the team. However, respondents who held doctoral degrees were significantly more likely to agree that their level of academic degree and professional role were viewed as valuable by other professions than respondents with bachelor's and master's degrees (5.46 compared to 4.80 and 4.65, $p=0.011$; 5.28 compared to 4.60 and 4.19, $p=0.000$). When asked about the value of others, respondents with doctoral degrees tended to value the role of providers from different professions and providers with lower academic degrees more when compared to respondents who held bachelor's and master's degrees. (5.64 compared to 5.00 and 5.27, $p=0.004$; 5.78 compared to 5.40 and 5.50, $p=0.008$).

Discussion

The goal of this pilot study was to examine whether differing academic degree levels influenced a health care provider's intention around IPC. Given the variety of degree levels on multidisciplinary health care teams, it is important to understand whether academic degree level has an impact on factors related to a provider's willingness to collaborate with others. Provider behavior and motivation can be challenging to quantify. Established behavior theory and question design assisted in providing context and measurable attributes associated with the collaborative behaviors. This study's findings provide further support that the level of academic degree has a positive association with IPC value and involvement, however for some health care providers with lower degree levels significant barriers persist to full participation in IPC activities.

Influence of Degree Level on Perceptions and Attitudes

The outcomes demonstrated that respondents of all academic degree levels and disciplines felt IPC is important to their profession and improving patient health outcomes. Significant differences in strength of agreement on the importance of IPC between respondents of different academic degree levels was demonstrated. Those with doctoral degrees

Table I. Respondent demographics (n=179)

Characteristics	n (%)	Characteristics	n (%)	Characteristics	n (%)
Gender		Academic Degree Level		Doctoral degree (continued)	
Male	78 (44.0)	Associate degree	0 (0.0)	Surgeon	3 (0.02)
Female	100 (56.0)	Bachelor's degree	7 (4.0)	Social Work	2 (0.01)
Prefer not to answer	1 (0.6)	Master's degree	30 (17.0)	Epidemiology	1 (0.01)
Age		Doctoral degree	142 (79.0)	Nursing (Anesthesiology)	1 (0.01)
Mean (SD)	49.5 (13.1)	Profession/Degree Breakdown		Occupational Therapy	1 (0.01)
Range	26-81	Associate degree		Ophthalmology	1 (0.01)
Profession		Bachelor's degree		Athletic Training	1 (0.01)
Dentistry (Dentist)	42 (23.0)	Dental Hygiene	5 (71.0)	Other	5 (0.04)
Medicine (Physician)	33 (18.0)	Nursing (RN)	2 (29.0)	Years in Practice	
Dentistry Dental Hygiene)	19 (11.0)	Master's degree		0-5	17 (10.0)
Physical Therapy	14 (8.0)	Dental Hygiene	14 (47.0)	6-10	34 (19.0)
Pharmacy	12 (7.0)	Social Work	6 (20.0)	11-15	26 (15.0)
Nursing (Registered Nurse)	11 (6.0)	Nursing	5 (17.0)	16-20	17 (10.0)
Nursing (Nurse Practitioner)	10 (6.0)	Physical Therapy	1 (0.03)	21-25	18 (10.0)
Social Work	7 (4.0)	Other	4 (13.0)	26 +	67 (37.0)
Anesthesiology	7 (4.0)	Doctoral degree		Primary Role	
Psychiatry	4 (2.0)	Dentistry (Dentist)	41 (29.0)	Practitioner/Clinician	83 (47.0)
Psychology	4 (2.0)	Medicine (Physician)	33 (23.0)	Educator	65 (37.0)
Medicine (Surgeon)	4 (2.0)	Pharmacy	12 (0.08)	Researcher	18 (10.0)
Nursing (Mid-Wife)	2 (1.0)	Physical Therapy	10 (0.07)	Administrator	11 (6.0)
Occupational Therapy	1 (0.6)	Nursing (NP)	8 (0.06)	Public Health	1 (0.5)
Nursing (Mid-Wife)	1 (0.6)	Nursing (RN)	8 (0.06)	Experience with IPE/IPC	
Ophthalmology	1 (0.6)	Anesthesiology	7 (0.05)	Yes	166 (93.0)
Athletic Training	1 (0.6)	Psychiatry	4 (0.03)	No	13 (7.0)
Other	5 (3.0)	Psychology	4 (0.03)		

felt stronger about the importance of IPC than those with master's or bachelor's degrees. This could suggest that faculty with higher degree levels have regular interaction with other health care providers, therefore, strengthening their belief that IPC is important. These results align with Miller et al., who found that higher educational level had a positive impact on IPC participation.⁵ This outcome could also suggest that those respondents with higher academic degrees had more confidence interacting with other health care providers, which would account for their positive perceptions of IPC.

Influence of Degree Level on Willingness to Collaborate

Attributes associated with willingness to collaborate can include desirability of the behavior, social or professional expectations, and the environment in which the behavior takes place. Respondents from all academic degree levels expressed attributes in favor of willingness to collaborate with health care providers with different levels of academic degrees. Those with doctoral degrees indicated they felt more strongly that the outcomes of collaborating were desirable (i.e., beneficial to the patient, pleasant for them, good use of their time, and useful)

Table II. Comparison between degree levels and perceptions and attitudes* (n=179)

Perceptions and Attitudes (Chronbach's alpha=0.537)	Bachelor's Degree		Master's Degree		Doctoral Degree		p<0.05
	n	mean	n	mean	n	mean	
Perceptions							
IPC is important for my profession.	7	5.14	28	5.75	130	5.76	0.046
IPC is important for improving patient health outcomes.	7	5.29	28	5.71	130	5.83	0.036
The level of a healthcare provider's academic degree is important for their profession.	7	5.29	28	4.61	130	4.89	0.282
The level of a healthcare provider's academic degree is important for improving patient health outcomes.	7	5.00	28	4.25	130	4.56	0.239
The level of a healthcare provider's academic degree is important for effective IPC.	7	4.29	28	3.82	130	3.79	0.675
I expect to collaborate with providers who have a different level of academic degree than me	6	5.00	28	5.64	129	5.40	0.184
I want to collaborate with providers who have a different level of academic degree than me	6	5.00	28	5.36	129	5.34	0.670
I intend to collaborate with providers who have a different level of academic degree than me	6	5.00	28	5.57	129	5.35	0.259
Desirability							
Collaborating with a team member who has a lesser academic degree than me is: <i>beneficial for the patient (1) or harmful for the patient (6)</i>	6	2.50	28	1.93	129	1.70	0.088
Collaborating with a team member who has a lesser academic degree than me is: <i>pleasant for me (1) or unpleasant to me (6)</i>	6	2.33	28	1.96	129	1.78	0.271
Collaborating with a team member who has a lesser academic degree than me is: <i>a good use of my time (1) not a good use of my time (6)</i>	6	2.83	28	1.96	129	1.77	0.018
Collaborating with a team member who has a lesser academic degree than me is: <i>useful (1) worthless (6)</i>	6	2.67	28	1.79	129	1.65	0.020
Comfort Taking Recommendations							
I am comfortable taking recommendations on patient treatment from a healthcare provider with a doctoral degree.	6	5.33	28	5.57	129	5.60	0.571
I am comfortable taking recommendations on patient treatment from a healthcare provider with a master's degree.	6	5.50	28	5.57	129	5.40	0.523
I am comfortable taking recommendations on patient treatment from a healthcare provider with a bachelor's degree	6	5.50	28	5.32	129	5.02	0.182
I am comfortable taking recommendations on patient treatment from a healthcare provider with an associate degree.	6	4.50	28	4.79	129	4.54	0.615

*1 = "Strongly Disagree"; 6 = "Strongly Agree"

Table III. Comparison between degree levels and norms* (n=179)

Norms (Chronbach's alpha=0.609)	Bachelor's degree		Master's degree		Doctoral degree		p<0.05
	n	mean	n	mean	n	mean	
It is expected of me to collaborate with healthcare providers from different disciplines.	6	4.00	27	4.85	128	5.18	0.067
People who are important to me want me to work collaboratively with healthcare providers from different disciplines.	6	4.67	27	4.96	128	5.03	0.806
I feel under professional pressure to work collaboratively with healthcare providers from different disciplines.	6	3.17	27	3.22	128	3.34	0.909

*1 = "Strongly Disagree"; 6 = "Strongly Agree"

Table IV. Comparison between degree levels and environmental factors* (n=179)

Environmental Factors (Chronbach's alpha=0.692)	Bachelor's degree		Master's degree		Doctoral degree		p<0.05
	n	mean	n	mean	n	mean	
I work in an environment that houses different healthcare providers.	5	5.00	26	4.77	123	5.35	0.060
I have administration support to collaborate with healthcare providers from other disciplines.	5	5.20	26	4.62	123	5.00	0.316
The complexity of my job makes it necessary for me to work collaboratively with healthcare providers from other health disciplines.	5	5.40	26	4.54	123	5.49	0.000

*1 = "Strongly Disagree"; 6 = "Strongly Agree"

than those respondents with bachelor's degrees. Azjen's TPB posits that the higher the degree of desirability, the higher the likelihood that person will participate in the behavior.¹¹

Further influencing the likelihood of a behavior is the TPB's construct of subjective norms. If a person feels positively about a behavior and thinks those who are important to him/her also value the behavior, their motivation to perform the behavior is much higher.¹¹ The construct of subjective norm was demonstrated by respondents feeling IPC is expected of them and people who are important to them want them to participate in IPC. Overall, respondents from all degree groups did not feel strong social or professional pressure to collaborate with health care providers outside their profession. Responses to norms questions were not strongly one directional. This could indicate that the construct of subjective norm does not have a great deal of influence on this behavior within this

study population. Other research contradicts this finding, however, reporting subjective norms do play an important role predicting behavior in other scenarios.¹⁴

The environment in which providers work and practice may influence their perceptions and attitudes towards IPC.¹² Respondents with master's degrees felt the least agreement with work environment questions related to working with other disciplines and professions, administrative support, and job complexity when compared to the other degree types. Most master's degree respondents in this study were registered dental hygienists. Because many dental hygienists work in clinical settings that require minimal face to face interaction with health care providers outside the field of dentistry, they may not feel that IPC is as necessary a part of their everyday clinical work environment.

Table V. Comparison between degree levels and self-efficacy* (n=179)

Self-Efficacy (Chronbach's alpha=0.879)	Bachelor's degree		Master's degree		Doctoral degree		p<0.05
	n	mean	n	mean	n	mean	
I am confident in my ability to contribute to the interprofessional team.	5	5.40	2	5.65	125	5.77	0.156
I believe my <i>professional role</i> is valuable within the interprofessional team	5	5.60	26	5.65	125	5.79	0.312
Healthcare providers from other disciplines believe my <i>professional role</i> is valuable within the interprofessional team.	5	4.60	26	4.19	125	5.28	0.000
I believe healthcare providers from other disciplines have a valuable <i>role</i> within the interprofessional team	5	5.40	26	5.50	125	5.78	0.008
My level of <i>academic degree</i> is valuable within the interprofessional team	5	5.00	26	5.23	125	5.46	0.199
Healthcare providers from other disciplines believe my level of <i>academic degree</i> is valuable within the interprofessional team.	5	4.80	26	4.65	125	5.22	0.011
Healthcare providers with a lesser <i>academic degree</i> than my own have a valuable role within the interprofessional team.	5	5.00	26	5.27	125	5.64	0.004
I am confident collaborating with healthcare providers from disciplines other than my own.	5	4.80	26	5.54	124	5.69	0.003
I am confident collaborating with healthcare providers who have a higher <i>academic degree</i> as me.	5	5.20	26	5.38	124	5.59	0.148
I am confident collaborating with healthcare providers who have a lesser <i>academic degree</i> as me.	5	4.80	26	5.54	124	5.65	0.005
I am confident collaborating with healthcare providers who have the same <i>academic degree</i> as me.	5	5.40	26	5.58	124	5.69	0.327

*1 = "Strongly Disagree"; 6 = "Strongly Agree"

Influence of Degree Level on Self-Efficacy

In general, respondents with bachelor's degrees felt slightly less confident collaborating with health care providers outside of their discipline and felt slightly less valued by other providers within the interprofessional team when compared to the respondents with master's and doctoral degrees. Although the groups with lower degree levels reported slightly less confidence in collaborating with others and felt less valued by others on the same interprofessional team, these respondents believed in the value of their own role and degree levels. Poor relational value, or not feeling valued by other members of the interprofessional team could be a major barrier to effective IPC. Relational value, inclusion, acceptance, and

self-esteem are all closely related. A meta-analysis by Harris et al. examined longitudinal social research and generally found that if an individual's perceived relational value is low, they will most likely also have low self-efficacy, and vice-versa.¹⁵ Additionally, higher academic degree levels may elicit more respect from other members of the interprofessional team. This increase in respect may play a role in high relational value and increased self-efficacy.

Previous research also identified the importance of professional identity and self-efficacy in a health care provider's ability to contribute to the interprofessional team. Sibandze et al. found that the higher the level of nursing education, the greater awareness of and application of their

professional values to patient care.⁶ With the master's degree respondents of this study answering slightly more confidently than bachelor's degree respondents, it could be hypothesized that health care providers with master's degrees are more confident than their colleagues with bachelor's degrees, indicating that providers with higher academic degrees could have increased self-efficacy.

Most respondents expressed positive feelings toward the behavioral theory constructs attributed to predicting behaviors which would indicate a willingness to participate in IPC activities. However, responses from all degree levels reported significantly less comfort in engaging in a key component of IPC; specifically, taking recommendations on patient treatment from a health care provider with an associate degree. Many health care professions, such as dental hygiene, nursing, and respiratory therapy, require a two-year, associate degree as the entry-level education for initial licensure. Although these health care providers have a valuable role within the interprofessional team, their education level may be a barrier to collaboration due to other providers' perceptions regarding the level of degree. These findings provide support for decades-long calls for a bachelor's degree as the minimum education level for entry into the dental hygiene profession.¹⁶⁻¹⁹ Advanced education could better prepare dental hygienists to more meaningfully contribute to patient care in diverse health care settings and establish parity among other members of the health care team.

Strengths and Limitations

A key strength of this study was the survey instrument which was designed to measure and score variables associated with the TPB and SCT. Such design provides quantitative evidence on factors that predict the likelihood of future behaviors, including what influences a health care providers' sense of self-efficacy and their willingness to collaborate with other health care providers. The study also included faculty from a wide range of health profession education programs.

Limitations include the self-reporting nature of the survey which could have introduced potential bias. This was a small-scale pilot study and respondents were all from the same academic institution and the results may not be representative of health profession faculty at other institutions. Another important limitation was that 80% of the respondents held a doctoral level degree and none of the respondents held an associate degree. At this institution faculty must hold a minimum of a bachelor's degree; and there were only seven bachelor's degree respondents in the sample which may have impacted the reliability of the results. This study sought to explore the influence of academic degree level on a provider's

perceptions of IPC and their willingness to collaborate using established behavioral constructs however the survey instrument did not control for other variables such as gender, age, race/ethnicity, or years in practice. It is possible these or other variables also have an impact on willingness to collaborate.

Future research should investigate why faculty report they value the role of health care providers with lower degrees but are less likely to seek collaboration or treatment recommendations from those providers. Researchers should explore interventions to promote provider participation in IPC that addresses behavioral factors related to provider attitudes, confidence, and intentions. Health professional faculty members play an integral role in preparing future health care providers for IPC. Currently there is a gap in the literature on how faculty perceptions of IPC could potentially influence their students' opinions of IPC; this should be examined in future studies. Future research should also investigate whether other factors such as gender, age, profession, number of years in practice, race/ethnicity, and primary role, influence health care providers' perception of IPC and willingness to collaborate.

Conclusion

Understanding and predicting behaviors is important to health care professionals tasked with developing interventions or policies that promote uptake of evidence-based practices such as IPC. While faculty valued IPC in improving patient outcomes, their perceptions of other health care providers' level of academic degree may play a role in their willingness to collaborate. Specifically, the lower level of comfort taking recommendations on patient care from a provider with an associate degree. With many health care education programs offering an associate degree, this could be viewed as a barrier for these health care providers to meaningfully contribute to the interprofessional team. Despite an institution's positive culture of IPC, potential bias and stereotypes regarding the level of academic degree should be addressed. Interventions that could improve willingness to collaborate include implicit bias training, cross training, as well as incorporating interprofessional learning experiences early during the health care education program.

Acknowledgements

The authors wish to acknowledge the U-M Center for Interprofessional Education for their support of this research and Nolan Kavanagh for assistance with the statistical analysis.

Megan R. Bilbee, RDH, MS is a graduate of the Master of Science in Dental Hygiene program, University of Michigan School of Dentistry; **Danielle Rulli, RDH, MS, DHSc** is a clinical associate professor and the Graduate Dental Hygiene Program Director, Department of Periodontics and Oral Medicine, University of Michigan School of Dentistry; **Stefanie M. VanDuine, RDH, MS**, is a clinical lecturer, Division of Dental Hygiene, Department of Periodontics and Oral Medicine, University of Michigan School of Dentistry; **Elizabeth K. Kuzma, DNP, FNP-BC**, is a clinical assistant professor and the FNP Program Lead, Department of Health Behavior and Biological Sciences, University of Michigan School of Nursing; **Jennifer L. Cullen, RDH, BSDH, MPH** is a clinical lecturer and the Director of the Dental Hygiene Degree Completion Program, Department of Periodontics and Oral Medicine, University of Michigan School of Dentistry; all at the University of Michigan, Ann Arbor, MI, USA.

Corresponding author: Megan Bilbee, RDH, MS;
mbilbee@umich.edu

References

1. United States Congress. Patient protection and affordable care act. Washington (DC): United States Congress; 2010. 974 p.
2. US Department of Health and Human Services. Oral health strategic framework 2014-2017. Washington (DC): U.S. Department of Health and Human Services. 2017. 48 p.
3. Bridges DA, Davidson RA, Odegard PS, et al. Interprofessional collaboration: three best practice models of interprofessional education. *Med Educ Online*. 2011 Apr;31(6):10-4.
4. Ateah CA, Snow W, Wener, P, et al. Stereotyping as a barrier to collaboration: does interprofessional education make a difference? *Nurse Educ Today*. 2011 Feb;31(2):208-13.
5. Miller JL. Level of RN educational preparation: its impact on collaboration and the relationship between collaboration and professional identity. *Can J Nurs Res Rev Can Rech En Sci Infirm*. 2004 Jun;36(2):132-47.
6. Sibandze BT, Scafide KN. Among nurses, how does education level impact professional values? A systematic review. *Int Nurs Rev*. 2018 Mar;65(1):65-77.
7. Furgeson D, Inglehart MR. Interprofessional education in dental hygiene programs and CODA standards: dental hygiene program directors' perspectives. *Int J Dent Hyg*. 2017 Apr;91(2):6-14.
8. Bagge JR, Harbaugh TC, Tabora IG, et al. Dental hygienists' interprofessional education and collaboration experiences: a survey of current behaviors and attitudes. *J Dent Hyg*. 2021 Aug;95(4):32-40
9. Cook K, Stoecker J. Healthcare student stereotypes: a systematic review with implications for interprofessional collaboration. *J Res Interprofessional Pract Educ*. 2014 Nov;4(2).
10. Pratt R, Gyllstrom B, Gearin K, et al. Identifying barriers to collaboration between primary care and public health: experiences at the local level. *Public Health Rep*. 2018 Jun; 133(3):311-7.
11. Ajzen I. The theory of planned behavior. *Organ Behav Hum Decis Process*. 1991 Dec;50(2):179-211.
12. Bandura A. Social cognitive theory of self-regulation. *Organ Behav Hum Decis Process*. 1991 Dec;50(2): 248-87.
13. Francis J, Eccles MP, Johnston M. Constructing questionnaires based on the theory of planned behavior: a manual for health services researchers. Centre for Health Services Research. 2012 Oct; 13(38):1-43.
14. Ham M, Jeger M, Ivkovic AF. The role of subjective norms in forming the intention to purchase green food. *Economic Research-Ekonomska*. 2015 Oct; 28(1):738-48.
15. Harris MA, Orth U. The link between self-esteem and social relationships: a meta-analysis of longitudinal studies. *J Pers Soc Psychol*. 2020 Dec;119(6):1459-77.
16. Battrell A, Lynch A, Steinbach P, et al. Advancing education in dental hygiene. *J Evid Based Dent Pract*. 2014 Jun; 14 Suppl: 209-11.e1.
17. Boyleston ES, Collins MA. Advancing our profession: are higher educational standards the answer? *J Dent Hyg*. Summer;86 (3):168-78.
18. Stolberg RL. The baccalaureate-educated dental hygienist. *J Evid Based Dent Pract*. 2016 Jun;16:136-43.
19. American Dental Hygienists' Association. ADHA policy manual [Internet]. Chicago (IL): American Dental Hygienists' Association; c2020 [cited 2021 Nov 20]. Available from: https://www.adha.org/resources-docs/7614_Policy_Manual.pdf

Prenatal and Pediatric Oral Health Education Among Dental Hygiene Programs in the United States

Denise M. Claiborne, PhD, RDH; Shillpa Naavaal, BDS, MS, MPH

Abstract

Purpose: Health care and dental providers must be prepared to address the oral health needs of mothers and children in order to reduce the burden of dental disease in these populations. The purpose of this study was to describe the curriculum and clinical experiences related to prenatal and pediatric oral health in the university and community college dental hygiene programs in the United States (US).

Methods: Dental hygiene program directors (PDs) from across the US were invited to participate in a cross-sectional electronic survey regarding the prenatal and pediatric oral health curriculum at their institution. In addition to program characteristics, the survey included items pertaining to curriculum and competencies, content delivery methods and hours spent, locations for clinical experiences, collaboration efforts, and professional policy guidelines. Responses were summarized, and descriptive analyses were conducted to examine program competency and curriculum by program type.

Results: A total of 124 PDs responded to the survey for a 37.9% response rate; over half (54%) were based in community colleges. Overall, most PDs indicated prenatal (77.3%) and pediatric oral health (66.1%) as a part of their program's core curriculum. However, prenatal oral health was a core competency for 52% of the respondents and less than half (46%) considered pediatric oral health a core competency. Most programs (>75%) reported teaching professional policies and guidelines. Universities reported more hours for prenatal and didactic and clinical experiences than community colleges. The most common barrier reported for prenatal and pediatric clinical experience was the lack of patients (55% and 35%, respectively).

Conclusions: Most dental hygiene programs are utilizing a variety of methodologies to incorporate prenatal and pediatric content into the curriculum and students are being exposed to professional guidelines and recommendations for these populations. However, patient care experiences for prenatal and pediatric patients were low due to lack of patients.

Keywords: prenatal oral health, pediatric oral health, dental hygiene education, oral health promotion

This manuscript study supports the NDHRA priority area, **Professional development: Education** (evaluation).

Submitted for publication: 5/12/21; accepted: 9/29/21

Introduction

Providing oral health educational and clinical guidance to women during the prenatal period is essential for promoting positive maternal and infant oral health outcomes. Prenatal oral health is an integral part of women's health and affects the health status of their child. Children whose mothers had untreated dental caries, or tooth loss were three times more likely to have a dental caries experience compared to their counterparts.¹ Dental caries, gingivitis, and periodontitis are common diseases women may encounter during pregnancy.² Roughly 60-75% of pregnant women experience some form of periodontal disease.³ If untreated, these diseases may put both the mother and newborn at risk for preterm birth and low-birth weight.⁴

Preventive oral care is safe and recommended throughout all trimesters of pregnancy.⁵ However, using data from the state of Virginia, researchers found that less than half of the expectant mothers utilized dental care during pregnancy.⁶ Similarly, although it is recommended that children have their first dental visit by age one, the proportion of children aged 0-4 years, regardless of insurance type (i.e., Medicaid/CHIP or public) who receive a dental visit, is lower as compared to children aged 5-18 years.⁷ To minimize dental problems such as early childhood caries (ECC), a common chronic oral disease among children,⁸ health care and dental providers must address the oral health needs of mothers and

children. In 2015-2016, 21.4% of children aged 2-5 years had a dental caries experience and 8.8% of those children had untreated tooth decay.⁹ Dental hygienists are ideal providers to promote oral health through education and the provision of preventive services to prenatal and pediatric patients.¹⁰ Moreover, dental hygienists can increase access to care among these vulnerable groups by providing care in health care settings such as hospitals, medical offices, and public health clinics. Currently, 39 states allow dental hygienist to work in these medical settings.¹¹ While the dental hygiene workforce is expanding beyond the traditional private practice settings, studies have shown that dental hygienists report requesting more continuing education courses focusing on prenatal¹² and infant and toddler oral health¹³ and early childhood caries¹⁴ as well as recommending more didactic and clinical experiences in the dental hygiene curricula.¹³

Dental hygienists must be prepared in their formal education and training with didactic and clinical experiences to demonstrate competence in providing care to diverse patient populations at all levels of development. Specifically, the Commission on Dental Accreditation (CODA) Standards for Allied Dental Education, standard 2-12 states, "Graduates must be competent in providing dental hygiene care for the child, adolescent, adult, geriatric, and special needs patient populations."¹⁵ However, providing care specifically to prenatal patients is not clearly defined within the standard description.

Given the broad scope of the dental hygiene standards, each dental hygiene program may provide varying levels and number of prenatal and pediatric clinical experiences for students. Schroth et al. found that Canadian dental hygiene programs reported an average of 3.5 hours devoted to prenatal oral health and an average of 5.5 hours was allocated to infant and toddler oral health within in the curriculum.¹⁶ Previous studies have suggested a closer examination of current dental hygiene curricula and CODA standards to ensure graduates have the necessary skillsets to provide care in diverse patient care settings.¹⁷⁻¹⁸ There is a gap in the literature regarding prenatal and pediatric oral health education among dental hygiene programs in the US. The purpose of this study was to describe the curriculum and clinical experiences related to prenatal and pediatric oral health and to determine differences by the type of dental hygiene program.

Methods

A cross-sectional survey was used to explore and describe prenatal and pediatric (infants and toddlers) oral health curriculum and clinical experiences among U.S. dental hygiene programs. A contact list of the 332 entry-level dental hygiene (DH) program directors (PDs) was obtained, and

the email addresses were confirmed from the institution's webpage. Programs were excluded (n=5) if the contact person could not be identified, required a separate IRB to participate, or if the program was inactive. An anonymous electronic survey link (Qualtrics; Provo, UT, USA) was sent to a final sample of 327 DH program directors with four weekly reminder emails from September – October 2018.

Survey Instrument and variables

The survey questions were adapted with permission from a previous study that examined prenatal, infant and toddler oral health curriculum among Canadian dental and dental hygiene programs.¹⁶ The survey included content related to prenatal and infant and toddler oral health in the following areas: curriculum and competencies, curriculum hours and methods for delivery, locations for clinical experiences, collaboration efforts, and professional policy guidelines. In addition to above listed topics, the survey also included questions about program characteristics (community college, technical college, university DH program without dental school, and university DH program with dental school), number of full-time faculty members, number of students accepted into the entering class each year, and the number of entering classes accepted within a 12 month period, clinical experiences with performing pediatric oral health assessments (OHAs) and applying fluoride varnish, settings for OHAs and fluoride varnish applications, and interprofessional pediatric service-learning experiences. The final survey consisted of 41 items that were examined for content and face validity as well as reliability by an expert panel of dental hygiene educators. The Human Subjects Committee at Old Dominion University deemed this study as exempt.

Data Analysis

The PDs' report of prenatal and pediatric oral health curriculum and clinical experiences for their students were examined by program type: community colleges (CC) (community and technical colleges) and universities (university/college without a dental school and university with a dental school). Descriptive analyses were conducted for summarizing sample characteristics. Chi-square, Fisher Exact, and Likelihood Ratio were used to test differences between categorical variables. Mann-Whitney U t-tests were used to examine differences in continuous variables (i.e., hours of didactic and clinical experiences related to prenatal and pediatric curriculum content between the two program types). All analyses were conducted using a statistical software program (SPSS v.26; IBM, Armonk, NY, USA) and the alpha was set at 0.05.

Results

A total of 124 PDs responded to the survey for a response rate of 37.9%. Over half of the respondents, were affiliated with a community college (54%, n=67) and most (72.8%, n=83) reported having 1-5 faculty members within the program. A majority (82.3%, n=93) accepted one DH class per year, with 42.9% (n=48) reporting a class size of 21-30 students (Table I).

Table I. Dental hygiene program characteristics (n=124)

Characteristic	n	%
Program type		
Technical college	14	11.3
Community college	67	54
University/college without a dental school	26	21
University with a dental school	17	13.7
Number of faculty members		
1-5	83	72.8
6-10	26	22.8
11 or More	5	4.4
Number of entering DH classes within 12 months		
0 Classes per year	1	0.9
1 Classes per year	93	82.3
2 Classes per year	11	9.7
3 Classes per year	1	0.9
Unknown	7	6.2
Number of accepted students in entering DH classes per year		
10-20	39	34.9
21-30	48	42.9
31-40	15	13.4
41 or more	10	8.9

Prenatal Oral Health

Curriculum and Experiences

Over three-fourths (77.3%) of respondents indicated prenatal oral health as a part of their program's core curriculum while just about half (51.6%) reported it as a core competency. For specific professional policies and clinical guidelines relating to prenatal oral health taught, nearly all respondents (90.5%) reported discussing the relationship between periodontal disease and preterm birth and low-birth weight. When asked whether the curriculum included information on the role of maternal/prenatal nutrition on infant and toddler oral health, (86.7%) of respondents

reported in the affirmative, and 89.5% reported discussing the vertical transmission of cariogenic bacteria from mother to infant. However only 22.9% of the respondents indicated that over half of their students received at least one or more hands-on experience(s) with prenatal patients (Table II). Although the curriculum and prenatal experiences varied between community colleges and universities, none of the differences were significant at $p<0.05$.

Hours of Didactic and Clinical Experiences and Barriers

Overall, universities reported more mean hours for all forms of didactic and clinical experiences than community colleges. Specifically, respondents from universities reported the highest number of mean hours for clinical patient care experiences versus community colleges (28.93 hrs vs.5.92 hrs, respectively). However, there was wide variation among reported hours in both groups. When examining only universities, there were more mean hours reported for video or web-based learning (8.23hrs) than didactic instruction (5.80hrs) for prenatal care (Table III). The three most common reported barriers for prenatal clinical experiences included lack of clients/patients (54.5%), students' schedules and appointment times (14.8%) and, patient perception of need (12.5%) (Figure 1).

Pediatric Oral Health

Curriculum and Experiences

Over two-thirds (66.1%) of all respondents reported having pediatric oral health as part of the DH core curriculum, while less than half (45.7%) reported pediatric oral health as a core competency. Over half of the respondents (56.8%), reported teaching the recommendation of the first dental visit by age one in their curriculum and 41.2% reported that over 75% of their students received one or more hands-on experience(s) with pediatric patients. When stratified by program type, 50% of community colleges and 60% of universities reported that more than 50% of their students received at least one hands-on experience with pediatric patients ($p<0.05$). When respondents were asked about students' performance of oral health assessments (OHAs) and applying fluoride varnish, nearly 20% reported that students were lacking this experience (Table IV). In terms of collaborative efforts, only 41.4% reported that their students have interprofessional learning experiences related to pediatric oral health. Respondents from universities had higher reports of interprofessional education (IPE) opportunities (48.6%) compared to community colleges (37.7%). Of those who reported collaborative efforts, over one-quarter (28.4%) reported that these experiences occurred in public health settings such as Head Start programs (data

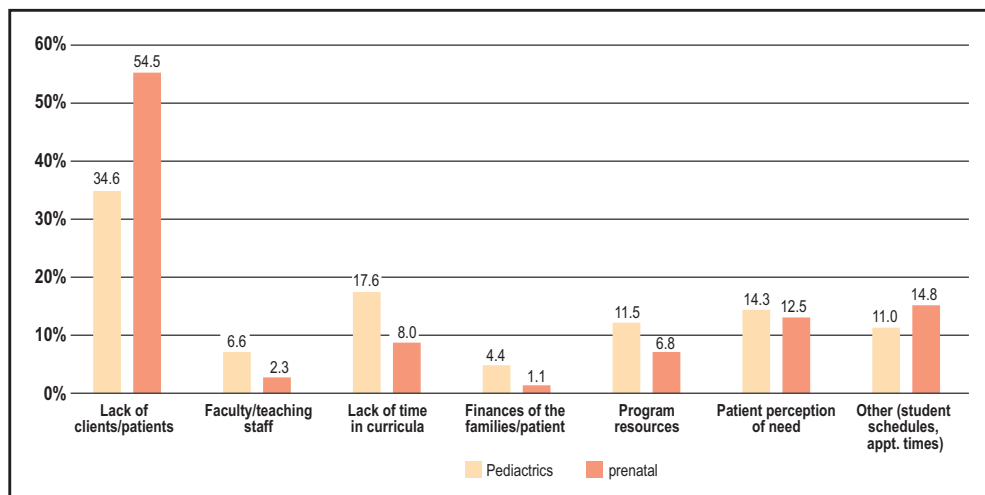
Table II. Prenatal oral health curriculum and experiences (n=124)*

Statement	Responses	DH Programs**		
		Total n (%)	Community Colleges n (%)	Universities n (%)
Prenatal OH core curriculum.	Yes	75 (77.3)	47 (74.6)	28 (82.4)
	No/Unsure	22 (22.7)	16 (25.4)	6 (17.6)
Prenatal OH core competency.	Yes	50 (51.6)	31 (48.4)	19 (57.6)
	No/Unsure	45 (46.4)	31 (48.4)	5 (42.4)
	Can be done as an elective	2 (2.1)	2 (3.1)	0 (0.0)
Periodontal disease preterm and low birth weight.	Yes	95 (90.5)	63 (91.3)	32 (88.9)
	No/Unsure	10 (9.5)	6 (8.7)	4 (11.1)
Prenatal nutrition during pregnancy pediatric OH.	Yes	91 (86.7)	60 (87.0)	31 (86.1)
	No/Unsure	14 (13.3)	9 (13.0)	5 (13.9)
Transmission of cariogenic bacteria from mother to infant.	Yes	94 (89.5)	64 (92.8)	30 (83.3)
	No/Unsure	11 (10.5)	5 (7.2)	6 (16.7)
Percentage of students with 1+ hands-on experience(s).	Up to 10%	54 (51.4)	38 (55.1)	16 (44.4)
	11-24%	14 (13.3)	6 (8.7)	8 (22.2)
	25-50%	13 (12.4)	10 (14.5)	3 (8.3)
	51-75%	11 (10.5)	8 (11.6)	3 (8.3)
	76-100%	13 (12.4)	7 (10.1)	6 (16.7)
Additional elective training for prenatal OH.	Yes	15 (14.3)	9 (13.0)	6 (16.7)
	No/Unsure	90 (85.7)	60 (87.0)	30 (83.3)

*Not all columns equal 124

** Community colleges includes technical colleges; university includes both university/college without a dental school and universities affiliated with a dental school

Figure 1. Reported barriers to providing clinical experiences to prenatal and pediatric patients.



not shown). Lastly, when asked about additional elective training opportunities related to pediatric oral health, only 1 in 5 programs reported having additional elective training opportunities (Table IV).

Hours of Didactic and Clinical Experiences and Barriers

With regards to the mean hours dedicated to delivery formats of pediatric oral health content, patient care experiences were higher for university than community programs (22.2hrs vs. 7.82hrs, respectively). This was followed by clinical observation only (9.32hrs vs. 5.80hrs) and didactic approaches (6.50hrs vs. 4.11hrs) (Table III). Similar to prenatal content, there was wide variation in pediatric content hours both between and within program types. The top three reported barriers included lack of clients/patients (34.6%), lack of time in curricula (17.6%), and patient perception of need (14.3%) (Figure 1).

Professional Policies and Clinical Guidelines

In general, most respondents reported teaching various pediatric oral health professional policies and clinical guidelines within dental hygiene programs. More than 90% reported discussing the following: infant oral health care, the definition of early childhood caries, caries-risk assessment tools, amount of toothpaste to use, the relationship between bottle-feeding practices and oral health, and the recommendation for the first dental visit. Interestingly, while 91.7% of respondents reported discussing the relationship between bottle-feeding practices and oral health, only 74.1% reported discussing breast-feeding practices and oral health.

When examining differences of the professional guidelines and

Table III. Hours of didactic and clinical prenatal and pediatric curriculum content for all programs* (n=124)

Prenatal			Pediatric		
Community College		University	Community College		University
	m ± sd	m ± sd		m ± sd	m ± sd
Didactic (lecture, seminars) **(0-42)	n=58 3.21 ± 3.0	n=30 5.80 ± 8.9	Didactic (lecture, seminars) **(1-45)	n=57 4.11 ± 5.4	n=34 6.50 ± 8.7
Video, Internet, or Web-based Learning (0-90)	n=24 1.54 ± 2.3	n=13 8.23 ± 24.7	Video, Internet, or Web-based Learning (0-10)	n=29 1.21 ± 1.4	n=18 1.22 ± 2.4
Clinical (observation only) (0-120)	n=15 4.73 ± 17.5	n=11 12.45 ± 35.8	Clinical (observation only) (0-120)	n=25 5.80 ± 19.0	n=22 9.32 ± 25.5
Clinical Dental Screening (0-98)	n=18 4.28 ± 13.8	n=14 15.50 ± 34.0	Clinical Dental Screening (0-36)	n=33 4.36 ± 6.7	n=19 3.16 ± 3.8
Clinical Patient Care (prevention and/or restorative) (0-360)	n=24 5.92 ± 10.6	n=14 28.93 ± 95.4	Clinical Patient Care (prevention and/or restorative) (0-360)	n=39 7.82 ± 10.5	n=27 22.2 ± 68.6

Note: multiple response questions; not all columns equal n=124.

*Community colleges includes technical colleges; university includes both university/college without a dental school and universities affiliated with a dental school

**Total minimum and maximum values in hours (combined) for each category.

policies by program type, respondents from universities, had higher reports of discussing infant oral health care, amount of toothpaste use, bottle-feeding practices and oral health, and the recommendation for the first dental visit than respondents who represented community colleges, but without statistical significance (Table V).

Discussion

This exploratory study provides an overview of prenatal and pediatric oral health content and clinical experiences delivery within the DH programs in the US. The following key findings were observed: respondents from both university-based and community college-based programs reported more curriculum and core competencies related to prenatal oral health content than pediatric oral health content; the average hours dedicated to didactic and clinical experiences for both prenatal and pediatric content was higher for university than community college programs; and reports of hands-on prenatal experiences were low for both program types (universities and community colleges).

Reports of prenatal oral health curriculum content and core competency was higher than pediatric oral health content in this study. Although the prenatal population is not explicitly mentioned in CODA standards, this finding suggests that DH programs are aware of maternal oral health importance and are incorporating prenatal oral health content in their curriculum as suggested by best practice approaches.¹⁰ On the other hand, the lower report of core competencies related to pediatric oral health may be a result of the broad term “child” that is used in the CODA standard 2-12. According to the American Academy of Pediatrics, the term “child” includes all children under the age of 12 years.¹⁹ Since the standard does not specify an age range for children, DH programs may have varying definitions and requirements for child patients. This study examined the pediatric content as it relates to infants and toddlers; many DH programs have may have competencies for children aged five years and above but not for zero to five years. Perhaps a closer evaluation or clarification of the current CODA standard may be necessary to highlight the competency requirements for infants and toddlers and to ensure that students are competent and confident to deliver DH care throughout the life span.

Table IV. Pediatric oral health curriculum and experiences for all programs* (n=124)

Statement	Responses	DH Programs		
		Total n (%)	Community Colleges n (%)	Universities n (%)
Pediatric OH core curriculum	Yes	78 (66.1)	47 (61.8)	31 (73.8)
	No	40 (33.9)	29 (38.2)	11 (26.2)
Pediatric OH core competency	Yes	53 (45.7)	31 (40.8)	22 (55.0)
	No	58 (50.0)	42 (55.3)	16 (40.0)
	Can be done as an elective	5 (4.3)	3 (3.9)	2 (5.0)
Recommended age for first dental visit	6 months	30 (25.4)	16 (21.1)	14 (33.3)
	By 12 months of age or 1 st birthday	67 (56.8)	43 (56.6)	24 (57.1)
	By 24 months of age or 2 nd birthday	12 (10.2)	9 (11.8)	3 (7.1)
	By 36 months of age or 3 rd birthday or after	9 (7.6)	8 (10.5)	1 (2.4)
Percentage of students with 1+ hands-on experience(s)**	Up to 10%	33 (32.4)	27 (41.5)	6 (16.2)
	11-24%	6 (5.9)	(3.1)	4 (10.8)
	25-50%	9 (8.8)	4 (6.2)	5 (13.5)
	51-75%	12 (11.8)	5 (7.7)	7 (18.9)
	76-100%	42 (41.2)	27 (41.5)	15 (40.5)
Clinical experiences performing OHAs and Fl- varnish application	No experience for students	21 (19.4)	16 (22.9)	5 (22.7)
	Variable experiences for students	44 (40.7)	28 (40.0)	16 (42.1)
	All students have experiences	43 (39.8)	26 (37.1)	17 (44.7)
Opportunities for IPE and pediatric oral health	Yes	43 (41.4)	26 (37.7)	17 (48.6)
	No	61 (58.7)	43 (62.3)	18 (51.4)
Additional elective training (opportunities beyond the curriculum).	Yes	21 (19.4)	12 (17.1)	9 (23.7)
	No	87 (80.6)	58 (82.9)	29 (76.3)

* Community colleges includes technical colleges; university includes both university/college without a dental school and universities affiliated with a dental school

**Statistically significant based on Chi-square test (Likelihood Ratio); not all columns N=124

In general, the average number of hours reported for the delivery of prenatal and pediatric didactic content and clinical experiences was higher among universities. This difference may be attributed to resource availability and connectedness with other allied health programs. For example, dental hygiene programs that are affiliated with a university and particularly a dental school, may have more opportunities for intraprofessional and interprofessional collaborations; as well as the ability to provide innovative methods of delivery and clinical experiences. For example, the University of North Carolina Chapel Hill developed a Prenatal Oral Health Program (pOHP) to provide prenatal oral health training for pediatric dentists and obstetricians and gynecologists.²⁰ The program later evolved and included senior dental hygiene students who worked collaboratively with dental students to provide preventive services to pregnant patients.²⁰ The researchers observed an overall increase in dental hygiene students' knowledge and confidence to screen and counsel pregnant patients after completion of the pOHP.²⁰ Similarly, Claiborne et al., created a service-learning experience for dental hygiene and nurse practitioner students to collaborate and deliver oral health education, oral screenings, and fluoride varnish application to pre-school age children attending a university-based child development program.²¹ The activity provided a space for both dental hygiene and nurse practitioner students to visualize their roles individually and collectively as it relates to pediatric oral health.

While there are documented collaborative efforts to provide prenatal and pediatric experiential clinical experiences;²⁰⁻²¹ the current study found that the reported percentage of students with one or more hands-on experiences for prenatal and pediatric

Table V. Professional policies and clinical guidelines for prenatal and pediatrics for all programs* (n=124)

Statement	Responses	DH Programs		
		Total n (%)	Community Colleges n (%)	Universities n (%)
Dental home	Yes	82 (78.8)	51 (77.3)	31 (81.6)
	No/Unsure	22 (21.2)	15 (22.7)	7 (18.4)
Infant oral health care	Yes	97 (90.7)	60 (87.0)	37 (97.4)
	No /Unsure	10 (9.3)	9 (13.0)	1 (2.6)
Definition of early childhood caries	Yes	103 (95.4)	67 (95.7)	36 (94.7)
	No/Unsure	5 (4.6)	3 (4.3)	2 (5.3)
Caries-risk assessment tools	Yes	98 (91.6)	64 (92.8)	34 (89.5)
	No/Unsure	9 (8.4)	5 (7.2)	4 (10.5)
Recommendation of fluoridated toothpaste	Yes	68 (63.0)	42 (60.0)	26 (68.4)
	No/Unsure	40 (37.0)	28 (40.0)	12 (31.6)
Amount of toothpaste	Yes	98 (90.7)	63 (90.0)	35 (92.1)
	No/Unsure	10 (9.3)	7 (10.0)	3 (7.9)
Benefits and frequency of FL- varnish	Yes	96 (88.9)	62 (88.6)	34 (89.5)
	No/Unsure	12 (11.1)	8 (11.4)	4 (10.5)
FL- varnish application	Yes	86 (79.6)	53 (75.7)	33 (77.3)
	No/Unsure	22 (20.4)	17 (24.3)	5 (13.2)
Proper diets with caregivers	Yes	96 (88.9)	63 (90.0)	33 (86.8)
	No/Unsure	12 (11.1)	7 (10.0)	5 (13.2)
Bottle-feeding and oral health	Yes	99 (91.7)	63 (90.0)	36 (94.7)
	No/Unsure	9 (8.3)	7 (10.0)	2 (5.3)
Breastfeeding and oral health	Yes	80 (74.1)	55 (78.6)	25 (65.8)
	No/Unsure	28 (25.9)	15 (21.4)	13 (34.2)
Recommendation for a first dental visit	Yes	100 (92.6)	63 (90.0)	37 (97.4)
	No/Unsure	8 (7.4)	7 (10.0)	1 (2.6)
Performing and positioning for an oral health examination	Yes	92 (85.2)	61 (87.1)	31 (81.6)
	No/Unsure	16 (14.8)	9 (12.9)	7 (18.4)
Recognition of dental caries during an oral health examination	Yes	96 (88.9)	63 (90.0)	33 (86.8)
	No/Unsure	12 (11.1)	7 (10.0)	5 (13.2)

Note: Not all columns equal n=124

*Community colleges includes technical colleges; university includes both university/college without a dental school and universities affiliated with a dental school

patients was low for both university and community college programs. Prenatal hands-on experiences were the lowest for both program types. This finding aligns with the respondents' reported barriers for prenatal clinical experiences; the highest reported barrier was a lack of clients/patients. This may be related with lower use of dental services among pregnant women. There are oral health knowledge gaps and many women do not feel that it is safe to receive routine dental care during pregnancy.^{22,23} Dental hygiene programs are in an ideal position to offer education and routine dental care to pregnant patients while also providing students with impactful clinical experiences. To increase prenatal patient experiences, DH programs can consider partnering with public health clinics or the Women Infant and Children (WIC) programs and create experiential learning opportunities for their students.

Regarding pediatric experiences, one in five respondents reported that their students did not have experience performing oral health assessments (OHAs) and applying fluoride varnish. In addition, fewer than half reported IPE experiences. These experiences are essential for DH students as fluoride varnish is a common preventive dental service that DHs can provide and one that is often provided in settings outside of dentistry.²⁴ Interprofessional experiences can expose dental hygiene students to other allied health professionals.¹⁷⁻¹⁸ One weakness identified in the dental hygiene curriculum is the minimum number of IPE opportunities reported in the entry-level curricula.^{17,25} Despite programmatic barriers to providing IPE experiences, dental hygiene programs are attempting to collaborate with other disciplines such as nursing to provide opportunities for students,²⁶ which is an ideal collaborator profession to address prenatal and pediatric oral health.

This study had limitations. First, this was a cross-sectional design; and is subject to recall and reporting bias. Program directors had to recall information about the entire program curriculum related to prenatal and pediatric oral health; specifically, they had to approximate number of hours for different methods of delivery for both prenatal and pediatric didactic and clinical experiences. The hours reported may be the total hours dedicated in the curriculum but may not be reflective of all students receiving the experience (i.e., clinical related experiences), which is evident in the responses related to hands-on clinical experiences. Despite these limitations, this was the first study to the researchers' knowledge to examine prenatal and pediatric oral health curriculum and clinical experiences within entry-level dental hygiene programs in the US. In addition, findings from the current study identifies the gaps in DH curriculum that should be addressed and improved upon while also highlighting the content areas where DH programs are successfully incorporating required content.

Conclusions

Although, DH programs vary in content and clinical experiences, it is evident that most programs are utilizing different methodologies to incorporate prenatal and pediatric content into the curriculum. In addition, DH students are being exposed to prenatal and pediatric oral health professional guidelines and recommendations. However, patient care experiences for prenatal and pediatric patients among both universities and community college programs are low due to several reported barriers, including a lack of patients. To develop a well-trained DH workforce, it is essential to identify opportunities to strengthen the prenatal and pediatric content and provide clinical experiences to the students. Integrating IPE opportunities and identifying health care professional collaborators providing care to prenatal and pediatric populations may be some strategies to increase patient encounters for DH students and better prepare them for addressing oral health among these populations.

Denise M. Claiborne, PhD, RDH is an assistant professor and the Graduate Program Director, College of Health Sciences, School of Dental Hygiene, Old Dominion University, Norfolk, VA, USA.

Shillpa Naavaal, BDS, MS, MPH, is an associate professor, Dental Public Health and Policy, School of Dentistry, Virginia Commonwealth University, Richmond VA, USA; and a faculty member, Oral Health Services Research Core, Philips Institute for Oral Health Research and Oral Health Equity Core, iCubed, Virginia Commonwealth University, Richmond, VA, USA.

Corresponding author: Denise M. Claiborne, PhD, RDH;
dclaibor@odu.edu

References

1. Dye BA, Vargas CM, Lee JJ, et al. Assessing the relationship between children's oral health status and that of their mothers. *J Am Dent Assoc.* 2011 Feb;142(2):173-83.
2. NCCDPHP Division of Oral Health. Pregnancy oral health [Internet]. Atlanta (GA): Centers for Disease Control; 2021 [last reviewed 2019; cited 2021 Apr 27]. Available from: <https://www.cdc.gov/oralhealth/publications/features/pregnancy-and-oral-health.html>
3. ADA Council on Access, Prevention, and Interprofessional Relations. Women's oral health issues: white paper 2006 [Internet]. Chicago (IL): American Dental Association; 2021 [cited 2021 Apr 27]. Available from: <https://ebusiness.ada.org/Assets/docs/2313.pdf>
4. Corbella S, Taschieri S, Del Fabbro M, et al. Adverse pregnancy outcomes and periodontitis: a systematic review and meta-analysis exploring potential association. *Quintessence Int.* 2016 Mar;47(3):193-204.
5. American College of Obstetricians and Gynecologists. Committee Opinion No. 569: oral health care during pregnancy and through the lifespan. *Obstet Gynecol.* 2013 Aug;122(2):417-22.
6. Naavaal S, Brickhouse TH, Hafidh S, Smith K. Factors associated with preventive dental visits before and during pregnancy. *J Womens Health (Larchmt).* 2019 Dec;28(12):1670-8.
7. MACPAC. Medicaid access in brief: Children's dental services. Issue brief [Internet]. Washington, DC: Medicaid and CHIP payment and Access Commission; 2021 [cited 2021 Apr 27]. Available from: <https://www.macpac.gov/wp-content/uploads/2016/06/Medicaid-Access-in-Brief-Childrens-Dental-Services.pdf>.
8. NCCDPHP Division of Oral Health. Children's oral health [Internet]. Atlanta (GA): Centers for Disease Control; 2021 [last reviewed 2021; cited 2021 Apr 27]. Available from: <https://www.cdc.gov/oralhealth/basics/childrens-oral-health/index.html>.
9. Fleming E, Afful J. Prevalence of total and untreated dental caries among youth: United States, 2015-2016. NCHS Data Brief, no 207 [Internet]. Hyattsville, MD: National Center for Health Statistics; 2021 [cited 2021 Apr 27]. Available from: <https://www.cdc.gov/nchs/data/databriefs/db307.pdf>.

10. Oral health care during pregnancy expert workgroup. Oral health care during pregnancy consensus statement [Internet]. Washington, DC: National Maternal and Child Oral Health Resource Center; 2021 [cited 2021 Apr 27]. Available from: <https://www.mchoralhealth.org/PDFs/OralHealthPregnancyConsensus.pdf>.
11. American Dental Hygienists' Association. Dental hygiene in medical settings and health clinics [Internet]. Chicago (IL): American Dental Hygienists' Association; 2021 [updated 2019 Jun; cited 2021 Apr 27]. Available from: https://www.adha.org/resources-docs/Dental_Hygiene_in_Medical_Settings.pdf.
12. Schramm SA, Jacks ME, Prihoda TJ, et al. Oral care for pregnant patients: a survey of dental hygienists' knowledge, attitudes and practice. *J Dent Hyg.* 2016 Apr;90(2): 121-7.
13. Ruiz VR, Quinonez RB, Wilder RS, Phillips C. Infant and toddler oral health: attitudes and practice behaviors of North Carolina dental hygienists. *J Dent Educ.* 2014 Jan;78(1):146-56.
14. Manksi MC, Parker EM. Early childhood caries: knowledge, attitudes, and practice behaviors of Maryland dental hygienists. *J Dent Hyg.* Fall 2010;84(4):190-5.
15. Commission on Dental Accreditation. Accreditation standards for dental hygiene education programs [Internet]. Chicago (IL): American Dental Association; 2021 [updated 2019 Aug; cited 2021 Apr 27]. Available from: https://www.ada.org/-/media/CODA/Files/dental_hygiene_standards.pdf?la=en.
16. Schroth RJ, Quinonez RB, Yaffe AB, et al. What are Canadian dental professionals taught about infant, toddler, and prenatal oral health. *J Can Dent Assoc.* 2015;81: f15
17. Fried JL, Maxey HL, Battani K, et al. Preparing the future dental hygiene workforce: knowledge, skills, and reform. *J Dent Educ.* 2017 Sep;81(9): eS45-52.
18. Theile CW. Strengths and weaknesses of current dental hygiene educational system. *J Dent Educ.* 2017 Sep;81(9): eS38-44.
19. American Academy of Pediatrics. Ages & stages [Internet]. Itasca (IL): American Academy of Pediatrics; 2021[cited 2021 Apr 27]. Available from: <https://www.healthychildren.org/English/ages-stages/Pages/default.aspx>.
20. Brame JL, Quinonez RB, Phillips C. Implementing a prenatal oral health program in dental hygiene curriculum. *J Dent Hyg.* 2020 Dec; 94(6):56-64
21. Claiborne DM, Poston R, Joufi A. Innovative collaborative service-learning experience among dental hygiene and nurse practitioner students: a pediatric oral health pilot study. *J Dent Hyg.* 2020 Jun;94(3):29-36.
22. Centers for Disease Control. Prevalence of selected maternal and child health indicators for all PRAMS sites, Pregnancy Risk Assessment Monitoring System, 2012-2015 [Internet]. Atlanta (GA): Centers for Disease Control; 2021 [cited 2021 Apr 27]. Available from: <https://www.cdc.gov/prams/pramstat/pdfs/mch-indicators/PRAMS-All-Sites-2012-2015-508.pdf>.
23. Children's Dental Health Project. Oral health during pregnancy. Issue brief [Internet]. Washington DC: Children's Dental Health Project; 2021 Sept. [cited 2021 Apr 27]. Available from: <https://www.cdhp.org/resources/339-issue-brief-oral-health-during-pregnancy>.
24. American Dental Hygienists' Association. Dental hygiene practice act overview: permitted functions and supervision levels by state [Internet]. Chicago (IL): American Dental Hygienists' Association; 2021 [revised 2019; cited 2021 Apr 27]. Available from: https://www.adha.org/resources-docs/7511_Permitted_Services_Supervision_Levels_by_State.pdf.
25. Furgeson D, Kinney J, Gwozdek A, et al. Interprofessional education in U.S. dental hygiene programs: a national survey. *J Dent Educ* 2015 Nov;79(11):1286-94.
26. Tolle SL, Vernon MM, McCombs G, De Leo G. Interprofessional education in dental hygiene: attitudes, barriers and practices of program faculty. *J Dent Hyg.* 2019 Apr;93(2):13-22.

Innovations in Dental Hygiene Education

Brief Motivational Interviewing: Evaluation of a skills-based education program

Michelle C. Arnett, MS, RDH; Michael D. Evans, MS; Cynthia L. Stull, DHSc, MDH, RDH

Abstract

Purpose: Oral health care providers have been charged with recommending the human papillomavirus (HPV) vaccine for the prevention of HPV oropharyngeal cancers (OPC). The purpose of this study was to determine dental hygiene student competency of the application of brief motivational interviewing (BMI) and the accuracy of HPV vaccine information for the prevention of HPV OPC.

Methods: A convenience sample of 59 senior dental hygiene (DH) students from the class of 2020 (n=31) and the class of 2021 (n=28) participated in the HPV OPC curriculum and skills-based BMI training at the University of Minnesota School of Dentistry. Students completed two audio-recorded patient interactions and one Objective Structured Clinical Examination (OSCE). Student self-assessment and faculty evaluation scores were determined by a standardized BMI HPV rubric. Descriptive statistics were used to analyze the data.

Results: Class of 2021 self-assessment ratings were higher than the class of 2020 in all components of the BMI HPV rubric at all three time points. Faculty evaluation achieved statistically significant improvement for the class of 2021 from patient Interaction 1 (evocation $p<0.01$; summary $p<0.01$) to the OSCE (evocation $p<0.05$; summary $p<0.01$). Both classes rated themselves as competent ($\geq 70\%$) for most BMI subcategories.

Conclusion: Dental hygiene student competence in demonstrating the components of the Spirit of MI to the accuracy of HPV and HPV vaccine information was achieved through the implementation of the skills-based BMI HPV training. Outcomes of student self-assessment and faculty evaluation highlighted the Kirkpatrick Model as a framework to evaluate BMI skills-based training.

Keywords: dental hygiene education, brief motivational interviewing, skills-based training, patient education, human papillomavirus vaccine

This manuscript supports the NDHRA priority area, **Professional development: Education** (evaluation).

Submitted for publication: 7/29/21; accepted: 12/23/21

Introduction

Most oropharyngeal cancers (OPC) in the United States (US) are attributed to the human papillomavirus (HPV), in particular HPV16 and HPV18.¹⁻³ Healthy People 2030 set an objective to reduce HPV-vaccine preventable infections from 15.1% to 8.7% for individuals aged 20 to 34⁴ and the indication for the HPV vaccine was expanded by the Food and Drug Association for the prevention of HPV-related OPCs in 2020.⁵ Despite this information, the incidence of HPV OPCs is increasing and the HPV vaccine uptake goal is still below the projected threshold.^{2,4}

Although health care provider communication has been identified as one of the most influential facilitators of vaccine

uptake, providers have reported barriers to discussing HPV with patients, including a lack of HPV OPC knowledge, comfort in discussing a sensitive topic, and a lack of confidence in vaccine advocacy communication.⁶⁻¹² Recent studies investigating HPV communication suggest that motivational interviewing (MI) may be the optimal counseling approach to HPV-OPC and HPV vaccine discussions during patient care.^{10,13-16} Motivational interviewing is a collaborative patient-centered counseling approach to support a positive behavior change.¹⁷ Research has explored using MI as an optimal communication approach for HPV counseling followed MI guiding strategies and MI RULES during brief motivational

interviewing (BMI) sessions.^{10,13-15} Brief motivational interviewing is intended for health care providers that have limited time (5-10 minutes) to counsel patients on their perceptions of change, provide behavior change support, and promote awareness.^{18,19}

Oral health care providers need knowledge on general HPV information, the role of HPV in OPC, and HPV vaccination facts to develop competent skills in HPV communication and vaccine advocacy. Additionally, MI training must include coaching, role-playing, and feedback to effectively deliver information and confidently counsel patients on HPV OPC prevention. Improved communication training may be effective in promoting provider confidence in their HPV discussion skills. Furthermore, the American Dental Association (ADA) has published a policy statement to encourage oral health care providers to recommend the HPV vaccine for the prevention of HPV OPC and asserts that “comprehensive skills-based training should be integrated into existing dental education programs” for vaccine advocacy.²⁰ A comprehensive curriculum for HPV OPC communication should include training in HPV knowledge and evidence-based communication strategies. However, formal didactic and clinical training to prepare students for HPV OPC communication has been found to be limited in dental hygiene education programs.²¹

In 2019, the University of Minnesota (UMN) School of Dentistry dental hygiene (DH) program launched a skills-based BMI HPV curriculum, consisting of an HPV OPC and HPV vaccination advocacy module and communication skills training. A critical aspect of implementing a training program in an education setting is the evaluation of student outcomes. The Kirkpatrick Model²² for training was used as the framework to evaluate this skills-based program. The Kirkpatrick Model includes four levels of evaluation, 1) “reaction” of the students’ training experience, 2) “learning” of knowledge and skills attained from the training, 3) “behavior” as a result of the training, and 4) “results” of the training to achieve an outcome.^{22,23}

The first phase of evaluation of this skills-based curriculum assessed the “reaction” from students. Students’ perceptions of the skills-based curriculum to enhance their knowledge, attitudes, confidence and comfort during HPV communication and vaccine advocacy has been assessed and reported previously.¹⁶ The second phase that was studied determined students’ level of “learning” the importance of and their confidence in applying BMI strategies during HPV communication and vaccine advocacy.¹⁵ The third phase had two specific aims: 1) evaluate student competence in

demonstrating the components of the Spirit of MI¹⁷ while applying BMI during HPV communication and 2) determine the accuracy of HPV and HPV vaccine information while using BMI. The purpose of this study was to measure the outcomes of the skills-based BMI HPV curriculum on student competency in alignment with the third (behavior) and fourth (results) levels of the Kirkpatrick Model.

Methods

This study was determined to be exempt by the Institutional Review Boards (IRB) of the UMN (STUDY00007617) and A. T. Still University (IRB #2019-106). A convenience sample of 59 DH students from the class of 2020 and the class of 2021 at the UMN DH program participated in the skills-based BMI HPV curriculum. The skills-based BMI HPV curriculum was developed utilizing the existing MI thread in the UMN DH program.

The MI thread begins in the communications course in semester two of a six semester program. In semester two, DH students have three 1-hour 40-minute sessions (five lecture hours) on MI content. Lecture and learning activities encompass coaching and role-playing, practicing the Spirit of MI, MI principles, MI guiding strategies, and MI RULES.^{17,18,24} Operational definitions are provided in Figure 1. Students learn the Elicit-Provide-Elicit (E-P-E) approach to ask evocative questions to understand patient awareness, provide information with permission to fill in gaps in understanding, and elicit patient motivation and readiness for change in semester two.¹⁷ Additionally, the MI thread includes evaluation of student competency of MI skills during Objective Structured Clinical Examinations (OSCE) with standardized patients in semesters 3-6 of their educational training. An OSCE is a gold-standard assessment tool to evaluate student clinical competence, while eliminating live patient bias.²⁵ The class of 2020 and the class of 2021 both completed the MI thread as students in the UMN DH program.

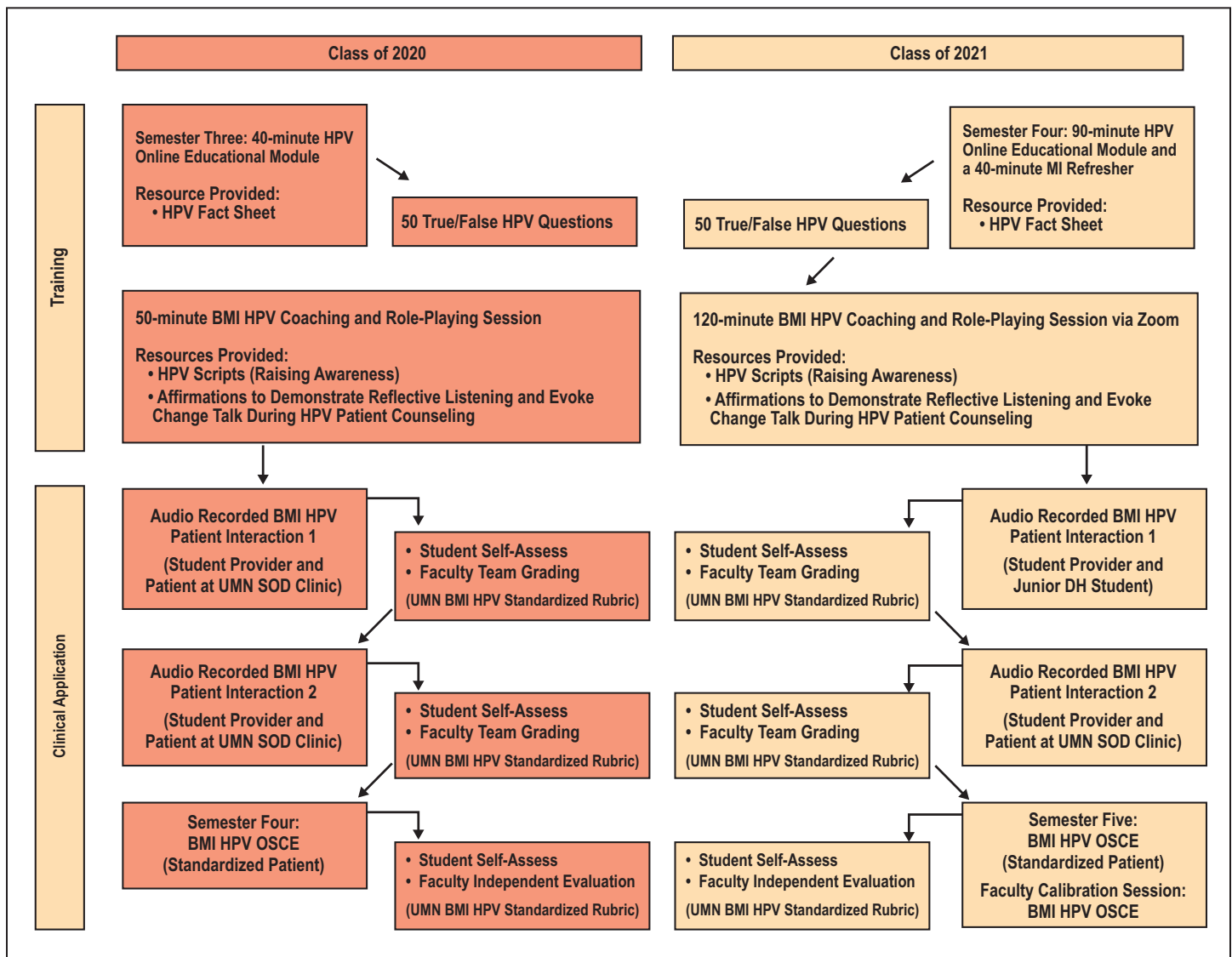
Students’ application of MI is evaluated using the UMN standardized MI rubric. In 2018, faculty participated in calibration sessions to determine inter-rater reliability and the results were used to make modifications to develop a revised UMN standardized rubric. The UMN standardized MI rubric has been used for evaluation of students’ application in the MI thread for three cohorts.

For the class of 2021, the skills-based HPV BMI curriculum was modified after evaluation of the curriculum.^{15,16} Additionally, the COVID-19 pandemic resulted in distance learning in 2020, requiring a revision of learning activities. Figure II displays the skills-based BMI HPV curriculum

Figure I. Operational definitions^{17,18,24}

Spirit of MI	Collaboration	The provider's ability to develop a collaborative partnership with the patient.
	Acceptance	The provider will demonstrate an attitude of acceptance for the patient's strengths, weaknesses, and ambivalence of change.
	Compassion	The provider's ability to actively promote the patient's well-being and give priority to their needs.
	Evocation	The provider's ability to evoke the patient's own thoughts or ideas, rather than the provider imposing goals or expectations.
MI Principals to Support Autonomy	Empathy	Provider's ability to show interest in understanding the patient's perception.
	Discrepancy	To distinguishing between the patient's values and behaviors that are inconsistent with their behavior change goals.
	Rolling with resistance	To avoid conflict.
	Self-efficacy	Give encouragement and praise to build confidence in the patient's ability to change a behavior.
MI Guiding Strategies	Open-ended question	Questions that cannot be answered with a yes or no statement.
	Affirmations	Giving encouragement or acknowledgment to the patient's strengths.
	Reflective listening	A form of listening that displays an understanding of the patient's perceptions, ambivalence, and efforts.
	Summarizing	Utilized by the provider to close the MI session and/or check for accuracy of the information presented by the patient.
	Elicit Change Talk	Self-reported argument of change.
	Importance or confidence ruler (readiness ruler)	Assessment of a patient's readiness to change.
	Ask for elaboration ("What else?")	Evoke change talk.
	Enhance self-efficacy	Build patient's confidence.
MI RULES	Resist the Righting Reflex	Provider's do not "fix" or "change" the patient's behaviors affecting their health.
	Understanding	Provider understands the patient's perceptions of motives, challenges, and ambivalence of change.
	Listening	Provider listens with empathy to the patient's challenges.
	Empower	Build self-efficacy and support patient autonomy.

Figure II. Skills-based BMI HPV curriculum (class of 2020 and 2021)



for the class of 2020 and the class of 2021. Details on the learning modules, resources, and activities for the skills-based BMI HPV curriculum have been described previously.^{15,16}

Evaluation instrument

Student self-assessment and faculty evaluation scores were determined by the standardized MI HPV rubric. The standardized UMN MI rubric was modified to include HPV and HPV vaccine language. The MI HPV rubric is worth 30 points and includes the Spirit of MI¹⁷ components with the following HPV vaccine language: collaboration to elicit ideas for change in HPV vaccine status (9 points possible), acceptance by asking permission before providing information about the HPV vaccine (6 points possible), compassion to understand patient perceptions with the HPV vaccine (6 points possible), evocation to support patient autonomy regarding the HPV vaccine (6 points possible) and the MI guiding strategy of

summarizing (3 points possible).^{18,25} Within each of these categories (excluding summary) are sub-categories (3 points per sub-category). Students can score a three or a zero in each sub-category on their application of MI principles, MI strategies, MI RULES, and the application of BMI, while delivering accurate HPV and HPV vaccine information via the E-P-E approach.

Student self-assessment and faculty evaluation

Students in the class of 2020 completed two audio recorded discussions with patients in the UMN clinic demonstrating BMI during HPV communication; students completed the HPV Patient Interaction 1 and self-assessed using the standardized MI HPV rubric. Two DH faculty investigators (CS and MA) team-graded the HPV Patient Interaction 1 using the same standardized MI HPV rubric. Faculty feedback provided an opportunity for students to implement

improved HPV knowledge and application of BMI to their audio recorded HPV Patient Interaction 2. Following the first patient interaction, students completed Patient Interaction 2, self-assessed, were team-graded and provided with faculty feedback. Once the two patient interactions were completed, student competency was evaluated during an OSCE. The OSCE simulations were recorded to allow students to self-assess and for faculty reference during the evaluation process. For the class of 2020, there was no faculty calibration session prior to the OSCE. It had been previously determined that the essence of MI principles had been preserved on the modified MI HPV rubric, so formal faculty calibration was deemed unnecessary for the OSCE evaluation. Dental hygiene faculty individually evaluated students during the BMI HPV OSCE in real-time and had access to the recording to confirm initial evaluation and feedback.

Students in the class of 2021 were given the option to complete the HPV Patient Interaction 1 with a first-year DH student as a mock patient. The first-year DH students had not yet been exposed to the MI thread in the curriculum. This modification was implemented to allow novice students to practice their HPV knowledge and BMI skills with a peer to gain confidence prior to a HPV Patient Interaction in clinic.^{15,16} The class of 2021 students completed the HPV Patient Interactions by audio recording, self-assessed, were

team-graded and provided with feedback by the same DH faculty (CS and MA) as the class of 2020. The only modification was a one-hour faculty calibration session via Zoom to prepare for the OSCE. During the faculty calibration session, the MI HPV rubric criteria was discussed, faculty team-graded two BMI HPV audio recordings from the class of 2020 and discussed grading discrepancies to standardize evaluations. Team grading led by MA and CS was used for the OSCE for the class of 2021. This modification served two purposes: 1) enhance student MI coaching by providing feedback by two faculty, 2) serve as an additional faculty calibration session.

Data analysis was performed using a statistical software program (R version 3.5.2) for the Wilcoxon signed-rank test to compare the two classes (2020 and 2021). Comparisons for each class were analyzed for Patient Interaction 1 (PI 1), Patient Interaction 2 (PI 2), and OSCE/Patient Interaction 3 (PI 3); *p*-values less than 0.05 were regarded as statistically significant. Agreement between student and faculty ratings were quantified using the percent agreement and kappa statistic.

Results

A total of 59 DH students from two cohorts (class of 2020, *n*=31; class of 2021, *n*=28) completed the skills-based BMI HPV curriculum. Students' self-assessment and faculty evaluation frequencies are shown in Table I. Class of 2021

Table I. Wilcoxon signed-rank test for time point comparisons for student and faculty groups

Group	Spirit of MI*	Class of 2020 versus Class of 2021								
		PI 1			PI 2			PI 3		
		2020	2021	<i>p</i>	2020	2021	<i>p</i>	2020	2021	<i>p</i>
Students	Collaboration ≥ 6	26	52	0.03**	87	93	0.02*	93	100	0.10
	Acceptance = 6	68	85	0.12	48	63	0.27	63	78	0.24
	Compassion = 6	58	78	0.12	77	89	0.22	83	89	0.55
	Evocation = 6	42	67	0.06	52	89	0.01**	57	70	0.29
	Summary** = 3	26	52	0.03**	52	81	0.02**	50	93	<0.01**
Faculty	Collaboration ≥ 6	74	78	0.53	77	93	0.95	87	85	0.71
	Acceptance = 6	55	70	0.20	77	75	0.83	90	93	0.77
	Compassion = 6	81	93	0.19	90	93	0.74	84	85	0.90
	Evocation = 6	48	81	<0.01**	70	85	0.15	55	78	0.05**
	Summary** = 3	26	70	0.01**	73	89	0.14	55	93	<0.01**

*Spirit of MI = Collaboration: Establish partnership and rapport development; Acceptance: Demonstrate respect, autonomy, and affirmations; Compassion: Show no judgement, shaming, or belittling; Summary - Reflects big picture, checks for accuracy of information provided by the patient and/or next steps; Patient Interaction 1 (PI 1); Patient Interaction 2 (PI 2); OSCE (PI 3)

** *p*<0.05

self-assessment ratings were higher than the class of 2020 in all components of the MI HPV rubric. Comparing the self-assessments from the class of 2020 to the class of 2021, there was a statistically significant improvement for Patient Interaction 1 (acceptance $p=0.03$), Patient Interaction 2 (collaboration $p=0.02$; evocation $p<0.01$; and summary $p=0.02$) and for the OSCE (summary $p<0.01$). Faculty evaluation of students was also higher for the class of 2021 as compared to the class of 2020, except for the MI HPV rubric component of acceptance for Patient Interaction 2. Comparing the faculty evaluation for the class of 2020 to the class of 2021, there was a statistically significant improvement for Patient Interaction 1 (evocation $p<0.01$; summary $p<0.01$) and the OSCE (evocation $p=0.05$; summary $p<0.01$).

The sub-categories of students' self-assessment, faculty evaluation frequencies are shown in Table II. Students from both classes rated themselves high ($\geq 70\%$) for most of the sub-categories of the MI HPV rubric. However, lower student self-assessment ratings and faculty evaluations ($<70\%$) were identified for both classes during Patient Interaction 1. There were statistically significant improvements for Patient Interaction 2 ("uses open-ended questions" $p=0.02$) and for the OSCE ("eliciting ideas for change" $p=0.01$; "supports self-efficacy/patient autonomy" $p=0.04$) when comparing the class of 2020 to the class of 2021. Faculty evaluations demonstrated statistically significant improvement between classes for the following: Patient Interaction 1 ("ask permission" $p=0.03$; "uses open-ended questions" $p<0.01$), Patient Interaction 2 ("uses open-ended questions" $p=0.05$) and for the OSCE ("introduction" $p=0.02$; "supports self-efficacy/patient autonomy" $p=0.02$).

Agreement between student self-assessment and faculty evaluation across three time points is shown in Table III. Agreement $\geq 70\%$ was achieved for two of the five components of the MI HPV rubric for the class of 2020 and faculty while agreement was achieved for three of the five components for the class of 2021 and faculty. The kappa statistic quantifies the relationship between the observed level of agreement and the level of agreement expected due to chance, given the distribution of observed ratings. The observed level of agreement for student self-assessment and faculty evaluation is more than chance, but not near perfect agreement (Table III).

Discussion

This study is the third phase of evaluating a skills-based curriculum to determine student "behavior" and "results" using the Kirkpatrick Model in assessing competency in applying the four Spirit of MI components (collaboration,

acceptance, compassion, and evocation) to support patient autonomy in receiving HPV and HPV vaccine information. The skills-based BMI HPV curriculum has been implemented for two classes in the UMN DH program and is planned to continue for future cohorts. The UMN DH program is a competency-based educational program; students are required to achieve a minimum of 70% for competency. Accordingly, a threshold of $\geq 70\%$ was set for students to demonstrate competency in the skills-based HPV BMI curriculum.

Regarding the first specific aim, many factors can inhibit student competency in demonstrating the components of the Spirit of MI while using BMI during HPV communication, including patient-provider trust and rapport and patient resistance. Patient Interactions 1 and 2 were dependent on the availability of patients meeting the assignment criteria. This resulted in unequal experiences for students. Qualifying patients who agreed to be recorded for the Patient Interactions who were engaged and interested in the HPV discussion, allowed students to practice their skills. Whereas other patients who agreed to support their student provider in completing an assignment but were not interested in receiving HPV or HPV vaccine information, demonstrated resistance to the topic. Stull et al., also reported that patient resistance may have negatively impacted students' confidence and comfort during HPV discussions.¹⁷

A lack of confidence and comfort in HPV discussions was reflected in low ($\leq 70\%$) self-assessment scores for all components of the Spirit of MI for Patient Interaction 1 for both cohorts in this study. Both Arnett et al. and Stull et al. reported that an increased number of patient encounters to practice using BMI for the delivery of HPV and HPV vaccine information resulted in higher perceptions of confidence.^{15,16} In this study, student self-assessment scores increased over time; the highest self-assessment scores were for the OSCE. This also aligned with faculty evaluation of student performance from Patient Interaction 1 to the OSCE. Another possible reason for this outcome was that an OSCE allows for equal, standardized experiences, improving consistency for faculty evaluation of students' skills.

A positive finding was the improved outcomes in the categories of evocation and summary for the class of 2021. Evocation is a foundational principal of the Spirit of MI to evoke a patient's own intrinsic motivation while building confidence and supporting autonomy.^{17,18,24} Since HPV OPCs and HPV vaccine acceptance are sensitive topics, students' ability to demonstrate evocation is key in maintaining patient autonomy. Additionally, to stay within the parameters of BMI (5-10 minutes), a skill is to demonstrate summaries to close

Table II. Wilcoxon signed-rank test for time point comparisons of the components of the Spirit of MI for student and faculty groups

Spirit of MI*	Components	Group	Class of 2020 versus Class of 2021								
			PI 1		PI 2		PI 3				
			2020	2021	p	2020	2021	p	2020	2021	p
Collaboration	Introduces self, role, is engaging, welcoming = 3	Student	52	69	0.09	88	88	0.97	85	83	0.91
		Faculty	100	100	1.0	100	100	1.0	81	100	0.02**
Collaboration	Collaborated with the patient by eliciting their ideas for change in HPV vaccination status or by providing support as a partnership = 3	Student	66	62	0.76	71	85	0.25	73	100	0.01**
		Faculty	42	48	0.64	50	74	0.06	74	74	1.0
Acceptance	Did not lecture; did not try to “fix” the patient =3	Student	79	85	0.62	92	96	0.52	85	96	0.19
		Faculty	68	78	0.04	77	78	0.16	59	63	0.36
Acceptance	Asks permission before eliciting accurate information about the HPV vaccination = 3	Student	93	96	0.61	96	93	0.67	96	100	0.34
		Faculty	84	100	0.03*	100	100	1.0	100	100	1.0
Compassion	Uses reflections to demonstrate listening =3	Student	31	56	0.06	61	70	0.49	73	84	0.35
		Faculty	65	67	0.87	77	74	0.83	90	96	0.38
Compassion	Tries to understand the patient’s perceptions and/or concerns with the HPV vaccination = 3	Student	76	89	0.21	85	93	0.37	89	92	0.71
		Faculty	81	93	0.19	93	93	0.92	87	89	0.84
Compassion	Does not judge, shame or belittle the patient = 3	Student	100	100	1.0	96	96	1.0	93	93	0.17
		Faculty	100	96	0.29	97	100	0.36	97	100	0.36
Evocation	Uses open-ended questions for any of the following: 1) patient understanding, 2) determining stage of change, 3) eliciting change talk = 3	Student	75	85	0.39	82	100	0.02**	85	81	0.52
		Faculty	65	96	<0.01**	87	100	<0.05**	77	89	0.25
Evocation	Supports self-efficacy, emphasizes patient autonomy regarding the HPV vaccination (rolls with resistance) =3	Student	79	88	0.37	86	92	0.51	73	95	0.04**
		Faculty	74	85	0.31	77	85	0.42	68	93	0.02**

*Spirit of MI=Collaboration: Establish partnership and rapport development; Acceptance: Demonstrate respect, autonomy, and affirmations; Compassion: Show no judgement, shaming, or belittling; Summary: Reflects big picture, checks for accuracy of information provided by the patient and/or next steps; Patient Interaction 1 (PI1); Patient Interaction 2 (PI2); OSCE (PI3)

** p<0.05

Table III. Levels of agreement between student and faculty rating

Group	Spirit of MI*	Kappa**	n=total***	n=agreement	% agreement
Class of 2020 and Faculty	Collaboration	0.31	91	47	52
	Acceptance	0.38	90	58	64
	Compassion	0.17	91	68	75
	Evocation	0.14	90	50	56
	Summary	0.53	90	69	77
Class of 2021 and Faculty	Collaboration	0.31	81	40	49
	Acceptance	0.17	81	53	65
	Compassion	0.13	81	67	83
	Evocation	0.29	81	59	73
	Summary	0.37	81	66	81

*Spirit of MI = Collaboration: Establish partnership and rapport development; Acceptance: Demonstrate respect, autonomy, and affirmations; Compassion: Show no judgement, shaming, or belittling Summary: Reflects big picture, checks for accuracy of information provided by the patient and/or next steps

**Kappa =1, indicating perfect agreement and kappa=0 indicating agreement no better than chance.

***Total n is 3 times the number of students for 3 time points of assessments, minus any missing assessments/values.

the MI session and check for accuracy. Students in the class of 2021 were able to meet competency in these two areas by their senior year compared to the class of 2020 who were not able to achieve this in their third year of the dental hygiene program.

The class of 2021 had higher overall self-assessments and faculty evaluation ratings. Unique to the class of 2021, the BMI HPV training was online and moved to semester four, whereas the class of 2020 was held in a traditional classroom environment and occurred in their third semester. Stull et al. suggested that BMI HPV skills-based training be presented late in the curriculum to allow DH students time to gain confidence in clinical protocols before approaching this potentially sensitive topic.¹⁶ This shift in the sequence of the skills-based BMI HPV curriculum produced stronger outcomes of student competency for the class of 2021 indicating a greater likelihood that these graduates will be able to demonstrate all aspects of the Spirit of MI during HPV communication as licensed professionals. These findings align with Reno et al. who found that as providers had more opportunities to implement MI during HPV discussions, the perceived usefulness of the communication technique increased.¹⁰

The learning transfer process is also noted as a determining factor of effective training.²³ Learning transfer from the Kirkpatrick Model (level 2) to level 3 (behavior) as reported by Arnett et al.¹⁵ was also demonstrated in this study. A noted limitation to the Kirkpatrick Model is the training of evaluators and other outside influences that may impact the evaluation of the training program.²³ To address this limitation, a faculty calibration session prior to the class of 2021 OSCE and faculty team-grading of student OSCEs was implemented to reduce contextual influences of faculty evaluation of student competency.

Each component of the MI HPV rubric included accuracy of HPV knowledge and vaccine advocacy coupled with BMI principles to assess the accuracy of the information provided. Student self-assessment and faculty evaluation frequencies ranged from 74%-100% for “eliciting accurate information about the HPV vaccine,” “understand the patient’s perceptions and/or concerns with the HPV vaccine,” and “emphasized patient autonomy

regarding the HPV vaccination.” Ratings for “eliciting their ideas for change in HPV vaccination status” varied for students’ self-assessments and faculty evaluation for Patient Interactions 1 and 2; however, final ratings from the OSCE ranged 73%-100%, suggesting curricular strength.

Stull et al. reported students’ lack of HPV and HPV vaccine knowledge may have impacted their application of BMI.¹⁶ Additionally, the application of MI requires training, coaching, and feedback to retain skills.^{15,27,28} This was evident with low frequencies of student self-assessment scores for Patient Interaction 1 for both cohorts and supports prior evidence that students need knowledge, training, and practice applying their BMI skills during HPV discussions.^{15,16} The class of 2021 completed a 90-minute HPV online educational module, an online 120-minute BMI coaching and role-playing session and a 40-minute MI refresher lecture;^{15,16} whereas, the class of 2020 completed a 40-minute HPV online education module and only had a 50-minute BMI coaching and role-playing session.^{15,16} The class of 2021 had higher self-assessment scores and faculty evaluations at all three time points and may indicate that the longer duration and sequencing of the BMI HPV curriculum may provide the appropriate amount of training for DH students to effectively and confidently apply BMI for HPV and HPV vaccination discussions.

Findings from the educational literature indicate that self-assessment in the DH curricula allows students to recognize gaps in their knowledge and skills to inform consequential, self-directed learning.²⁸ This may explain why

general knowledge of HPV improved for students in this study. The curriculum provided three opportunities for students to self-assess on their HPV knowledge, which may have contributed to their demonstrated knowledge of HPV information and vaccination advocacy. Daley et al. reported dental hygienists as having discrepancies in their HPV OPC knowledge and identified a need for increased education.¹¹ This study suggests that the learning transfer from Kirkpatrick Model level 2 (learning) to level 3 (behavior) of demonstration of accurate HPV information may have been accomplished through self-assessment. Students were able to determine inaccuracies in their provided HPV information to self-correct for Patient Interaction 2 and the OSCE. The accuracy of HPV knowledge and vaccine advocacy was evaluated with both self-assessments and faculty evaluation, with results ranging between 84%-100%, indicating that the skills-based BMI HPV training enhanced students' knowledge, a known gap in the literature.⁶⁻⁸ Further, the OSCE results demonstrated that the intended goals of the program were achieved with this skills-based training and completed the final evaluation level (results) of the Kirkpatrick Model.

Dental hygiene programs interested in implementing a skills-based BMI HPV training program need to include training on the Spirit of MI, MI principles, MI guiding strategies, MI RULES and the E-P-E technique for BMI counseling. Students need patient experiences for practicing their MI skills on general oral health topics, to gain confidence and competence applying MI within the parameters of 5-10 minutes to align with BMI. It is also important for students to have MI skills before applying BMI to counsel patients on HPV and HPV vaccine advocacy. Education programs need to have a curriculum that includes the epidemiology of HPV and OPC and the role of vaccination in preventing OPC. A skills-based BMI HPV curriculum is best implemented during students' senior year of a DH program when they are more confident in their own clinical skills. It is critical to have topic-expert faculty to develop, implement, and evaluate the curriculum in addition to faculty training in BMI and HPV.

This study had limitations. Using a convenience sample of DH students from one dental school in the Midwest does not represent the general population of DH students at other educational settings. The UMN MI and the modified MI HPV rubrics were standardized evaluation tools used in the MI thread at one institution, however neither rubric is validated to determine student competency. This is the first known evaluation of a skills-based BMI HPV training program to prepare students for HPV education and HPV vaccine advocacy. Future research should identify how much BMI HPV training is needed to be knowledgeable on the

role of HPV in OPCs and improve HPV vaccine uptake and literacy of patients. Longitudinal data is needed to determine whether BMI HPV skills acquired as students are retained and applied as licensed oral health care professionals.

Conclusion

Results from this study address the call for educational institutions to provide skills-based training to prepare oral health care professionals to raise awareness of oral HPV and provide vaccine advocacy. Dental hygiene student competence in demonstrating the components of the Spirit of MI applied to the accuracy of HPV and HPV vaccine information was achieved with the implementation of the skills-based BMI HPV training. Outcomes of students' self-assessments and faculty evaluations in this study highlighted the Kirkpatrick Model as the framework to evaluate skills-based training. Dental hygiene programs can use the findings of this study to evaluate students' application of BMI communication to raise HPV OPC awareness and HPV vaccine advocacy.

Disclosure

This research was supported by the National Institutes of Health's National Center for Advancing Translational Sciences, grant UL1TR002494. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health's National Center for Advancing Translational Sciences.

Michelle C. Arnett, MS, RDH is an assistant professor, Department of Primary Dental Care, Division of Dental Hygiene; **Michael D. Evans, MS** is a senior biostatistician and the Associate Director, Biostatistical Design and Analysis Center, Clinical and Translational Science Institute; **Cynthia L. Stull, DHSc, MDH, RDH** is an assistant professor, the Director of the Division of Dental Hygiene, Department of Primary Dental Care, Division of Dental Hygiene; all at the University of Minnesota, Minneapolis, MN, USA.

Corresponding author: Michelle C. Arnett, MS, RDH; marnett@umn.edu

References

1. Ellington TD, Henley SJ, Senkomago V, et al. Trends in incidence of cancers of the oral cavity and pharynx - United States 2007-2016. *MMWR Morb Mortal Wkly Rep.* 2020;69(15):433-8.
2. Centers for Disease Control and Prevention. HPV-Associated Cancer Statistics [Internet]. Atlanta (GA): Centers for Disease Control and Prevention; 2019 [cited 2019 Mar 25]. Available from: <https://www.cdc.gov/cancer/hpv/statistics/index.htm>

3. Rieth KKS, Gill SR, Lott-Limbach AA, et al. Prevalence of high-risk human papillomavirus in tonsil tissue in healthy adults and colocalization in biofilm of tonsillar crypts. *JAMA Otolaryngol - Head Neck Surg.* 2018 Mar;144(3):231–7.
4. Office of Disease Prevention and Health Promotion. Reduce infections of HPV types prevented by the vaccine in young adults—IID-07 [Internet]. Rockville (MD): US Department of Health and Human Services [updated 2021 Jan 16; cited 2021 Jul 17]; [about 2 screens]. Available from: <https://health.gov/healthypeople/objectives-and-data/browse-objectives/infectious-disease/reduce-infections-hpv-types-prevented-vaccine-young-adults-iid-07>
5. United States Food and Drug Administration. Gardasil 9 [Internet]. Silver Spring (MD): United States Food and Drug Administration; 2021[updated 2020 Aug 21; cited 2021 Jul 17]; [about 3 screens]. Available from: <https://www.fda.gov/vaccines-blood-biologics/vaccines/gardasil-9>
6. Walker KK, Jackson RD, Sommariva S, et al. USA dental health providers' role in HPV vaccine communication and HPV-OPC protection: a systematic review. *Hum Vaccin Immunother.* 2019;15(7):1863–9.
7. Stull CL, Lunos S. Knowledge, attitudes and practices regarding human papilloma virus communication and vaccine advocacy among Minnesota dentists and dental hygienists. *J Dent Hyg.* 2019 Feb;93(1):33–42.
8. Kline N, Vamos C, Thompson E, et al. Are dental providers the next line of HPV-related prevention? Providers' perceived role and needs. *Papillomavirus Res.* 2018 Jun;5:104–8.
9. Brewer NT, Hall ME, Malo TL, et al. Announcements versus conversations to improve HPV vaccination coverage: a randomized trial. *Pediatrics.* 2017 Jan;139(1). pii: e20161764.
10. Reno JE, Thomas J, Pyrzanowski J, et al. Examining strategies for improving healthcare providers' communication about adolescent HPV vaccination: evaluation of secondary outcomes in a randomized controlled trial. *Hum Vaccin Immunother.* 2019;15(7-8):1592-8.
11. Daley EM, Thompson EL, Vamos CA, et al. HPV-related knowledge among dentists and dental hygienists. *J Cancer Educ.* 2018 Aug;33(4):901-06.
12. Northridge ME, Manji N, Piamonte RT, et al. HPV, oropharyngeal cancer, and the role of the dentist: a professional ethical approach. *J Health Care Poor Underserved.* 2012 Nov;23(4 Suppl):47–57.
13. Wermers R, Ostroski T, Hagler D. Health care provider use of motivational interviewing to address vaccine hesitancy in college students. *J Am Assoc Nurse Pract.* 2021 Jan 1;33(1):86-93.
14. Dempsey AF, Pyrzanowski J, Lockhart S, et al. Effect of a health care professional communication training intervention on adolescent human papillomavirus vaccination: a cluster randomized clinical trial. *JAMA Pediatr.* 2018 May 7;172(5):e180016.
15. Arnett MC, Evans MD, Stull CL. Students' perceptions of the “importance” of and “confidence” with applying brief motivational interviewing during HPV patient counseling. *J Dent Hyg.* 2022 Apr 96(2):50-9.
16. Stull C, Evans MD, Arnett MC. Examining the role of HPV communication training in dental hygiene students' knowledge, attitudes, confidence, and comfort. *J Dent Hyg.* 2021 Oct;95(5):47-55.
17. Miller WR, Rollnick S. *Motivational interviewing helps people change.* 3rd ed. Guilford Press; 2013. 482 p.
18. Koerber A. Brief interventions in promoting health behavior change. In: Ramseier CA, Suvan JE. *Health behavior change in the dental practice.* Wiley-Blackwell; 2010: p. 93-112.
19. Gillam DG, Yusuf H. Brief motivational interviewing in dental practice. *Dent J (Basel).* 2019 May 1;7(2):51.
20. Villa A, Chmieliauskaite M, Patton LL. Including vaccinations in the scope of dental practice: the time has come. *J Am Dent Assoc.* 2021 Mar;152(3):184-6.
21. Trauger KA, Stull CL, Arnett MC, et al. Human papillomavirus content inclusion in dental hygiene program curricula in the United States. *J Dent Hyg.* 2021 Apr;95(2):42-9.
22. Kirkpatrick Partners. *The Kirkpatrick Model* [Internet]. Newnan (GA): Kirkpatrick Partners; c2009-2021[cited 2021 Jul 17]. Available from: <https://www.kirkpatrickpartners.com/Our-Philosophy/The-Kirkpatrick-Model>
23. Bates R. A critical analysis of evaluation practice: the Kirkpatrick model and the principle of beneficence. *Eval Program Plan.* 2004 Aug;27(3):341–7.
24. Catley D, Goggin K, Lynam I. Motivational interviewing (MI) and its basic tools. In: Ramseier CA, Suvan JE.

Health behavior change in the dental practice. Wiley-Blackwell; 2010: p. 59-92.

25. Harden RM. Assessment of clinical competence using objective structured examination. *Med Educ.* 2016 Apr;50(4):376-9.
26. Mills A, Kerschbaum WE, Richards PS, et al. Dental hygiene students' perceptions of importance and confidence in applying motivational interviewing during patient care. *J Dent Hyg.* 2017 Feb;91(1):15-23.
27. Arnett M, Korte D, Richards PS, et al. Effect of faculty development activities on dental hygiene faculty perceptions of and teaching about motivational interviewing: a pilot study. *J Dent Educ.* 2017 Aug;81(8):969-77.
28. Asadoorian J, Batty HP. An evidence-based model of effective self-assessment for directing professional learning. *J Dent Educ.* 2005 Dec;69(12):1315-23.

Innovations in Dental Hygiene Education

Implementing Environmental Sustainability Educational Intervention in Dental Hygiene Instruction

Wai-Sum Leung, MS, RDH; Laura Dubbs, PhD; Tiffanie White, MEd, CDA, RDH;
Elizabeth C. Kornegay, MS, RDH

Purpose: The planet faces a climate crisis threatening public health. Dentistry contributes to a large portion of the waste output in the United States. The purpose of this study was to assess dental hygiene (DH) students' perceptions and knowledge on environmentally sustainable dentistry (ESD) prior to and following an educational intervention.

Methods: A convenience sample of second-year DH students (n=34) at the University of North Carolina at Chapel Hill (UNC-CH) was recruited for this pilot study consisting of a pre-survey, an online educational module and immediate post-survey, and a final assignment followed by another post-survey. The educational module followed a funnel approach to educate learners on the topic of sustainability before narrowing down to how sustainability can be applied to dentistry. Paired t-tests compared pre- and post-module survey scores on changes in knowledge and attitudes. Univariate and qualitative analyses were conducted on the post-assignment component.

Results: Twenty-five participants had qualifying responses for the pre- and post-module survey (71.4% response rate); 22 participants completed the post-assignment survey (62.7% response rate). There was a statistically significant increase from pre- to post-module knowledge scores ($p < 0.0005$). Most respondents (>90%) indicated that the follow-up assignment strengthened their learning experience. Qualitative analysis revealed that the assignment helped participants apply module concepts in the real world and adopt less wasteful behaviors in clinic.

Conclusion: Instructional interventions on ESD in DH education may improve students' knowledge of environmentally sustainable habits and encourage behavioral changes. Study findings can help introduce an environmental sustainability component to the DH educational curriculum.

Keywords: dental hygiene education, environmental sustainability, environmentally sustainable dentistry, climate change

This manuscript supports the NDHRA priority area **Professional development: Education** (evaluation).

Submitted for publication: 4/11/21; accepted: 1/26/22

Introduction

The United States (US) healthcare system is one of the largest waste emitters on the planet,¹ contributing to climate change and creating threats to human and environmental health.² Climate change is one of the biggest challenges facing the current and future generations by threatening the food, water, home, and health security of millions of people worldwide.³ Considering that dentistry is a major component of the US health care system, it is logical to assume that dentistry, by extension, also contributes a significant portion of the national waste output. However, the exact scope of the impact dentistry in the US has on the environment is still unknown.

Dental care professionals have an ethical obligation and responsibility to understand and minimize the profession's environmental and public health impact.⁴ In 2017, the

Fédération Dentaire Internationale (FDI) World Dental Federation, the leading organization representing dentistry in the world, issued the following statement: "Dentistry as a profession should integrate sustainable development goals into daily practice and support a shift to a green economy in the pursuit of healthy lives and well-being for all through all stages of life."⁵ In alignment with this statement, the United Kingdom's (UK) Centre for Sustainable Healthcare (CSH) established the Sustainable Healthcare Education (SHE) network, an interprofessional coalition of over 900 clinicians, academics, and students aiming to incorporate sustainable healthcare education into the health profession curriculum and general education.⁶ Presently, there is no US-based equivalent of CSH. Existing organizations, such as The

Medical Society Consortium on Climate and Health, are focused on internal medicine with no mention of dentistry, despite dentistry being a billion-dollar medical industry within the US.^{7,8}

Dental hygienists are essential in promoting community and individual well-being as front-line healthcare workers and advocates for preventive oral health. Further education on the impact of climate change and environmental sustainability for DH students is essential in preventing adverse health outcomes related to the environment and promoting healthier communities. Equipped with the knowledge and mechanisms behind ESD, dental hygiene students can be a catalyst towards a more environmentally conscious dental workforce. However, resources for the education of environmentally sustainable dentistry (ESD) in the US-based dental and dental hygiene curriculum are sparse, and their effectiveness has not been reported in the literature. Survey research indicates interest in implementing ESD into dental education;⁹ however, there is a lack of educational materials and knowledge on ESD.⁹ To overcome these challenges, Joury et al. proposed the creation of ESD-related learning outcomes and capacity for educators to embed ESD in dental education.⁹

Recognizing these same barriers to implementation of ESD in DH education, an educational intervention on ESD was created in the undergraduate DH education program at the University of North Carolina at Chapel Hill (UNC-CH) Adams School of Dentistry. The purpose of this study was to determine the baseline for DH students' attitudes and perceptions towards environmentally ESD and determine the usefulness of an educational intervention in the dental hygiene curriculum on ESD.

Methods

Study Design

Recruitment for this study included a convenience sample of second-year DH students (n=34) enrolled in the Bachelor of Science DH program at the UNC-CH Adams School of Dentistry during the fall semester of 2020. Second-year DH students were the target population because they have completed at least one year of clinical work with patients and had likely witnessed the ways dentistry may impact the environment. The UNC-CH Institutional Review Board (IRB) determined this study exempt (#20-1313).

This study consisted of two phases: an educational module and a follow-up assignment. Phase One utilized an educational online module intervention paired with immediate pre- and post-online surveys (Qualtrics; Provo, UT, USA). Phase Two employed a follow-up assignment and a post-assignment

online survey. Completing the education module and post-module assignment was a mandatory requirement for second-year DH students, while completing the pre and post surveys was voluntary. Students choosing not to participate in the surveys were not considered part of the study sample.

Pre- and Post- Module Surveys

The pre- and post-surveys contained items on attitudes and knowledge towards climate change and ESD practices. The surveys were designed to take no more than three minutes to complete and were administered immediately before and after completing the online educational asynchronous module. The surveys were pilot tested for face validity by three dental hygienists and three dentists who had graduated within the past three years. Pilot testers provided feedback on the time needed to complete the surveys, comprehension, and clarity of survey questions.

Participants were assigned a random ID number in the pre-survey to track changes in knowledge and attitudes from pre- and post-survey responses. The random ID also ensured that survey responses remained anonymous. Survey responses and module participation were kept separate with no linkages. The pre-survey consisted of six items focused on knowledge regarding environmental issues and seven items on attitudes and beliefs regarding climate change and its relationship to dentistry. Question difficulty was developed according to what an average person who had completed high school would know and then increased in difficulty for individuals who were up-to-date with current environmental news. Questions utilized a mixture of multiple-choice knowledge-based and Likert-style questions ranging from strongly disagree to strongly agree. For example, question 11 in the pre-survey asked, "Please indicate your level of agreement with this statement: Environmental sustainability is important." The post-module survey had an additional optional free response section to allow participants an opportunity to share additional general feedback at their own discretion.

Module Design

The educational module embedded the post-survey link at the end of the module; participants could not access the link until the module was completed. The post-survey consisted of six knowledge questions and seven attitude questions that mimicked those of the pre-survey. However, there was an addition of two Likert-style questions asking participants for their opinion of the module and a free-response option for any other miscellaneous feedback. At the end of the post-survey, participants had the choice to opt-in for an equal chance to receive a \$15 gift card by providing their name and email address.

The asynchronous online educational module was titled “Environmental Sustainability and Dentistry” (Table I). The same pilot testers for the pre- and post-surveys pilot also tested the educational module for ease of use, completion time, and accessibility. It was hosted on the UNC-CH Learning Management System (Sakai) and consisted of six sections: 1) Environmental Sustainability, 2) Climate Change Impacts, 3) Healthcare & Dentistry, 4) Sustainable Laws and Policies, 5) Applications, and 6) References. A series of papers by Duane et al. focused on guiding dental practices to implement more environmentally friendly practices informed the module content.¹⁰ Module information was presented in short video format through PowerPoint slides and a voiceover.

Table I. Education module section objectives

Section Title	Objectives
Environmental Sustainability	Define “Environmental Sustainability” Define “Climate Change” Describe connection between climate change and environmental sustainability Identify sources of greenhouse gases (GHG)
Climate Change Impacts	Outline three environmental impacts of climate change
Healthcare and Dentistry	Identify energy intensive healthcare processes Compare US healthcare waste output to rest of world Identify common types of dental waste Discuss environmental danger of dental amalgam
Sustainable Laws and Policies	Identify key legislation and initiatives relevant to environmental sustainability, especially in healthcare Discuss politicization and instability of environmental issues in US
Applications	Provide examples on how to practice environmentally sustainable dentistry List manufacturers/suppliers at local dental institution that have recycling services/options for student’s reference Discuss how to pressure suppliers/manufacturers to provide environmentally friendly options for their products
Climate Change Impacts	Describe three environmental impacts of climate change

Sections 1 and 2 introduced students to environmental sustainability and its importance by highlighting climate change impacts sourced from human activities. Section 3 drew the connection between climate change and dentistry. Section 4 informed study participants on the current state of policies and current administration regarding environmentally sustainable dentistry and healthcare in the US. Section 5 educated students on utilizing sustainable dentistry and introduced methods that they could employ in private practice. Section Six included all references used for the creation of the module and its material. Content-based questions were embedded throughout the module to promote participant engagement and information retention. Completion of all embedded questions was required to ensure that participants completed the module before accessing the post-survey. The embedded questions and responses were not recorded.

Follow Up Assignment

Three weeks following the module, students engaged in a short assignment to reinforce the module content. Students identified an area of dentistry that may or may not benefit from a sustainable approach. Once identified, they evaluated the pros and cons of the approach, described any challenges towards implementing the change, and identified alternative sustainable products if applicable.

Students reported their findings via VoiceThread,¹¹ a collaborative online tool that allows users to present virtually with slides/images on the Learning Management System and commented on at least two of their classmates’ presentations. Following the assignment, students were given the opportunity to provide further feedback on the assignment through a post-assignment survey. While completion of the assignment was required of all students, participation in the survey and study was not. Survey responses were anonymous, and participants could indicate consent for the assignment and feedback for inclusion in the study.

Post-Assignment Survey

The post-assignment survey was administered online (Qualtrics; Provo, UT, USA) and pilot-tested for face validity by dental hygienists who had graduated within three years. The pilot testers provided feedback on survey completion time, readability, and question comprehension. The post-assignment survey took no more than eight minutes to complete. Questions utilized

a combination of Likert-style and open-ended questions to gauge student impressions toward the value of the post-module assignment. For example, question 2 asked, “This assignment helped me apply concepts learned in the module in the real world.” Likert-style response options ranged from “disagree” to “agree.” Four qualitative questions in the post-assignment survey were organized into the following categories: enrichment, change, and continuity. These questions helped determine what students thought should be discontinued, continued, or added to improve their learning experience. For example, question 7 asked, “What part(s) of this assignment should be stopped/changed to improve the learner experience?”

Data Analysis

Quantitative statistical analysis using statistical software (SAS 9.4; SAS Institute Inc., Cary, NC, USA) included paired t-tests to compare participant knowledge and attitude responses from pre- and post-surveys. Survey responses were grouped into the following subgroups: pre-knowledge, pre-attitude, post-knowledge, post-attitude, and self-perceived module effectiveness. All tests were conducted at the 95% confidence interval, and significance was set at $p < 0.05$. Univariate and bivariate analyses were also performed on pre- and post-module surveys and post-assessment survey.

Open-ended responses were analyzed using descriptive coding. The codes were then categorized to create themes. Quotes, representative of these themes, were used to present the data. Intercoder reliability (ICR) between two separate coders was used to minimize potential bias. There was an ICR of 80% agreement out of twenty-five total measures.

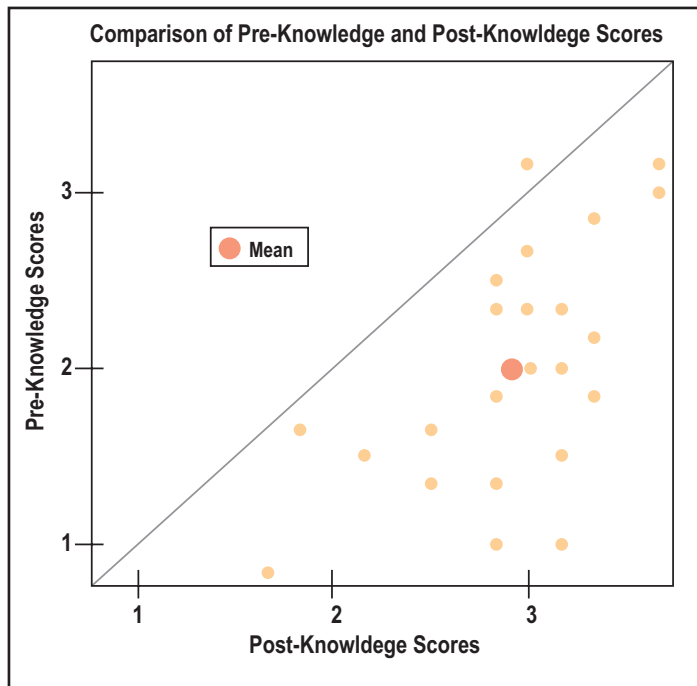
Results

Out of the thirty-four students, 25 completed the pre- and post-surveys for phase one (71.4% response rate). Responses that were incomplete or lacked matching pre-/post-surveys were omitted from the analysis. Of these participants ($n=25$), twenty-four had matching pre-/post-survey responses (68.6% response rate). The pre-survey data revealed that most (74.0%, $n = 20$) participants supported implementing environmentally friendly dentistry. However, a majority (89.0%, $n = 24$) also self-reported possessing little to moderate knowledge on environmental sustainability, and a third (33.0%, $n=9$) felt that they had little to no knowledge of climate change.

There was a statistically significant ($p < 0.0001$) difference between pre-survey and post-survey knowledge scores (Figure 1). Study participants scored an average of 1.987 out of 6 (standard deviation (SD) ± 0.651) possible points on

knowledge in the pre-survey. In the post-survey, knowledge scores increased 0.9167 points to an average of 2.917 out of 6 points (SD) ± 0.496).

Figure 1. Agreement between pre-knowledge and post-knowledge scores after completion of education module



There was a statistically significant ($p < 0.0001$) positive difference between pre-survey and post-survey attitude scores. (Figure 2). Participants scored an average of 6.085 points out of 7 (SD) ± 0.852 total possible points on attitude in the pre-survey. Attitude scores increased by 0.708 points to an average of 6.744 points out of 7 (SD) ± 0.541 total possible points in the post-survey. In the pre-survey, 26.0% ($n=7$) strongly agreed that environmentally sustainable dentistry did not compromise current standards of care. However, post-survey results showed that 41.0% ($n=11$) strongly agreed, and even more participants had increased their results to a more positive stance. Comparisons of the average pre- and post-survey knowledge and attitude scores are shown in Figure 3.

Responses to free-response questions in the immediate post-module survey aligned with two major themes: module format and module content. Study responses regarding module content revealed an unanimously positive response. One such response was, “It was very informative and eye opener to help the environment as part of the dental professionals.” Responses about module format were evenly divided between positive and critical responses. One study respondent expressed appreciation for the format, “I really liked

Figure 2. Agreement between pre- and post-attitude scores after completion of education module

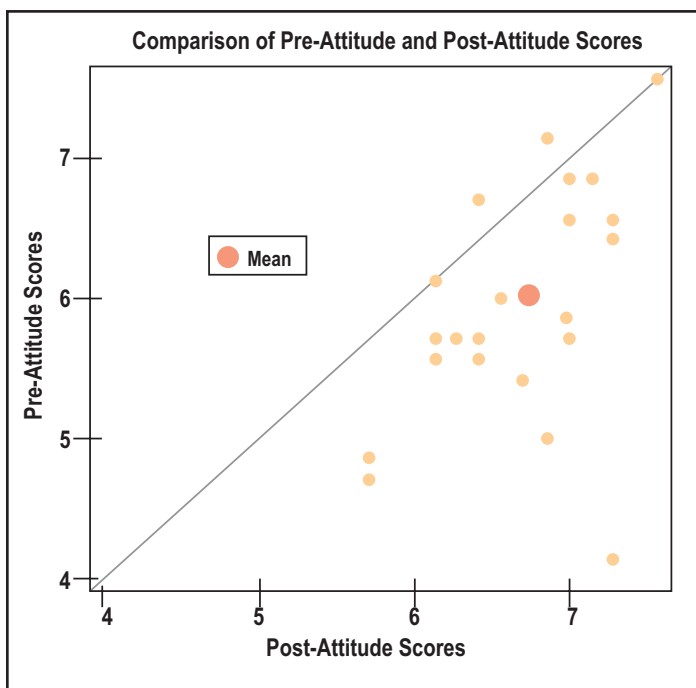
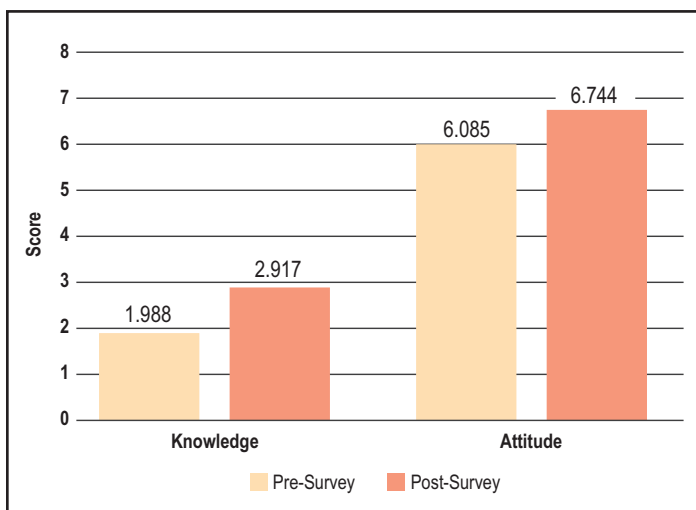


Figure 3. Comparison of average pre-survey and post-survey knowledge and attitude scores



the short video format.” While another voiced dissatisfaction with the pacing of the module, “Talked way too fast to keep up while taking notes.”

In the follow-up assignment three weeks after the education module, participants presented topics including autoclavable patient napkins, biodegradable gloves, reusable glass syringes, bamboo charcoal floss, and high-technology dry vacuum for water conservation. The students discussed the benefits and challenges of implementing these types of measures in dental practice.

Twenty-two students agreed to participate in the follow-up assignment survey (64.7% response rate). Univariate analysis revealed 100.0% of the participants expressed that the reflective assignment was at least “somewhat helpful” and a valuable supplement to the module intervention. Additionally, nearly all (90.0%, n=20) of the respondents felt that the reflective assignment helped students apply module concepts in the real world, and that they had learned about a dental product they were unaware of previously (95.0%, n = 21). Most respondents (90%, n=20) felt that the follow-up assignment helped them think at least somewhat creatively or critically on environmental sustainability and dentistry.

Open-ended responses to the post-module assignment survey revealed the following themes: reinforcement, critical thinking, behavioral change, satisfaction, external factors, design, content, and non-applicable (Table II). Most respondents indicated that the follow-up assignment was useful in helping to apply concepts introduced in the module to the real world and clinic. A few respondents (9.0%, n=2) stated that the assignment pushed them to think critically about reducing dental waste and conducting their own research. One participant stated, “Continue to encourage independent research. I thought that was the most interesting part of the project, learning about all the efforts to make dentistry more sustainable.” While others expressed a need for improvement due to external factors such as, “This project came along in the same week when all of our (other) projects were due” (18.0%, n = 4).

Discussion

Environmental sustainability is vital to improving patient and public health outcomes. Duane et al. recognized healthcare’s contribution to environmental waste and the need to shift to sustainable delivery of healthcare.¹² Dentistry, in particular, has been slow to adapt to the growing need for sustainable practices.¹² Environmental sustainability should be implemented across all sectors, yet oral health professionals know very little about environmental sustainability and dentistry.⁹ Results from this pilot study help fill this gap. The study determined the baseline level of knowledge and attitudes of DH students at one dental hygiene program, implemented an educational intervention, and assessed its helpfulness in improving DH students’ perceptions of environmentally sustainable practices in dentistry. Participants displayed statistically significant increases in their knowledge ($p < 0.0001$) and attitude scores ($p < 0.0001$) after the study interventions. Analysis of the study results determined that the most significant area of change in DH student attitudes was the belief regarding whether environmentally sustainable dentistry is achievable without compromising current standards of care.

Table II. Themes and examples for post module assignment survey

Code	Frequency	Example(s)
Reinforcement	6	<p>“I learned about how we use a lot of stuff that has a better alternative.”</p> <p>“It opened my eyes to the amount of waste that comes from practicing dentistry.”</p>
Critical Thinking	3	<p>“...gave ideas on how to reduce waste.”</p> <p>“I thought that (doing independent research) was the most interesting part of the project, learning about all the efforts to make dentistry more sustainable.”</p>
Behavioral Change	2	<p>“I’ve tried to be less wasteful in clinic because of the environmental lesson.”</p> <p>“Allowed me to think about how to contribute to a more sustainable environment.”</p>
Satisfactory	8	<p>“Lesson is great as is!”</p> <p>“The videos were helpful and served as a memorable way to express content.”</p> <p>“Continue breakdown of material, well organized and easy to understand.”</p>
External Factors	4	<p>“Don’t wait until almost final weeks to ask us to do the project.”</p>
Design	2	<p>“Printable/downloadable version for notes/reference.”</p> <p>“When engaging in the content and clicking through each section, it’s easy to miss questions. Therefore, would prefer them all in one place.”</p>
Content	3	<p>“More examples on how to cut down unnecessary waste.”</p> <p>“More information on how the dental office can reduce carbon footprint and alternatives to materials and barriers.”</p>

Regarding potential shifts towards ESD, participant responses in the pre-survey indicate that while DH students may be receptive to any future shifts towards ESD, they lack the knowledge and means to push and advocate for that change. Results from this study correspond to research by Joury et al. on barriers to implementing ESD in dental and dental hygiene education that included a lack of knowledge and awareness on ESD.⁹ The causes behind the absence of knowledge and awareness of ESD in both dental and DH students is due, in part, to the lack of educational material on ESD.⁹ The provision of ESD educational materials similar to the online module and follow-up assignment in this study could be used in other DH programs or as a CE course to help overcome the knowledge and awareness barriers.

The educational materials created for this study can be reproduced or serve as a model for future educational interventions related to ESD. Implementation of a follow-up assignment following any educational interventions is also recommended to reinforce the educational material. Based on post-assignment survey responses, most participants felt that the follow-up assignment was beneficial to their learning about environmentally sustainable dentistry. Participants also thought that the assignment pushed them to make behavioral changes in the clinic to limit waste.

Practical Implications

The inclusion of environmental sustainability in the DH curriculum is a valuable component of the public health aspect of DH education. Teaching environmental sustainability and its role in public health will help encourage dental hygiene students to look beyond the obvious when evaluating variables that affect their patient’s oral health.

The topic of nutrition can illustrate this point well. In school, DH students learn about the connection between diet and oral health. For example, patients with imbalanced diets high in sugar and carbs are at elevated risk of caries development.¹³ However, it is not as simple as telling a patient to eat more nutritious foods and factors such as social inequities must be considered. Though social inequities are a more abstract variable to consider for oral health factors, they are no less important. Similarly, ESD is also an abstract but important variable of oral health. For example, environmental sustainability is crucial in developing equitable food security policies that push for better diets for the public and promote oral health. Environmental sustainability and its principles are utilized for managing variables such as water use, minimizing food waste, and effective use of resources.¹⁴⁻¹⁵ There is an undeniable tie between environmental sustainability and oral health.

Integrating environmental sustainability into the DH curriculum may also create opportunities for interprofessional education (IPE) and collaboration. For example, ESD can be further strengthened by including sustainability into the curriculum of dental and dental assisting students. In clinical practice settings, as well as in dental education, dentists and dental assistants are often responsible for procuring, managing, and disposing of supplies.

IPE collaboration can also extend beyond dental education students. Outside of the SHE network, the CSH also has a Fellows and Scholars program where healthcare professionals of various backgrounds learn about environmental sustainability and are trained to incorporate strategies into their practice settings.¹⁶ Health care professionals in the US can consider adopting a similar approach. Students of various healthcare backgrounds (dental, medical, social work etc.) could learn together and identify areas of practice within their respective professions that would benefit from a sustainable approach. Not only would they be able to learn more from each other and about their respective health care fields, but students would also learn from experts that they may not have been exposed to otherwise such as environmentalists, scientists, and public health experts. The feasibility of IPE on environmentally sustainable healthcare is especially promising in educational settings where there are already student groups from varied fields of study dedicated to the topic.¹⁷

Limitations and Future Research

Although the educational module intervention supported the study hypothesis, there were limitations. One limitation was the small sample size from one institution and this study should be considered a pilot study to provide insight into what one may expect to see on a similar study at a larger scale. Participant recruitment and response rate were also limited due to the COVID-19 pandemic. Opportunities to recruit a larger pool of participants outside of the UNC-CH second-year DH class had to occur virtually. Recruitment and data gathering also occurred at the beginning of the COVID pandemic, when participants found themselves in volatile and likely overwhelming situations.

Initially, the study intervention was planned to be an in-person seminar with active learning opportunities such as group discussions to enforce learner engagement and information retention. Due to the COVID-19 pandemic, students could not attend an in-person seminar, and the intervention occurred online. While there were concerns that the quality of education may decline due to online format, participants indicated that they appreciated the module for its novel content and design featuring short video presentations

with accompanying questions. The virtual intervention did not appear to affect the quality and effectiveness of education. These findings were supported by a meta-analysis on the evaluation of distance learning by Allen et al. which demonstrated no significant decline in the effectiveness of online education compared to traditional in-person learning.¹⁸ While the quality of education did not diminish, future research may also consider implementing alternative educational interventions that incorporate more face-to-face interactions. Comparisons between live, virtual-only, and hybrid educational interventions could also be implemented to determine which educational delivery method may be the most effective.

Conclusion

Results from this study indicate that the topic of environmental sustainability be considered for inclusion in the DH curriculum. The environmental impact of dental waste is closely connected to the overall health of patients and the public. Dental hygiene students in this study were receptive to ESD educational material, became familiar with new and alternative products, and found the learning experience fulfilling. Results of this study can advocate for the widespread implementation of ESD in dental and dental hygiene education, but also in other health care professions creating both intra- and interprofessional education opportunities. Future research should include testing this ESD education module on a larger sample size and include follow-up studies on the retention of environmentally sustainable interventions in clinical practice.

Acknowledgments

The authors would like to extend a special thank you to Dr. Ceib Phillips and Miss Pooja Saha for their guidance with the statistical analysis of this study.

Wai-Sum Leung, MS, RDH is a 2021 graduate of the University of North Carolina at Chapel Hill Master of Science in Dental Hygiene program and a patient care coordinator at the Adams School of Dentistry; ***Laura Dubbs, PhD*** is a research associate professor at the Institute for the Environment and the Associate Director of the North Carolina Ocean Energy Program and the Coastal Studies Institute; ***Tiffanie White, MEd, CDA, RDH*** is an assistant professor in the dental hygiene programs, Adams School of Dentistry, Division of Comprehensive Oral Health; ***Elizabeth C. Kornegay, MS, RDH*** is an assistant professor in the dental hygiene programs, Adams School of Dentistry, Division of Comprehensive Oral Health; all at the University of North Carolina at Chapel Hill, Chapel Hill, NC, USA.

References

1. Pichler P, Jaccard I, Weisz U, Weisz H. International comparison of health care carbon footprints. *Environ Res Lett.* 2019 May 24;14(6):1-8.
2. EPA. Wastes [Internet]. Washington, DC: US Environmental Protection Agency; 2021 [cited 2021 Mar 27]. Available from: <https://www.epa.gov/report-environment/wastes>
3. FDI. Basic responsibility and rights of dentists [Internet]. Geneva (CH): FDI World Dental Federation; 2020 [cited 2020 Nov 23]. Available from: <https://www.fdiworlddental.org/resources/policy-statement/basic-responsibilities-and-rights-of-dentists>
4. FDI. Sustainability in Dentistry [Internet]. Geneva (CH): FDI World Dental Federation; 2020 [cited 2020 Oct 11]. Available from: <https://www.fdiworlddental.org/resources/policy-statements-and-resolutions/sustainability-in-dentistry>
5. BDA. Education, ethics and the dental team [Internet]. London (UK): British Dental Association; 2020 [cited 2020 Oct 12]. Available from: <https://bda.org/dentists/governance-and-representation/advisory-committees/Pages/Education-Ethics-and-the-Dental-Team.aspx>
6. CSH. Sustainable healthcare education and training [Internet]. Oxford (UK); Centre for Sustainable Healthcare; 2020 [cited 2020 Nov 24]; [about 4 screens]. Available from: <https://sustainablehealthcare.org.uk/what-we-do/education-and-training>
7. IBISWorld. Dentists in the US - market size [Internet]. Los Angeles (CA): IBISWorld; 2021 [cited 2021 Mar 27]; [about 3 screens]. Available from: <https://www.ibisworld.com/industry-statistics/market-size/dentists-united-states/>
8. Consortium. About the Medical Society Consortium on Climate and Health [Internet]. Fairfax (VA): George Mason University; 2021 [cited 2021 Mar 25]; [about 2 screens]. Available from: <https://medsocietiesforclimatehealth.org/about/>
9. Joury E, Lee J, Parchure A, Mortimer F, et al. Exploring environmental sustainability in UK and US dental curricula and related barriers and enablers: a cross-sectional survey in two dental schools. *Br Dent J.* 2021 May;230(9):605-10.
10. Duane B, Ramasubbu D, Harford S, Steinbach I. Environmental sustainability and waste within the dental practice. *Brit Dent J.* 2019 Apr; 226(8):611-18.
11. VoiceThread. Voicethread fills the social presence gap found in online learning interactions [Internet]. Durham (NC): VoiceThread; 2021[cited 2021 Mar 27]; [about 2 screens]. Available from: <https://voicethread.com/products/highered/>
12. Duane B, Stancliffe R, Miller FA, et al. Sustainability in dentistry: a multifaceted approach needed. *J Dent Res.* 2020 Aug;99(9):998-1003.
13. Al-Dajani M, Limeback H. Nutritional strategies for caries reduction. *Dimens Dent Hyg.* 2014 Aug 1;12(8):30-3.
14. GNR. Pro-equity policy agenda to deliver nutrition actions [Internet]. United Kingdom: Global Nutrition Report; 2021 [cited 2021 Oct 16]; [about 12 screens]. Available from: <https://globalnutritionreport.org/reports/2020-global-nutrition-report/introduction-towards-global-nutrition-equity/>
15. McCarthy D. The necessary link between food security and sustainability [Internet]. New Haven (CT): Yale Environment Review; 2021 [cited 2021 Oct 16]. Available from: <https://environment-review.yale.edu/necessary-link-between-food-security-and-sustainability-0>
16. CSF. Fellows and scholars [Internet]. Oxford (UK); Centre for Sustainable Healthcare; 2020 [cited 2020 Oct 12]; [about 9 screens]. Available from: <https://sustainablehealthcare.org.uk/who-we-are/fellows-and-scholars>
17. Buring S, Bhushan A, Brazea G, et al. Keys to successful implementation of interprofessional education: learning location, faculty development, and curricular themes. *Am J Pharm Educ.* 2009 Jul 10;73(4):60.
18. Allen M, Mabry E, Mattrey M, et al. Evaluating the effectiveness of distance learning: a comparison using meta-analysis. *J Communication.* 2004 Sept 1;54(3):402-20.