



American
Dental
Hygienists'
Association

Journal of Dental Hygiene

THE AMERICAN DENTAL HYGIENISTS' ASSOCIATION

AUGUST 2014 VOLUME 88 NUMBER 4

- HPV-Positive Head and Neck Cancers: A Review of the Literature
- Addressing Early Preventive Oral Health Care among Young Children: A Pilot Evaluation of the Baby Oral Health Program (bOHP) among Dental Professionals
- Building Online Learning Communities in a Graduate Dental Hygiene Program
- Endoscopic vs. Tactile Evaluation of Subgingival Calculus
- Microbial Contamination of Power Toothbrushes: A Comparison of Solid-Head Versus Hollow-Head Designs
- The Use of Social Media in Dental Hygiene Programs: A Survey of Program Directors
- Smiles Over Time: An Older Adult Oral Health Survey in Illinois

Journal of Dental Hygiene

VOLUME 88 • NUMBER 4 • AUGUST 2014

STATEMENT OF PURPOSE

The *Journal of Dental Hygiene* is the refereed, scientific publication of the American Dental Hygienists' Association. It promotes the publication of original research related to the profession, the education, and the practice of dental hygiene. The Journal 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 published quarterly online by the American Dental Hygienists' Association, 444 N. Michigan Avenue, Chicago, IL 60611. Copyright 2010 by the American Dental Hygienists' Association. Reproduction in whole or part without written permission is prohibited. Subscription rates for nonmembers are one year, \$60.

SUBMISSIONS

Please submit manuscripts for possible publication in the *Journal of Dental Hygiene* to JoshS@adha.net.

EDITORIAL REVIEW BOARD

Celeste M. Abraham, DDS, MS
Cynthia C. Amyot, MSDH, EdD
Joanna Asadoorian, AAS, BScD, MSc, PhD candidate
Caren M. Barnes, RDH, MS
Phyllis L. Beemsterboer, RDH, MS, EdD
Stephanie Bossenberger, RDH, MS
Linda D. Boyd, RDH, RD, EdD
Kimberly S. Bray, RDH, MS
Colleen Brickle, RDH, RF, EdD
Lorraine Brockmann, RDH, MS
Patricia Regener Campbell, RDH, MS
Dan Caplan, DDS, PhD
Marie Collins, EdD, RDH
Barbara H. Connolly, DPT, EdD, FAPTA
MaryAnn Cugini, RDH, MHP
Susan J. Daniel, BS, MS
Michele Darby, BSDH, MSDH
Janice DeWald, BSDH, DDS, MS
Susan Duley, EdD, LPC, CEDS, RDH, EdS
Jacquelyn M. Dylla, DPT, PT
Kathy Eklund, RDH, MHP
Deborah E. Fleming, RDH, MS
Jane L. Forrest, BSDH, BS, MA
Jacquelyn L. Fried, RDH, MS
Mary George, RDH, BSDH, MED
Kathy Geurink, RDH, MA
Joan Gluch, RDH, PhD
Maria Perno Goldie, MS, RDH
Ellen B. Grimes, RDH, MA, MPA, EdD
JoAnn R. Gurenlian, RDH, PhD
Anne Gwozdek, RDH, BA, MA
Linda L. Hanlon, RDH, PhD, BS, Med
Kitty Harkleroad, RDH, MS
Lisa F. Harper Mallonee, BSDH, MPH, RD/LD
Harold A. Henson, RDH, MED
Alice M. Horowitz, PhD
Laura Jansen Howerton, RDH, MS
Olga A. C. Ibsen, RDH, MS

2013 – 2014 ADHA OFFICERS

PRESIDENT

Kelli Swanson Jaecks, MA, RDH

PRESIDENT-ELECT

Jill Rethman, RDH, BA

VICE PRESIDENT

Betty A. Kabel, RDH, BS

TREASURER

Louann M. Goodnough, RDH, BS

IMMEDIATE PAST

PRESIDENT

Denise Bowers, RDH, MSEd

EXECUTIVE DIRECTOR

Ann Battrell, RDH, BS, MSDH
annb@adha.net

EDITOR-IN-CHIEF

Rebecca S. Wilder, RDH, BS, MS
rebeccaw@adha.net

EDITOR EMERITUS

Mary Alice Gaston, RDH, MS

COMMUNICATIONS

DIRECTOR

John Iwanski
JohnI@adha.net

STAFF EDITOR

Josh Snyder
joshs@adha.net

LAYOUT/DESIGN

Josh Snyder

Mary Jacks, MS, RDH
Heather Jared, RDH, MS, BS
Wendy Kerschbaum, BS, MA, MPH
Janet Kinney, RDH, MS
Salme Lavigne, RDH, BA, MSDH
Jessica Y. Lee, DDS, MPH, PhD
Deborah Lyle, RDH, BS, MS
Deborah S. Manne, RDH, RN, MSN, OCN
Ann L. McCann, RDH, MS, PhD
Stacy McCauley, RDH, MS
Gayle McCombs, RDH, MS
Shannon Mitchell, RDH, MS
Tanya Villalpando Mitchell, RDH, MS
Tricia Moore, EdD
Christine Nathe, RDH, MS
Johanna Odrich, RDH, MS, PhD, MPH
Jodi Olmsted, RDH, BS, MS, EdS, PhD
Pamela Overman, BS, MS, EdD
Vickie Overman, RDH, Med
Ceib Phillips, MPH, PhD
Marjorie Reveal, RDH, MS, MBA
Kathi R. Shepherd, RDH, MS
Deanne Shuman, BSDH, MS, PhD
Judith Skeleton, RDH, Med, PhD, BSDH
Ann Eshenaur Spolarich, RDH, PhD
Rebecca Stolberg, RDH, BS, MSDH
Julie Sutton, RDH, MS
Sheryl L. Ernest Syme, RDH, MS
Terri Tilliss, RDH, PhD
Lynn Tolle, BSDH, MS
Margaret Walsh, RDH, MS, MA, EdD
Pat Walters, RDH, BSDH, BSOB
Donna Warren-Morris, RDH, MeD
Cheryl Westphal, RDH, MS
Karen B. Williams, RDH, MS, PhD
Nancy Williams, RDH, EdD
Pamela Zarkowski, BSDH, MPH, JD

Features

Review of the Literature

- 194 HPV-Positive Head and Neck Cancers: A Review of the Literature**
Matilda Minassian, RDH, MS; Jacquelyn L. Fried, RHD, MS; Robert A. Ord, DDS, MD, FRCS, FACS, MS

Critical Issues in Dental Hygiene

- 202 Addressing Early Preventive Oral Health Care among Young Children: A Pilot Evaluation of the Baby Oral Health Program (bOHP) among Dental Professionals**
Cheryl A. Vamos, PhD, MPH; Rocio Quinonez, DMD, MS, MPH; Anca Gaston, PhD, MS; Joyce Sinton, BDS, BMSc, DDPH
- 213 Building Online Learning Communities in a Graduate Dental Hygiene Program**
Ellen J. Rogo, RDH, PhD; Karen M. Portillo, RDH, MS

Research

- 229 Endoscopic vs. Tactile Evaluation of Subgingival Calculus**
Joy B. Osborn, RDH, MA; Patricia A. Lenton, RDH, MA; Scott A. Lunos, MS; Christine M. Blue BSDH, MS
- 237 Microbial Contamination of Power Toothbrushes: A Comparison of Solid-Head Versus Hollow-Head Designs**
Donna W. Morris, RDH, MEd; Millicent Goldschmidt, MS, PhD; Harris Keene, DDS; Stanley G. Cron, MSPH
- 243 The Use of Social Media in Dental Hygiene Programs: A Survey of Program Directors**
Rachel K Henry RDH, MS; Jennifer A Pieren RDH, MS
- 250 Smiles Over Time: An Older Adult Oral Health Survey in Illinois**
Sherri M. Lukes, RDH, MS, FAADH; Julie A. Janssen, RDH, MA; Kathleen K. Thacker, RDH, MPH; Sangeeta Wadhawan, DDS, MPH

Editorial

- 193 A Tribute to a Friend: Dr. Connie L. Drisko**
Rebecca S. Wilder, RDH, BS, MS



A Tribute to a Friend: Dr. Connie L. Drisko

The dental and dental hygiene profession lost a true treasure in June of this year. Dr. Connie L. Drisko died from a recent diagnosis of acute myelogenous leukemia. Connie began her career in the dental profession when she graduated from Baylor College of Dentistry, Caruth School of Dental Hygiene, in 1961 with honors and a certificate. She later pursued a BS degree from Baylor and graduated in 1975. During that time Connie contributed to dental hygiene by clinical practice and clinical teaching...at Tyler Junior College in Texas and at the University of Oklahoma. Connie practiced as a dental hygienist for 16 years before she entered dental school at the University of Missouri - Kansas City. Her love for learning did not end there! She went on to complete a General Practice Residency from the Veteran's Affairs Medical Center in Kansas City, MO and then a certificate in periodontics from the Department of Veterans Affairs Medical Center in Leavenworth, Kansas. Then...she entered a long and successful academic career.

I could go on and on about how she served as Associate Dean for Research, Associate Dean for Academic Planning and Faculty Development, and Director of the Dental Education and Research Center at the University of Louisville School of Dentistry in Louisville, KY; was a fellow of the prestigious Executive Leadership in Academic Medicine Program for Women (ELAM); was one of a very few female deans, serving in that role for 10 years at the College of Dental Medicine at Georgia Regents University (GRU); oversaw construction of a new state-of-the-art dental school in Georgia; was awarded GRU's inaugural employee Diversity Award for promoting and enhancing diversity among staff, faculty, and students...and on and on. I recommend that you search her name on the internet to see all of the contributions she has made to dental hygiene and dentistry because they are too many to write in this editorial!

Even though Connie accomplished many things in her career, I will remember Connie mostly for 3 things. First, she did not let age get in the way of achieving her goals. She was the first to tell people that she was the oldest dental student in her class. One must remember that she graduated from den-

tal school in 1980 when there were few female dental students ... much less older female dental students!! Connie had gifts and goals and she was determined to make it happen. We could all learn a lot from her about not putting goals on hold. Second, Connie contributed tremendously to the dental and dental hygiene literature. I have read Connie's extensive reviews of the periodontal debridement literature for most of my career and I always knew I could count on her papers to be thorough and evidence based. She never wavered from her core values of honesty and being trustworthy in professional writings. Connie's most recent contribution was an article titled, "Periodontal Debridement: Still the Treatment of Choice."¹ As Guest Editor of the Evidence Based Dental Practice Annual Report on Dental Hygiene, Dr. Terri Tillis noted that Connie's paper... "was a final gift to dental hygiene." In the paper, Connie discussed the evidence base for several treatment options for inflammatory periodontitis. Emphasizing that dental hygienists specialize in providing treatment of this inflammatory disease, she sought to clearly present the existing evidence. Connie achieved many accolades in dentistry but she never forgot her dental hygiene roots! Lastly, I will never forget Connie's attitude. She was always warm, welcoming, encouraging... and she always had a huge, beautiful smile on her face. She was a leader and a mentor and the first to encourage others to believe in themselves. The late Maya Angelou once quoted the following, "I've learned that people will forget what you said, people will forget what you did, but people will never forget how you made them feel." Connie made people feel better about themselves and the world around them. We will miss you Connie.

Sincerely,

Rebecca Wilder, RDH, BS, MS
Editor-in-Chief, Journal of Dental Hygiene

References

1. Drisko CL. Periodontal debridement: still the treatment of choice. *J Evid Based Dent Pract.* 2014;14 Suppl:33-41.e1.

Review of the Literature

HPV-Positive Head and Neck Cancers: A Review of the Literature

Matilda Minassian, RDH, MS; Jacquelyn L. Fried, RHD, MS; Robert A. Ord, DDS, MD, FRCS, FACS, MS

Introduction

Currently, over 110 million individuals are infected with sexually transmitted diseases (STDs), costing the U.S. health care system more than 16 billion dollars.¹ STDs caused by the human papillomavirus (HPV) are the most prevalent, affecting an estimated 79 million Americans.² It is predicted that annually another 14 million people will become newly infected with HPV.² This virus is so common that at least 50% of sexually active men and women contract it at some point in their lives.²

HPV is an etiologic factor in cervical cancer and has a strong association with oropharyngeal cancer (OPC). A causal relationship between cervical cancer and a sexually transmitted source was first hypothesized in 1842.³ Today, research shows that HPV is the main cause of cervical cancer.⁴ HPV is also linked with the risk of developing head and neck cancer (HNC), specifically OPC.⁵

Patient risk profiles for OPC and oral cavity cancer differ. Cancers limited to the oral cavity are most commonly carcinogen related and are typically found in older adults who smoke and consume alcohol.⁶ In contrast, OPC is increasingly prevalent in younger adult populations with no histories of smoking or drinking.⁷⁻⁹ Researchers report that HPV infection may explain the development of HNC in individuals who lack the typical risk factors for oral cancer.^{6,10} Certain sexual behaviors are related to greater risk for OPC. While some researchers state that the main risk factor for becoming infected with oral HPV is practicing oral sex,⁷ others also consider open mouth/deep kissing a risk factor.^{6,9}

Adolescents and young adults, aged 15 to 24 years, constitute only 25% of the sexually active population.¹¹ However, according to the Centers for Disease Control and Prevention (CDC), young adults have the highest prevalence of STDs.¹ Research shows that young adults represent over 65% of all

Abstract

Purpose: The human papillomavirus (HPV) is a sexually transmitted disease (STD) that is rampant among young adults and is linked with cervical and oropharyngeal cancers (OPC). As the preventive arm of oral health care, dental hygienists can take the lead in educating the young adult population about risk factors for HPV and OPC. Dental hygienists' active involvement in educational initiatives may help minimize the spread of HPV associated STDs, prevent transmission of HPV to the head and neck region, and decrease the development of OPC.

Keywords: human papillomavirus, oropharyngeal cancer, risk factors, at-risk behaviors, dental hygienists, sexually transmitted diseases

This study supports the NDHRA priority area, **Health Promotion/Disease Prevention:** Assess strategies for effective communication between the dental hygienist and client.

reported sexually transmitted infections.^{12,13} Young adults may be more willing to engage in risky sexual behaviors, such as oral or anal sex, and thereby increase their risks for developing oral HPV.^{5,7,14} Since the suspected transmission of genital HPV to the oral cavity is due to high risk sexual practices, young adults may be a prime population with whom to discuss HPV and its associated risks.

As the preventive arm of oral health care, dental hygienists should be knowledgeable about oral HPV and its link to OPC. Dental hygienists can take the lead in educating the young adult populations they treat about risky sexual practices, HPV and OPC. Their active involvement in educational initiatives may help minimize the spread of HPV associated STDs, prevent transmission of HPV to the oral cavity and decrease the development of OPC.

Human Papillomavirus

HPV is a complex group of viruses that include over 100 strains. HPV infections are transmitted by direct skin-to-skin contact, with penetrative sex being the most frequent route of transmission.¹⁵ HPVs are categorized according to their ability to convert cells into cancer. Common low risk strains include HPV 2, 4, 6, 11, 13, 32 and those responsible for genital warts, benign cervical changes, recurrent re-

spiratory papillomatosis,¹⁶ and oral conditions, such as squamous cell papillomas, verruca vulgaris, condyloma acuminatum, and focal epithelial hyperplasia.¹⁷ Strains 16 and 18 are high risk and have been linked to cervical cancer and head and neck, particularly OPC.¹⁶ HPV associated conditions are of special interest to oral health care professionals due to the relationship between HPV and HNC.

Risk Factors

Risk factors for HPV infection include high risk sexual behavior and age.⁷ Prevalence rates of HPV infection among sexually active young adults range from 29 to 39%.¹¹ From a representative sample of U.S. females 14 to 59 years of age, Dunne et al found that the prevalence of HPV was highest among those 20 to 24 years of age.¹⁶ Brown et al revealed that over 80% of their study participants, which consisted of females 14 to 17 years old, presented with evidence of HPV infection.¹²

The number of life-time sexual partners and frequency of sexual encounters, whether penetrative intercourse or other intimate skin-to-skin contact, are risk factors for HPV infection.^{7,15} Researchers support the premise that sexual intercourse is the primary route of genital HPV infection and that life-time number of sexual partners and HPV prevalence are associated.^{7,15,18} The chance of oral HPV infection also rises with an increased number of oral sex partners.⁸

HPV and Cervical Cancer

HPV is a main cause of cervical cancer.⁴ HPV 16 and 18, the most common high-risk HPV types, are found in approximately 90% of cervical cancers.¹⁹ More recently, these HPV types have been associated with OPCs, a subset of HNCs.^{7,10,16}

Head and Neck Cancers

HNCs commonly originate in squamous cells and include cancers of the oral cavity, oropharynx, hypopharynx, larynx, sinonasal tract and nasopharynx.²⁰ Globally, head and neck squamous cell carcinoma (HNSCC) is the sixth most common type of cancer,²⁰ with an annual incidence of approximately 400,000 worldwide.²¹ The American Cancer Society estimates that, in 2013, 53,640 new cases of HNSCC will be detected in the U.S. and that these cancers will be responsible for 11,520 deaths.²²

Oral Cancer/Oral Cavity Cancer

The most common oral cavity cancer sites include the anterior two-thirds of the tongue, floor of the

mouth, gingiva, lip vermillion and buccal and retro-molar mucosa, and the hard palate.⁵ The majority of head and neck tumors occur in the oral cavity.²³ In 2000, 300,000 of the 615,000 new cases of oral cavity tumors reported worldwide were squamous cell carcinomas.²⁴

Cancers limited to the oral cavity are most commonly carcinogen related, and are typically found in older adults.⁶ Historically, approximately 80 to 90% of U.S. oral cancer cases have been caused by tobacco and alcohol abuse.²⁵ Nearly 80% of patients with oral cavity squamous cell carcinoma are current or past tobacco users.²⁴ Compared with nonsmokers, these patients have a 5 to 7 times greater risk of developing malignant head and neck tumors.²⁴ Muwonge et al found that alcohol and tobacco create a synergistic effect which promotes mucosal permeability to carcinogens.²⁶

Early detection is the key to increased survival rates. Clinical signs and symptoms of oral cavity cancers are often generic and may be mistaken for other common conditions.²⁴ Nearly 80% of early-stage oral cancers are treatable, while individuals with advanced-stage cancers have survival rates of 21%.²⁴ The overall 5 year survival rate for patients with oral cavity squamous cell carcinoma is between 45 and 72%.²⁴ White males have a higher 5 year relative survival rate than African American males.²² Health care professionals must be aware of the possibility of oral cancer, understand the importance of conducting oral cancer exams and be knowledgeable about oral cancer signs and symptoms.

Oropharyngeal Cancer

OPC sites include the base of the tongue, soft palate, uvula, palatine tonsil fossa and oropharynx.⁵ The incidence of OPC is increasing worldwide.^{20,27} While previously a greater risk for OPC existed among individuals who smoked and consumed alcohol,²⁸ an increase of HPV-related OPC in nonsmokers and nondrinkers is currently reported.²⁷⁻²⁹ Younger individuals who lack the usual risk factors for oral cancer are presenting with OPC.^{9,10,30} Researchers examining the association between HPV and the typical risk factors for HNC, tobacco and alcohol use, found little indication that viral status was linked to either habit.⁵ Reports from a phase III cancer therapy trial stated that HPV-positive patients were younger and had less extensive tobacco exposure when compared with HPV-negative patients.³¹ Other studies attribute an HPV etiology to squamous cell carcinoma rather than smoking and alcohol.^{28,29} Pintos et al found an association between HPV and OPC, independent of smoking and alcohol consumption.³⁰ Others suggest that the increase in OPC is caused by an epidemic

of HPV-16 sexually transmitted disease.²⁰ Although previous risk factors for HNSCCs included tobacco smoking and alcohol consumption, HPV infection is a new addition.

Similar to oral cavity cancer, most OPCs originate in squamous cell tissue. In OPCs, the tonsils are the most common site, with the base of tongue following.²⁰ These cancer sites comprise 90% of all OPCs.²⁰ In the U.S., tonsillar cancer accounts for 15 to 20% of all OPCs. Data collected between 1973 and 2001 reveal an increased risk of developing tonsillar cancer among white males aged 40 to 65 years.²⁹ From 1973 and 2004, Chaturvedi et al reported an increase in the percentage of HPV-related OPCs in the U.S.²⁹

In general, survival rates for HPV-related OPC are better than those for non-HPV-related neoplasms.³¹ The estimated 5 year relative survival rate for oropharynx/tonsil cancer stages I, II, III, and IV are 56, 58, 55, and 43%, respectively; and for tongue cancer stages I, II, III, and IV are 71, 59, 47, and 37%, respectively.³² Favorable survival rates for HPV-related OPC may be due to enhanced radiation sensitivity, higher response rates to chemotherapy and lack of field cancerization and cumulative patient exposure to tobacco and alcohol.^{33,34}

Causal Relationship Between HPV and OPC

During the past few decades, HPV DNA has been discovered in approximately 25% of individuals diagnosed with HNSCC.³⁵ In a recent study, researchers found a relationship between the detection of HPV-HR types in oral cells and the existence of HPV-HR types in tumor tissue; HPV-16 was the most frequent genotype detected.³⁶ HPV DNA was identified in 40 to 60% of OPC cases versus only 15% in oral cavity cancer cases.^{10,36}

As previously stated, several sexual behaviors increase the risk for developing OPC.¹⁰ These include number of sexual partners, age at first intercourse and the practices of oral-genital and oral-anal sex.¹⁰ It is reported that the chance of developing oral HPV infection substantially grows with an increased number of lifetime oral or vaginal sex partners.⁸ These findings corroborate results from a cross-sectional study of 2,065 females aged 18 to 29 years in which the number of sexual partners in the past 6 months and the number of lifetime sexual partners were independently related to higher risk for HPV infection and prevalence.¹⁸ Numerous cross-sectional and longitudinal studies report that the risk of HPV infection increases at early sexual debut or when a shorter time frame exists between sexual debut and the onset of the menstrual cycle.³⁷⁻⁴⁰ Compared to women 55 and older, individuals younger than 25 years are

more likely to have had their first intercourse experience before age 18.³⁷ Data from Smith et al revealed that younger patients had higher numbers of sexual partners compared to older patients and that younger-age OPC cases had a greater prevalence of HPV in tumors.⁵ Younger individuals also had a much higher likelihood of engaging in both oral-genital sex and oral-anal sex than did older individuals.⁵ Surveys of young adult sexual behavior suggest that most young adults engage in oral sex prior to vaginal intercourse.¹⁴ Young adults consider oral sex less risky than vaginal intercourse and report having more oral than vaginal sex partners.⁴¹ A U.S. survey found that 38.8% of males and 43.6% of females ages 15 to 19 years had performed oral sex.⁴²

An HPV vaccine is presumed to prevent HPV-related cervical cancer.⁴³ Currently, 2 HPV vaccines, Cervarix (Human Papillomavirus Bivalent (Types 16 and 18) Vaccine, Recombinant), GlaxoSmithKline Biologicals) and Gardasil (Human Papillomavirus Quadrivalent (Types 6, 11, 16 and 18) Vaccine, Recombinant), Merck Sharp & Dohme Corp., a subsidiary of Merck & Co., Inc.), are available to protect against low and high-risk HPV types.⁴⁴ Both vaccines are effective against HPV 16 and 18;⁴³⁻⁴⁵ however, only Gardasil protects against HPV 6 and 11 and associated genital warts.⁴⁴ Initially, these vaccines were recommended for females aged 11 to 26 years;⁴⁶ today, one of the vaccines (Gardasil) is also recommended for males aged 11 to 21 years.⁴⁷ The HPV vaccine's ability to prevent OPC is possible but unknown.^{6,9,23}

Communication Regarding Sensitive Topics

Communication between health care providers and patients is essential; however, many health professionals lack the required skills to communicate effectively.⁴⁸ Patient education is a critical aspect of the dental hygienist's role and is the cornerstone of the profession. Consequently, dental hygienists must possess the necessary knowledge and skills to communicate with their patients about HPV.

Health Professionals' Communication

In general, health care providers have limited training in communication skills.⁴⁸ It appears that dentists, physicians, nurses and pharmacists need to improve their communication techniques.⁴⁹ Studies show that most physicians have had minimal education and practice regarding communication and compromised physician-patient communication has been documented.^{48,50} A 2007 study identified lack of time and heavy workloads as barriers to provider-patient communication.⁵⁰ Results from another study showed that several factors contributed to communication deficits: time pressures, fear of "opening a

can of worms,” provider discomfort and avoidance, embarrassment, and lack of confidence and expertise.^{51,52}

Health care providers consider discussions regarding accepted health concerns part of their scope of practice, but for various reasons, many avoid discussions about sensitive topics. They may encounter situations where communication is stifled because of the sensitive nature of a topic.⁵¹ In a study aiming to describe health care providers’ attitudes toward discussing sexuality-related issues with patients, researchers found that providers rarely discuss these topics with patients.⁵⁰ Lack of training and difficulty in discussing certain personal matters were the primary reasons for not addressing sexuality-related concerns.⁵⁰ Research on nurses’ attitudes and beliefs towards discussing sexuality with patients shows that a majority feel that talking about sexuality is one part of their responsibilities.⁵³ Although most doctors and nurses feel that addressing sexual issues are part of their roles, most state they are poorly trained and, thus, unlikely to discuss them with patients.⁵⁴

Dental Hygienists and Patient Education

The main risk factor for oral HPV infection, unsafe sexual behavior, is a sensitive topic. Dental hygienists might avoid initiating conversations with young adult patients and their parents due to discomfort regarding the topic. Nonetheless, dental hygienists have an obligation to promote their patients’ well-being by educating and addressing personal and public health concerns with them.

Although not as personal as sexual practices, dental hygienists have counseled patients regarding sensitive health topics, i.e., tobacco cessation.⁵⁵⁻⁵⁷ Many dental hygienists consider initiating conversations related to tobacco use part of their scope of practice, yet barriers exist to integrating a cessation plan into the dental hygiene maintenance appointment.⁵⁶ A survey of 58 dental hygienists reported a deficit in education and training with respect to smoking cessation.⁵⁷ Other barriers to integrating cessation plans into practice include those reported by medical professionals, e.g. too little time, financial limitations, no interest on the part of the patients, respect for individual freedom, lack of experience in providing smoking cessation advice and fear of losing patients.⁵⁶

Dental hygienists have a professional obligation to educate patients about preventing the transmission of oral HPV. A study conducted in 2011 found that while some dental hygienists were willing to initiate HPV-related communication with patients, others were hesitant because of discomfort regarding

the topic and concerns with confidentiality.⁵⁸ When educating young adults about oral HPV and sexual behaviors, dental hygienists must consider the sensitive nature of these topics. Stigmatization often is associated with them. According to McCormick et al, “Societal stigma associated with certain behaviors or conditions often infiltrate the medical encounter and may adversely impact provider communication skills.”⁵¹

Given that HPV is the most common sexually transmitted disease among young adults,¹³ and that OPC is on the rise,²⁹ dental hygienists must be knowledgeable about oral HPV and OPC and be proactive in initiating discussions with their young adult patients and parents. Few studies have investigated practicing dental hygienists’ knowledge and attitudes regarding oral HPV and OPC;⁵⁹ however, several investigations have addressed these topics with dental students, practicing dentists, nurses and physicians.⁶⁰⁻⁶³ Results from these studies show deficiencies in knowledge regarding oral HPV and OPC and avoidance by these professionals.⁶⁰⁻⁶³

Since many health care providers are reticent to explore sensitive topics, dental hygienists can take the lead in educating young adults about risky sexual behaviors, oral HPV and OPC. In contrast to medical professionals, dental hygienists see their patients more routinely, often every 3 to 6 months. Dental hygiene appointments emphasize prevention, and create an environment conducive to counseling patients about health behaviors, including risky sexual behaviors, HPV and OPC. Studies are needed to present empirical evidence that dental hygienists can help to reduce at risk behaviors of young adults by providing HPV and OPC related education.⁵⁹

Conclusion

HPV is a STD rampant among young adults.¹ It causes cervical cancer and is linked to the occurrence of OPCs.¹⁶ Young adults tend to engage in risky sexual behaviors, making them vulnerable to STDs. Given the reluctance to address sensitive topics among most health care professionals, it is important that dental hygienists adopt a proactive stance. Dental hygienists treat young adults and must be willing to intervene with at-risk patients and have the skill set to be comfortable performing this service. Dental hygiene educators need to consider including HPV-related information in their curricula.

Through educational interventions, hygienists may broaden young adults’ knowledge base and shape their attitudes about HPV and OPC and at-risk behaviors. With respect to cervical cancer, HPV may

persist for more than 10 years before transforming from infection to malignancy.²⁷ It is unclear how long oral HPV may persist before transforming from infection to malignancy; however, the possibility of young adults developing OPC in their later adult-hoods exists. Dental hygienists' early interventions may prevent the development of oral HPV infection, OPCs and potentially decrease the incidence of subsequent neoplastic disease.

Matilda Minassian, RDH, MS, is Instructor, Dental Hygiene at Howard Community College. Jacquelyn L. Fried, RHD, MS, is an Associate Professor and Director of Interprofessional Initiatives at the Univer-

sity of Maryland School of Dentistry. Robert A. Ord, DDS, MD, FRCS, FACS, MS, is Chairman of the Oral-Maxillofacial Surgery Department at the University of Maryland School of Dentistry.

Acknowledgments

I would like to express my great appreciation to Ben Manesh, DDS. As my first dental employer, Dr. Manesh was an integral part of my introduction to the field of dental hygiene. I would also like to convey my utmost gratitude to Glenda R. Caceres, without whose support this manuscript would not be possible.

References

1. Incidence, Prevalence, and Cost of Sexually Transmitted Infections in the United States. Centers for Disease Control and Prevention. 2013.
2. Sexually Transmitted Diseases (STDs): Genital HPV Infection Fact Sheet. Centers for Disease Control and Prevention. 2013.
3. Sexually Transmitted Diseases (STDs): Genital HPV Infection Fact Sheet. Centers for Disease Control and Prevention. 2013.
4. Rigoni-Stern D. Statistical facts relating to cancerous diseases. *Giorn, Prog Patol Therap.* 1842;2:507-517.
5. zur Hausen H. Papillomaviruses in the causation of human cancers - a brief historical account. *Virology.* 2009;384(2):260-265.
6. Smith EM, Ritchie JM, Summersgill KF, et al. Age, sexual behavior and human papillomavirus infection in oral cavity and oropharyngeal cancers. *Int J Cancer.* 2004;108(5):766-772.
7. Psyrri A, DiMaio D. Human Papillomavirus in cervical and head-and-neck cancer. *Nat Clin Pract Oncol.* 2008;5(1):24-31.
8. Gillison ML. Human papillomavirus-related diseases: oropharynx cancers and potential implications for adolescent HPV vaccination. *J Adolesc Health.* 2008;43(4):S52-S60.
9. D'Souza G, Agrawal Y, Halpern J, Bodison S, Gillison ML. Oral sexual behaviors associated with prevalent oral human papillomavirus infection. *J Infect Dis.* 2009;199(9):1263-1269.
10. Marur S, D'Souza G, Westra WH, Forastiere AA. HPV-associated head and neck cancer: a virus-related cancer epidemic. *Lancet Oncol.* 2010;11(8):781-789.
11. D'Souza G, Kreimer AR, Viscidi R, et al. Case-control study of human papillomavirus and oropharyngeal cancer. *N Engl J Med.* 2007;356(19):1944-1956.
12. Da Ros CT, Schmitt Cda S. Global epidemiology of sexually transmitted diseases. *Asian J Androl.* 2008;10(1):110-114.
13. Brown DR, Shew ML, Qadadri B, et al. A longitudinal study of genital human papillomavirus infection in a cohort of closely followed adolescent women. *J Infect Dis.* 2005;191(2):182-192.
14. Cates W Jr. Estimates of the incidence and prevalence of sexually transmitted diseases in the United States. American Social Health Association Panel. *Sex Transm Dis.* 1999;26(4):S2-S7.
15. Halpern-Felsher BL, Cornell JL, Kropp RY, Tschann JM. Oral versus vaginal sex among adolescents: perceptions, attitudes, and behavior. *Pediatrics.* 2005;115(4):845-851.

16. Veldhuijzen NJ, Snijders PJ, Reiss P, Meijer CJ, van de Wijgert JH. Factors affecting transmission of mucosal human papillomavirus. *Lancet Infect Dis*. 2010;10(12):862-874.
17. Dunne EF, Unger ER, Sternberg M, et al. Prevalence of HPV infection among females in the United States. *JAMA*. 2007;297(8):813-819.
18. Garlick JA, Taichman LB. Human papillomavirus infection of the oral mucosa. *Am J Dermatopathol*. 1991;13(4):386-395.
19. Lensenlink CH, Melchers WJ, Quint WG, et al. Sexual behavior and HPV infections in 18 to 29 year old women in the pre-vaccine era in the Netherlands. *PLoS One*. 2008;3(11):e3743.
20. Hariri S, Steinau M, Rinas A, et al. HPV Genotypes in High Grade Cervical Lesions and Invasive Cervical Carcinoma as Detected by Two Commercial DNA Assays, North Carolina, 2001–2006. *PLoS One*. 2012;7(3):e34044.
21. Ramqvist T, Dalianis T. Oropharyngeal cancer epidemic and human papillomavirus. *Emerg Infect Dis*. 2010;16(11):1671-1677.
22. Parkin DM, Bray F, Ferlay J, Pisani P. Global Cancer Statistics, 2002. *CA Cancer J Clin*. 2005;55(2):74-108.
23. Siegel R, Naishadham D, Jemal A. Cancer Statistics, 2013. *CA Cancer J Clin*. 2013;63(1):11-30.
24. Shi W, Kato H, Perez-Ordóñez B, et al. Comparative prognostic value of HPV16 E6 mRNA compared with in situ hybridization for human oropharyngeal squamous carcinoma. *J Clin Oncol*. 2009;27(36):6213-6221.
25. Kademani D. Oral Cancer. *Mayo Clin Proc*. 2007;82(7):878-887.
26. Sturgis EM, Wei Q, Spitz MR. Descriptive epidemiology and risk factors for head and neck cancer. *Semin Oncol*. 2004;31(6):726-733.
27. Muwonge R, Ramadas K, Sankila R, et al. Role of tobacco smoking, chewing and alcohol drinking in the risk of oral cancer in Trivandrum, India: A nested case-control design using incident cancer cases. *Oral Oncol*. 2008;44(5):446-454.
28. D'Souza G, Dempsey A. The role of HPV in head and neck cancer and review of the HPV vaccine. *Prev Med*. 2011;53(1):S5-S11.
29. Angiero F, Gatta LB, Seramondi R, et al. Frequency and role of HPV in the progression of epithelial dysplasia to oral cancer. *Anticancer Res*. 2010;30(9):3435-3440.
30. Chaturvedi AK, Engels EA, Anderson WF, Gillison ML. Incidence trends for human papillomavirus-related and -unrelated oral squamous cell carcinomas in the United States. *J Clin Oncol*. 2008;26(4):612-619.
31. Pintos J, Black MJ, Sadeghi N, et al. Human papillomavirus infection and oral cancer: a case-control study in Montreal, Canada. *Oral Oncol*. 2008;44(3):242-250.
32. Chung CH, Gillison ML. Human papillomavirus in head and neck cancer: its role in pathogenesis and clinical implications. *Clin Cancer Res*. 2009;15(22):6758-6762.
33. Oral Cavity and Oropharyngeal Cancer. American Cancer Society [Internet]. 2011. Available from: <http://www.cancer.org/acs/groups/cid/documents/webcontent/003128-pdf.pdf>.
34. Lindel K, Beer KT, Laissue J, Greiner RH, Aebbersold DM. Human papillomavirus positive squamous cell carcinoma of the oropharynx: a radiosensitive subgroup of head and neck carcinoma. *Cancer*. 2001;92(4):805-813.
35. Lindquist D, Romanitan M, Hammarstedt L, et al. Human papillomavirus is a favourable prognostic factor in tonsillar cancer and its oncogenic role is supported by the expression of E6 and E7. *Mol Oncol*. 2007;1(3):350-355.
36. Dahlstrand HM, Dalianis T. Presence and influence of human papillomaviruses (HPV) in Tonsillar cancer. *Adv Cancer Res*. 2005;93:59-89.
37. Smith EM, Ritchie JM, Summersgill KF, et al. Human papillomavirus in oral exfoliated cells and risk of head and neck cancer. *J Natl Cancer Inst*. 2004;96(6):449-455.
38. de Sanjose S, Cortés X, Méndez C, et al. Age at sexual initiation and number of sexual partners in the female Spanish population results from the AFRODITA survey. *Eur J Obstet Gynecol Reprod Biol*. 2008;140(2):234-240.

39. Kahn JA, Rosenthal SL, Succop PA, Ho GY, Burk RD. The interval between menarche and age of first sexual intercourse as a risk factor for subsequent HPV infection in adolescent and young adult women. *J Pediatr.* 2002;141(5):718-723.
40. Collins SI, Mazloomzadeh S, Winter H, et al. Proximity of first intercourse to menarche and the risk of human papillomavirus infection: a longitudinal study. *Int J Cancer.* 2005;114(3):498-500.
41. Khan JA, Rosenthal SL, Succop PA, Ho GY, Burk RD. Mediators of the association between age of first sexual intercourse and subsequent human papillomavirus infection. *Pediatrics.* 2002;109(1):E5.
42. Prinstein MJ, Meade CS, Cohen GL. Adolescent oral sex, peer popularity, and perceptions of best friends' sexual behavior. *J Pediatr Psychol.* 2003;28(4):243-249.
43. Mosher WD, Chandra A, Jones J. Sexual behavior and selected health measures men and women 15-44 years of age, United States, 2002. US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics. 2005.
44. Mammas IN, Sourvinos G, Spandidos DA. Human papilloma virus (HPV) infection in children and adolescents. *Eur J Pediatr.* 2009;168(3):267-273.
45. HPV Vaccine - Questions & Answers. Centers for Disease Control and Prevention. 2012.
46. Giuliano AR, Palefsky JM, Goldstone S, et al. Efficacy of quadrivalent HPV vaccine against HPV infection disease in males. *N Engl J Med.* 2011;364(5):401-411.
47. Committee On Infectious Diseases. HPV vaccine recommendations. *Pediatrics.* 2012;129(3):602-605.
48. CDC Press Briefing Transcript: ACIP recommends all 11-12 year-old males get vaccinated against HPV. Centers for Disease Control and Prevention. 2011.
49. Back AL, Arnold RM, Baile WF, Tulskey JA, Fryer-Edwards K. Approaching difficult communication tasks in oncology. *CA Cancer J Clin.* 2005;55(3):164-177.
50. Rozier RG, Horowitz AM, Podschun G. Dentist-patient communication techniques used in the United States: The results of a national survey. *J Am Dent Assoc.* 2011;142(5):518-530.
51. Hautamaki K, Miettinen M, Kellokumpu-Lehtinen PL, Aalto P, Lehto J. Opening communication with cancer patients about sexuality-related issues. *Cancer Nurs.* 2007;30(5):399-404.
52. McCormick KA, Cochran NE, Back AL, Merrill JO, Williams EC, Bradley KA. How primary care providers talk to patients about alcohol. *J Gen Intern Med.* 2006;21(9):966-972.
53. McNulty CA, Freeman E, Bowen J, Shefras J, Fenton KA. Barriers to opportunistic chlamydia testing in primary care. *Br J Gen Pract.* 2004;54(504):508-514.
54. Saunamäki N, Andersson M, Engstrom M. Discussing sexuality with patients: nurses' attitudes and beliefs. *J Adv Nurs.* 2010;66(6):1308-1316.
55. Haboubi NH, Lincoln N. Views of health professionals on discussing sexual issues with patients. *Disabil Rehabil.* 2003;25(6):291-296.
56. Parker DR. A dental hygienist's role in tobacco cessation. *Int J Dent Hyg.* 2003;1(2):105-109.
57. Ramseier CA, Fundak A. Tobacco use cessation provided by dental hygienists. *Int J Dent Hyg.* 2009;7(1):39-48.
58. Edwards D, Freeman T, Roche AM. Dentists' and dental hygienists' role in smoking cessation: an examination and comparison of current practice and barriers to service provision. *Health Promot J Austr.* 2006;17(2):145-151.
59. Daley E, DeBate R, Dodd V, et al. Exploring awareness, attitudes, and perceived role among oral health providers regarding HPV-related oral cancers. *J Public Health Dent.* 2011;71(2):136-142.

60. Bigelow C, Patton LL, Strauss RP, Wilder RS. North Carolina dental hygienists' view on oral cancer control. *J Dent Hyg.* 2007;81(4):83.
61. Cannick GF, Horowitz AM, Drury TF, Reed SG, Day TA. Assessing oral cancer knowledge among dental students in South Carolina. *J Am Dent Assoc.* 2005;136(3):373-378.
62. Maybury C, Horowitz AM, Yan AF, Green KM, Wang MQ. Maryland dentists' knowledge of oral cancer prevention and early detection. *J Calif Dent Assoc.* 2012;40(4):341-350.
63. Kwan TT, Lo SS, Tam KF, Chan KK, Ngan HY. Assessment of knowledge and stigmatizing attitudes related to human papillomavirus among Hong Kong Chinese healthcare providers. *Int J Gynaecol Obstet.* 2012;116(1):52-56.
64. Applebaum E, Ruhlen TN, Kronenberg FR, Hayes C, Peters ES. Oral cancer knowledge, attitudes and practices: A survey of dentists and primary care physicians in Massachusetts. *J Am Dent Assoc.* 2009;140(4):461-467.

Critical Issues in Dental Hygiene

Addressing Early Preventive Oral Health Care among Young Children: A Pilot Evaluation of the Baby Oral Health Program (bOHP) among Dental Professionals

Cheryl A. Vamos, PhD, MPH; Rocio Quinonez, DMD, MS, MPH; Anca Gaston, PhD, MS; Joyce Sinton, BDS, BMSc, DDPH

Introduction

Dental caries is the most common chronic disease in childhood and represents a significant public health concern.¹ Early childhood caries (ECC) is defined as affecting the dentition of children <72 months old.² Disparities in ECC are evident, and rates are associated with the social determinants of health (i.e. family income, immigrant status, areas of social deprivation, etc.).¹⁻³

The period from preconception to approximately age 3 is a critical window for caries prevention efforts.⁴ Children can acquire caries-related bacteria from their primary caregivers during the first 3 years of life, and it becomes more difficult to change the oral environment and prevent dental disease without significant professional interventions after this window of infectivity closes. Thus, the very early childhood period is a critical time for early identification of risk factors and early intervention to help change the trajectory of a child's oral health.

Many professional associations involved in pediatric care advocate early oral health visits as a public health strategy to promote population oral health and to reduce the prevalence of ECC. The Canadian and American Academies of Pediatric Dentistry and Pediatrics recommend that children establish a dental home by age one.⁵⁻⁷ The American Academy of Pediatric Dentistry defines a dental home as "the ongoing re-

lationship between the dentist and the patient, inclusive of all aspects of oral health care delivered in a comprehensive, continuously accessible, coordinated, and family-centered way. Establishment of

Abstract

Purpose: Many communities lack dental professionals with the knowledge and behavioral skills needed to deliver care to young children (<3 years). This study aimed to examine the impact of an intervention (the Baby Oral Health Program (bHOP)) on dental providers' knowledge, values, confidence and practice behaviors regarding preventive oral health care to young children (<3 years), and assess the feasibility and satisfaction of the bOHP among dental providers in a Canadian community setting.

Methods: A quasi-experimental design was employed, with 24 intervention (4.5 hour workshop, and booster session 1 month following) and 18 control group participants completing pre- and post-surveys.

Results: A significant group interaction effect emerged for value and knowledge ($p < 0.05$), with participants in the intervention group demonstrating significantly higher baseline to post-intervention change scores. No significant group differences were found for confidence and practice behaviors ($p > 0.05$). Mean scores for perceived workshop usefulness and perceived influence on practice were high.

Conclusion: Findings suggest that bOHP is effective in increasing dental professionals' knowledge and values about the importance of preventive oral health among young children. However, consideration to provider's stage of readiness to change and more systems-based approaches to enhancing early oral health interventions should be assessed.

Keywords: prevention, pediatric dentistry, behavior, public health dentistry

This study supports the NDHRA priority area, **Clinical Dental Hygiene Care:** Develop and test interventions to reduce the incidence of oral disease in special at-risk populations (diabetics, tobacco users, cardiac patients and genetically susceptible).

a dental home begins no later than 12 months of age and includes referral to dental specialists when appropriate.⁸ Research conducted in the U.S. has demonstrated that providing dentists with training in the management of very young children and in family-centered dental care can increase dentists' confidence and their willingness to provide services.^{9,10} However, little research has been conducted regarding early oral health visits in Canada and this study aims to explore this translation of research to practice gap.

The Baby Oral Health Program (bOHP) was developed in North Carolina and has been implemented in other states in the U.S. Its mission is "to educate dental health care providers on the principles of infant and toddler oral health in order to equip them with the necessary tools to be comfortable and competent at providing preventive oral health services for young children."^{11,12}

The purpose of this study was to conduct a pilot evaluation of the bOHP program in a Canadian community setting. The specific objectives were to examine the impact of this intervention on dental providers' practice knowledge, values, confidence and practice behaviors regarding providing oral health care to young children (<3 years), and to assess the feasibility and satisfaction of the bOHP among dental providers in a community setting. This study employed a mixed methodology prospective quasi-experimental design with a 1, 3 and 6 month follow-up. This paper focuses on findings between the pre- and post-test. Findings for the follow-up assessments (3 and 6 months) are presented for descriptive purposes only.

Methods and Materials

Sample

A master list of dental practices in a southwestern community in Ontario (n=61) and their corresponding contact information was obtained from the Royal College of Dentist Surgeons of Ontario (RCDSO). All registered practices received, via postal mail, an invitation to attend the intervention workshop titled "Family-centered dental care: Treating infants & toddlers in your practice." Follow-up telephone calls were made 1 week after the invitations were mailed out, and a second invitation was either hand delivered, faxed or emailed to the offices that indicated they had not received the original mailed invitation.

Control participants were recruited by comparing the master list of dental practices originally obtained from the RCDSO with the attendance list from the workshop to identify those dental practices that did

not participate in the intervention. A convenience sample of those remaining dental practices were sent a letter via postal mail, followed by a telephone call 1 week later explaining the study and inviting them to participate. Researchers randomly sampled practices until the sample size was approximate to the intervention group. All dental professionals participating in patient care (i.e., dentists; dental hygienists; dental assistants; etc.) were invited to attend the workshop and all participants (intervention and control groups) received a \$15 gift card as a token of appreciation for their participation in the study.

Intervention

The intervention consisted of a 1 day workshop (4.5 hours) and a take-home personal bOHP kit. The kit consisted of a binder containing information and tools (i.e., DVD, flip chart, clinical and supplemental forms) intended to serve as an educational resource when discussing oral health with parents/caregivers of young children. The presenter of the workshop was a faculty member from the Department of Pediatric Dentistry at the University of North Carolina-Chapel Hill who is also the director of bOHP. Topics covered included:

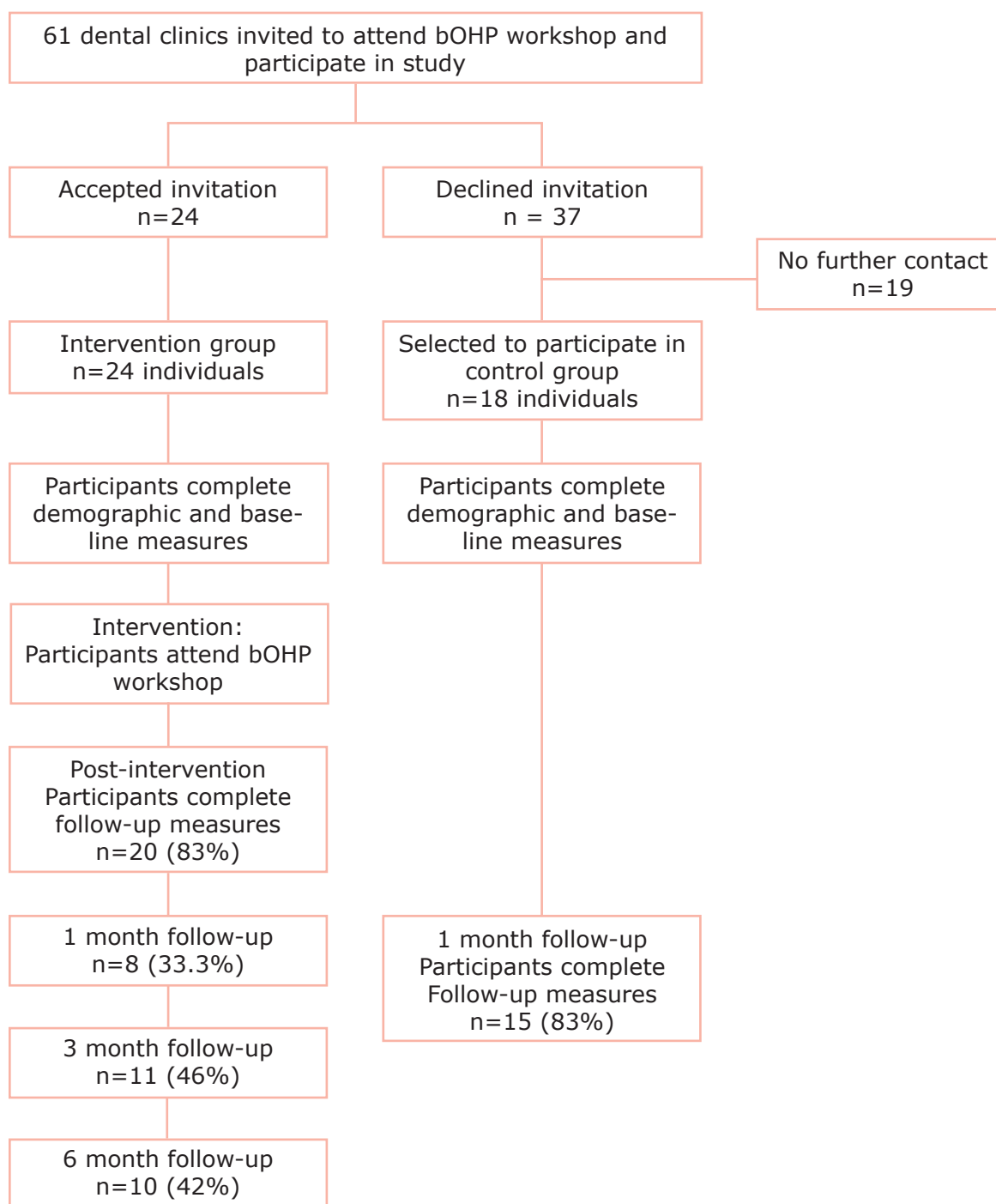
- Background on policies and guidelines of early childhood oral health
- Principles of pediatric preventive care for infants and toddlers including strategies for caregiver interviewing, anticipatory guidance and clinical examination
- Child development in the delivery of preventive oral health services to infants and toddlers
- The promotion of practice through a family centered approach

Participants were eligible to receive continuing education credits (CE) for attending the workshop. In addition, at 1 month post-intervention, each participant completed the follow-up survey and then received a booster session which consisted of a visit from a dental program member who reviewed the health information presented at the workshop and discussed any questions or issues that may have arisen in regards to each practices' progress in implementing the bOHP.

Procedure

After collecting written informed consent, participants in the intervention group completed a pre- and post-survey immediately prior and after the workshop, and follow-up surveys at 1, 3 and 6 months post-intervention. Participants in the control group completed the baseline measures consisting

Figure 1: Flow Diagram of Design and Procedure



of demographic items and outcome measures upon entry into the study and a follow-up survey at 1 month. The overall design of the study can be seen in Figure 1. Research ethics board approval was obtained prior to commencing the study.

Survey Instrument

The survey instrument was adapted from the authors of the bOHP who previously evaluated the

intervention among dental students.¹² The baseline and follow-up questionnaires were pilot tested by 6 general dentists prior to dissemination and modifications were made based on their feedback. The survey included demographic items and the following baseline measures to measure change and intervention effectiveness: knowledge, values, confidence and practice behaviors (Table I). An item to assess participants' stages of change was used to classify participants as currently caring for infants

Table I: Selected Measures From Survey Instrumentation

Construct	Example Questions	Response Category
Demographics	Please describe yourself: a. Role b. Gender How long have you been in dental practice?	Dental Assistant; Dental Hygienist; Dentist; Other (please specify) Male; Female ≤2 years, 3 to 5 years, 6 to 10 years, 11 to 19 years, ≥20 years
Stages of Change	Do you care for infants and toddlers in your practice?" If you answered NO to [the above question], are you thinking of caring for infants' and toddlers' oral health in your practice?"	Yes; No Yes (contemplation) or No/Not Sure (pre-contemplation).
Practice Behaviors	How often do you provide preventive care to 0 to 2 year olds?	4-point scale from 1 (never) to 4 (often)
Value	On a scale of 1 to 10, how important do you feel it is for general dentists to provide preventive care to infants and toddlers (0-3 years)?	10-point scale from 1 (not important) to 10 (very important)
Confidence	How comfortable are you in: a. Performing an infant or toddler oral health examination? b. Dealing with a crying infant or toddler c. Diagnosing dental caries in infants or toddlers d. Discussing proper infant or toddler feeding practices with infants or toddlers	5-point scale from 1 (very uncomfortable) to 5 (very comfortable) Reliability was adequate at baseline ($\alpha=0.81$) and follow-up ($\alpha=0.87$).
Knowledge	Please indicate your level of agreement with the following statements regarding dental care for infants and toddlers: a. Only bottle-fed children are at risk of early childhood caries (False) b. Pediatric patients are recommended to receive the first dental exam by three years (False) c. Fluoride varnish is safe and effective and is recommended for infants and toddlers (True)	1 (strongly disagree) to 5 (strongly agree) True/False
Barriers	Please provide 3 barriers to providing dental care for infants and toddlers.	Open-ended
Perceived usefulness of workshop	How useful did you find this workshop?	10-point scale from 1 (not useful) to 10 (very useful)
Perceived influence on practice behaviors	To what extent do you anticipate that the workshop will influence your practice behaviors?	10-point scale from 1 (no influence) to 10 (strong influence)

and toddlers in practice (action) or not currently caring for infants and toddlers in practice (pre-contemplation/contemplation).¹³ Participants also completed 2 measures assessing the workshop's usefulness and the extent to which they expected the workshop to influence their practice behaviors. Two

open-ended written questions included an item on barriers to providing dental care for infants and toddlers and an item on soliciting general feedback on this topic (pre- and post-survey) and the workshop (post-survey only).

Table II: Demographic Characteristics For Control And Intervention Groups

Variable	Control (n=18)	Intervention (n=24)	Statistic	p-level
Position	-	-	$\chi^2(3, N= 42) = 4.66$	0.19
Dental Assistant	9 (40.0%)	10 (41.7%)	-	-
Dental Hygienist	4 (22.2%)	10 (41.7%)	-	-
Dentist	1 (5.6%)	3 (12.5%)	-	-
Other	4 (22.2%)	1 (4.2%)	-	-
Gender	-	-	$\chi^2(1, N= 42) = 1.57$	0.21
Male	0 (0.0%)	2 (8.3%)	-	-
Female	18 (100.0%)	22 (91.7%)	-	-
Years in Dental Practice	-	-	$\chi^2(4, N= 42) = 3.27$	0.51
Under 2 years	0 (0.0%)	1 (4.2%)	-	-
3-5 years	3 (16.7%)	7 (29.2%)	-	-
6-10 years	1 (5.6%)	3 (12.5%)	-	-
11-19 years	6 (33.3%)	4 (16.7%)	-	-
20 or more years	8 (44.4%)	9 (37.5%)	-	-
Currently care for infants and toddlers in practice	-	-	$\chi^2(1, N= 42) = 2.65$	0.11
Yes (Action)	12 (66.7%)	21 (87.5%)	-	-
No	6 (33.3%)	3 (12.5%)	-	-
Contemplation	1 (17%)	0	-	-
Pre-contemplation	5 (83%)	2 (67%)	-	-
Missing	0	1 (33%)	-	-
Access to pediatric dentist (SD)	7.11 (3.27)	7.00 (3.06)	$t(40)=0.11$	0.91

Analyses

Frequencies, chi-square and independent-samples t-tests were conducted to examine group differences in socio-demographic and other practice characteristics. For the quantitative data, each construct was represented by a mean score calculated by summing the items and then dividing by the total number of items. Change scores were computed for practice behaviors, knowledge, values and confidence by subtracting baseline values from post-intervention scores. Independent t-tests were then used to examine whether change scores differed between the intervention and control groups. This paper focuses on findings between the pre- and post-test. Findings for the follow-up assessments (3 and 6 months) are presented for descriptive purposes only. All quantitative analyses were conducted using PASW Statistics 18, Release Version 18.0 (©SPSS, Inc., 2009, Chicago, Ill).

Qualitative data from the open-response items were independently analyzed by 2 researchers. Us-

ing an inductive and grounded-theory approach, open, axial and selective coding was employed to discover themes. Two researchers met to compare codes and any discrepancies were discussed. Only minor differences in the label (name) of the codes were found. Illustrative quotations from the responses were documented to provide examples and further context to the themes that emerged.

Results

Participant Demographics

The final sample consisted of 42 dental professionals. The majority were female (n=40, 95%) worked as dental assistants or dental hygienists (n=33, 78%) and reported working in the dental profession for 11 or more years (n=27, 64%). In addition, 33 participants (79%) reported already caring for infants and toddlers in their practice. In regards to the stages of change construct, 21 (87.5%) and 12 (66.7%) participants in the intervention and control groups, respectively, reported

Table III: Mean Scores by Group and Time for Practice Behaviors, Values, Confidence, Knowledge, Perceived Usefulness and Perceived Degree of Influence on Practice

Variables		Control (n=18)	Intervention (n=24)
Current Practice Behaviors (SD)	Baseline		3.16 (0.49)*
	Post-intervention		3.21 (0.65)
	1 month follow-up	2.81 (0.55)*	3.04 (0.38)
	3 month follow-up	2.99 (0.45)	3.21 (0.31)
	6 month follow-up		3.16 (0.36)
Value	Baseline		7.17 (3.11)
	Post-intervention		8.96 (1.98)
	1 month follow-up	7.33 (2.68)	9.55 (0.53)
	3 month follow-up	6.67 (2.87)	9.64 (0.50)
	6 month follow-up		8.50 (2.12)
Confidence (SD)	Baseline		4.23 (0.53)*
	Post-intervention		4.27 (0.55)
	1 month follow-up	3.76 (0.87)*	4.37 (0.74)
	3 month follow-up	3.89 (0.79)	4.36 (0.46)
	6 month follow-up		4.39 (0.53)
Knowledge (SD)	Baseline		3.12 (0.41)
	Post-intervention		3.82 (0.62)
	1 month follow-up	3.31 (0.45)	4.07 (0.58)
	3 month follow-up	3.33 (0.54)	3.58 (0.34)
	6 month follow-up		3.50 (0.32)
Perceived workshop usefulness	-	-	9.47 (0.90)
Perceived influence on practice	-	-	8.21 (1.87)

*Note: Groups significantly different from each other at baseline ($p < .05$). SD = standard deviation.

Table IV: Mean Unadjusted Pre- to Post-Score Group Differences and Statistical Results Practice Behaviors, Values, Confidence and Knowledge

Variables	Control (n=18) Mean (SD*)	Intervention (n=24) Mean (SD*)	t(40)	p-value	95% Confidence Interval for the Difference
Practice Behaviors	0.18 (0.54)	0.07 (0.72)	0.54	0.59	-0.30, 0.52
Value	-0.67 (3.16)	1.79 (3.24)	2.46	0.02	-4.48, -0.44
Confidence	0.13 (1.02)	0.03 (0.54)	0.41	0.68	-0.39, 0.59
Knowledge	0.02 (0.44)	0.48 (0.79)	2.21	0.03	-0.87, -0.04

being in the action phase. All demographic characteristics are presented by group in Table II.

Group Equivalency Summary

The intervention and control groups were similar in demographic and practice characteristics (Table II), therefore it was deemed unnecessary to use demographic variables as covariates in the subsequent analyses. Mean scores across time for all variables of interest are presented in Table III. Independent t-tests revealed that the intervention group scored

significantly higher with respect to confidence and practice behaviors at baseline compared to the control group ($p < 0.05$, Table III)

Pre-Post Group Differences

A significant group interaction effect emerged for value and knowledge ($p < 0.05$), with participants in the intervention group demonstrating significantly higher baseline to post-intervention change scores. No group differences were observed with respect to confidence or practice behaviors ($p > 0.05$).

Barriers

Barriers identified from the intervention and control groups at baseline were combined. Four main overarching themes emerged:

1. Child developmental/behavioral barriers ("child is too young," "behavioral management," "child cooperation" and "nervous/fear")
2. Parent/caregiver barriers ("parent interruption/interference," "parents are nervous," "must have parent/caregiver cooperation" and "lack of knowledge of parents when the first visit should be")
3. Access to care barriers ("cost," "transportation," and "waiting list for pediatric dentists")
4. Environmental barriers ("open concept office environments," "gloves/masks/protective eye-wear" and "sounds and smells")

Workshop Satisfaction

Items addressing workshop satisfaction were very positive as the mean scores for perceived workshop usefulness ($M=9.47$, $SD=0.90$) and perceived influence on practice ($M=8.21$, $SD=1.87$) were high. Open-responses regarding workshop satisfaction were also positive among intervention participants as indicated in the following examples: "The information provided in this course was very educational and helpful," "I feel much more comfortable in infant toddler care since this workshop" and "This was a very good course! It's great to be able to help small children to care for their teeth."

Other comments from participants reflected the positive impact of the workshop at the individual level, but highlighted the concern that support and buy-in at the practice level is needed: "I found this very informative; unfortunately the rest of my large office was unable to attend. I will gladly share my information and enthusiasm with them," "I really enjoyed the seminar, unfortunately I am a single participant from a large practice" and "Enjoyed the program but don't think it can influence my doctors." Interestingly, other additional comments that participants provided conveyed a notion that early preventive care is not the responsibility of the dental practice and placed the responsibility on parents and had a sense of pessimism: "Treating infants could very well lead to a life long fear of dentistry; diagnosing problem areas, then referral to a pediatric specialist with sedation would be best" and "The only reason this age group would need dental treatment is because of poor caregiver knowledge. Children only eat and drink what they are given. Caregivers need to be responsible for oral care and nutrition. Educate them!"

Discussion

The present findings indicate that the bOHP program had an impact on intervention participants' knowledge and value of oral health care among young children (<3 years), and that the impact appeared to be sustained for at least 6 month. In addition, workshop satisfaction was very positive as reflected in the perceived workshop usefulness and the perceived influence on practice scores.

However, data suggest that the bOHP intervention alone did not impact participants' confidence or practice behavior in treating young children. This may have been because the recruitment attracted professionals who already had an interest in this topic, or that the items used to measure these constructs were not sufficiently sensitive to detect increases that may have resulted from the intervention. Furthermore, the focus of the workshop was more knowledge-based versus skill building-based. Although the workshop had a hands-on component where participants were able to practice oral health care on young children volunteers, many participants were involved in this brief practice as observers only.

Some contradictory results regarding caring for young children emerged. The majority of intervention (87.5%) and control (66.7%) participants reported that they were in the action phase. However, these results were in direct contradiction to participants' responses to the 2 items used in the current practice behaviors scale to assess their frequency of caring for 0 to 2 year olds. Specifically, 100% of control group participants and 76.2% of participants in the intervention group reported that they "rarely" or "never" provided preventive and restorative treatment to 0 to 2 year olds. This later measure (providing preventive and restorative treatment to 0 to 2 years olds) was more consistent with what the researchers expected to find, since during formative research within the local health unit prior to planning the bOHP intervention, the following issues were documented:

- Community dentists were uncomfortable in treating children <3 years
- Parents attending well-baby clinics reported that dental offices have told them that their child is "too young" to be seen until the child is at least 3 years
- A total of 23% of school entrants had experienced dental caries prior to starting school at age 4

The apparent contradiction may be due to several factors, including social desirability or a weakness

in questionnaire design. For example, participants may have thought they were practicing the desired behavior and then later realized how infrequently they were doing so, or how their own definition of "caring for toddlers" differed from "best practice."

The majority of participants were also from mature dental practices (65% of all participants reported working in the dental profession for 10 or more years). Fein et al found that after the bOHP intervention 89% of student participants reported that they were more likely to provide care to young children in the future.¹² Thus, the impact of the program on different dental professional sub-populations warrants further study, particularly among dental students and/or recent graduates who are most likely to be receptive to change. Moreover, interventions such as bOHP may need to be tailored for experienced dental professionals as their confidence and motivation for accepting very young patients may differ from recent dental graduates. Although the dental profession has seen a paradigm shift from a surgical to a preventive focus in some practices, a business case highlighting the economic benefit may motivate mature dental providers to provide preventive oral health care to very young patients. For instance, in addition to training programs, economic incentives that allow for increased reimbursement for dental offices that treat infant and young children have shown to be effective.¹⁴

The literature suggests that continuing education alone is not sufficient for provider practice changes. Sohn et al's review of interventions for preventing ECC revealed that continuing education was important but a more systems-based approach was necessary for desired changes.¹⁵ In the present study, the majority of participants were either dental assistants or dental hygienists, and may not have the authority to change office policies. This theme of "lack of authority to change office policy" also emerged in the qualitative data. Future research should focus on the entire dental team as both the professional and office levels impact individuals' practice behaviors. Moreover, some participants' perceived early preventive dental care was not part of their role, but a responsibility of the parent/caregiver, suggesting that research should also explore attitudes and subjective norms among dental professionals.

Although practice guidelines indicate a dental home should be established by age 1, few dental offices in this study's community routinely following these guidelines. A number of theoretical frameworks suggest that the decision to adopt practice guidelines is complex. As applied to the Information-Motivation-Behavior-Skills Model, information related to practice guidelines and the importance

of early preventive care, motivation related to individual attitudes and social norms, and behaviors such as objective skills and perceived self-efficacy could be influencing practice behaviors.¹⁶ Barriers as outlined in Cabana's framework could include: lack of familiarity and awareness of guidelines (knowledge), lack of agreement with specific guidelines, lack of outcome expectancy, lack of self-efficacy, lack of motivation (attitudes), and external barriers, patient factors, guideline factors (e.g. presence of contradictory guidelines) and environmental factors (e.g. time, resources, organizational constraints, reimbursement concerns).¹⁷ Future research on the above constructs could be useful in developing additional interventions that facilitate dental providers' ability and decrease barriers related to providing preventive care to young children.

In addition, one of the goals of this study was to assess the feasibility of implementing the bOHP among dental professionals in the community. While 61 dental practices employing an unknown number of dental professionals received an invitation to participate, only 24 individuals were recruited into the bOHP evaluation, and only 3 dentists were in attendance. The inability of the current study to recruit dentists is indicative of the real-world challenges associated with reaching this body of professionals and engaging them into these types of programs. In addition, the thorough approach we took to invite dentists (i.e., through personalized invitations sent to every dental clinic along with a reminder letter) represents a strength of the present pilot study. Nonetheless, these numbers indicate the need for exploring novel recruitment and retention strategies and for raising awareness among the dental community about the benefits of professional development. One possible solution would be to promote and get buy-in for interventions with existing professional bodies such as the RCDSO or the College of Dental Hygienists of Ontario to increase future participation and the credibility of future community events. The importance of strategies to increase attendance at trainings has also been highlighted in a recent Cochrane Review which confers the benefits of continuing health education. Specifically, the review which included 81 trials involving more than 11,000 health professionals, found that attending educational meetings or workshops was associated with improved professional practice as well as improved healthcare outcomes for patients.¹⁸

Moreover, although the majority of the participants were dental hygienists/dental assistants, these provider groups are important as they provide critical oral health education and care to patients. From a life course perspective, dental hygienists provide a continuum of care, as they typically see the same

Figure 2: Mean and Standard Error Scores Between Treatment Groups Across Time For Perceived Importance of Providing Preventive Care to Children 0 to 3 Years (Value)

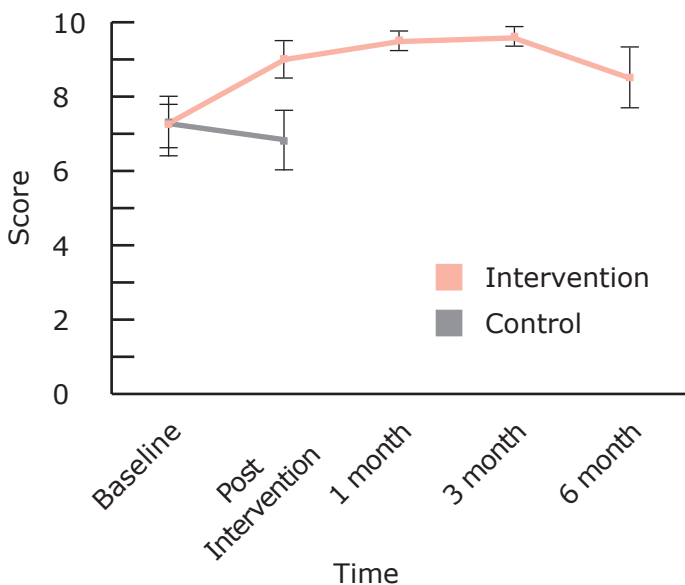
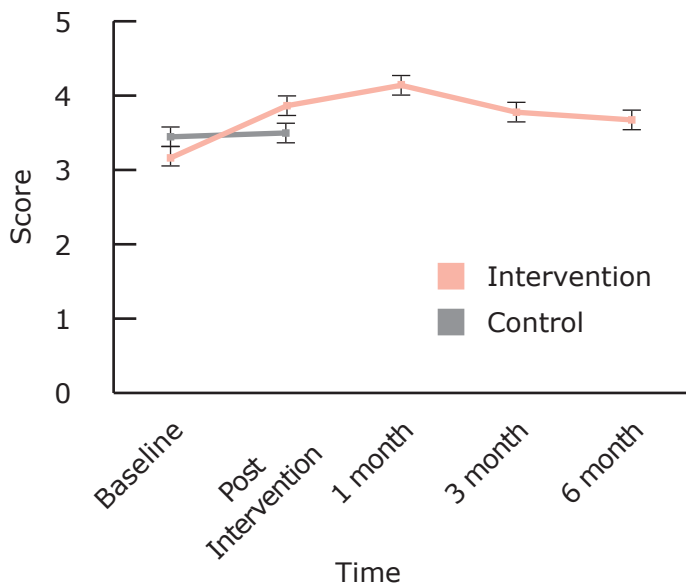


Figure 3: Mean and Standard Error Scores Between Treatment Groups Across Time For 'Knowledge'



patients year after year. Thus, they are witness to major life changes and events, such as the birth of children. As such, they have the potential to play a major role in educating patients about oral health issues, including raising awareness among the general population about the importance of infant oral health care. Thus, focusing on educating hygienists and assistants may represent an important starting point for efforts aimed at promoting infant oral health care.

The issue of sustainability is an important consideration for any public health program. Unfortunately, there were a high percentage of participants who were lost to follow-up, thus the long-term impact of the bOHP warrants further study. However, at 6 month follow-up, the mean scores for value and knowledge did remain higher compared to baseline measures among the intervention group (descriptive data only) (Figures 2, 3). Moreover, hands-on practical skill training and continuous booster sessions have been found to be critical in sustaining the desired practice behavior among providers and would assist in maintaining the positive impact of the bOHP program.^{12,15,19}

While this is the first study to evaluate the bOHP program among dental professionals in a Canadian community setting, several limitations should be acknowledged. First, the possibility of self-selection bias must be noted given the recruitment methods and the lack of randomization into the intervention and control groups. It is likely that those who chose to attend already had an interest in infant and toddler oral health. Second, more than half of the par-

ticipants were lost to follow-up. Third, methodological challenges remained, such as a small sample size and the inability to randomly assign participants to the intervention and control groups. However, similar to many other public health community interventions, this quasi-experimental design may be more natural and characteristic of the real world setting in which interventions are implemented and may possess more external validity, particularly when implementing and evaluating interventions at a local level. Fourth, this study employed a 6 month follow-up to explore whether changes in dental providers' knowledge, values, confidence and practice behaviors regarding preventive oral health care to young children were sustained. Future research should include longer follow-up periods to provide more meaningful assessments regarding whether these changes have been instituted into practice.

Findings from a national forum on ECC in the U.S. concluded: "...oral health should be integrated into broader child health and development systems; dental caries should be addressed through a chronic disease management model; and comprehensive approaches incorporating multiple strategies that involve families, clinicians and child services providers in ECC prevention and reduction efforts should be employed"²⁰ As professional guidelines and governmental initiatives highlight the importance of early preventive oral health care among young children, it is imperative that the local dental workforce is willing and prepared to provide such care. Subsequently, Simpson's framework for implementing oral health promotion interventions outlines 4 stages (training, adoption, implementation

and practice) and calls for careful examination of system-level factors (e.g. public health, organization) that could be considered when implementing and sustaining such evidence-based interventions.²¹

Conclusion

Notwithstanding the above limitations, results from this community pilot evaluation suggest that the bOHP program may serve as a promising intervention to increase dental professionals' knowledge and the value of providing oral health care to young children and that participants found the workshop useful and applicable. This program may help fill the gap between clinical guidelines and dental practice behaviors; however, evaluating this in the context of varying stages of readiness to change requires further consideration. This may assist in further ensuring a knowledgeable, skilled and confident dental workforce as a critical component in public health efforts focusing on early detection and decreasing the negative sequelae associated with caries in childhood and across the lifespan.

Summary Points:

- Dental caries is the most common chronic disease in childhood and represents a significant public health concern. In addition, the very early childhood period is a critical time for early identification of risk factors and early intervention to help change the trajectory of a child's oral health.
- Findings suggest the bOHP is effective in increas-

ing dental professionals' knowledge and values about the importance of preventive oral health among young children. However, expanding the current program to focus on stages of readiness and including more systems-based approach to enhancing early oral health provider interventions should be considered.

- Ensuring a knowledgeable, skilled and confident dental workforce is a critical component in public health efforts focusing on early detection and decreasing the negative sequelae associated with caries in childhood and its impact across the lifespan, particularly among the most vulnerable populations.

Cheryl A. Vamos, PhD, MPH, is an Assistant Professor, Associate Director, Center for Transdisciplinary Research in Women's Health (CTR-WH), Department of Community and Family Health, College of Public Health, University of South Florida. Rocio Quinonez, DMD, MS, MPH, is an Associate Professor, Department of Pediatric Dentistry, School of Dentistry, University of North Carolina-Chapel Hill. Anca Gaston, PhD, MS, is a Data Analyst Coordinator, Brant County Health Unit. Joyce Sinton, BDS, BMSc, DDPH, was previously the Director of Family Health, Brant County Health Unit.

Acknowledgments

The authors would like to acknowledge Tricia Atkinson, Dental Hygienist, and Jackie Milton, Preventative Dental Assistant, for their assistance with data collection activities.

References

1. A National call to action to promote oral health. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institutes of Health, National Institute of Dental and Craniofacial Research. NIH Publication No. 03-5303. 2003.
2. Committee on Clinical and Scientific Affairs. Report on early childhood caries. Canadian Dental Association [Internet]. 2010. [cited 2012 March 14] Available from: http://www.jcda.ca/uploads/pdf/ccsa/ECC-Report-FINAL-April-2010_for-jcda-website.pdf
3. Atkinson T, McIntosh B, Sinton J, Stevens A, Huang M, Mofid L. Oral health status of Brant County elementary school children, 2002-2008. Brantford, ON: Brant County Health Unit; 2009.
4. Gunay H, Dmoch-Bockhorn K, Gunay Y, Geurtsen W. Effect on caries experience of a long-term preventive program for mothers and children starting during pregnancy. *Clin Oral Investig*. 1998;2(3):137-142.
5. Hale KJ, American Academy of Pediatrics Section on Pediatric Dentistry. Oral health risk assessment timing and establishment of the dental home. *Pediatrics*. 2003;111(5 Pt 1):1113-1116.
6. Dental home by age one - recognition and treatment of ECC. Canadian Academy of Pediatric Dentistry [Internet]. [cited 2012 July 5]. Available from: http://www.capd-acdp.org/index.php?option=com_content&view=article&id=4:dental-home-by-age-one-recognition-and-treatment-of-ecc-&catid=2:hot-topics&Itemid=4

7. CDA position on first visit to the dentist. Canadian Dental Association [Internet]. 2005 [cited 2012 April 15]. Available from: http://www.cda-adc.ca/_files/position_statements/firstVisit.pdf
8. Council on Clinical Affairs. Definition of dental home. American Academy of Pediatric Dentistry [Internet]. 2010 [cited 2013 January 15]. Available from: http://www.aapd.org/media/Policies_Guidelines/D_DentalHome.pdf
9. Kobayashi M, Chi D, Coldwell SE, Domoto P, Milgrom P. The effectiveness and estimated costs of the Access to Baby and Child Dentistry Program in Washington State. *J Am Dent Assoc.* 2005;136(9):1257-1263.
10. Weber-Gasparoni K, Kanellis MJ, Qian F. Iowa's public health-based infant oral health program: a decade of experience. *J Dent Educ.* 2010;74(4):363-371.
11. Mission statement. Baby Oral Health Program [Internet]. [cited 2012 September 5]. Available from: <http://www.bohp.unc.edu/>
12. Fein JE, Quinonez RB, Phillips C. Introducing infant oral health into dental curricula: A clinical intervention. *J Dent Educ.* 2009;73(10):1171-1177.
13. Prochaska JO, Redding CA, Evers KE. Transtheoretical model and stages of change. In: Glanz K, Rimer BK, Lewis FM, ed. *Health behavior and health education: Theory, research and practice.* San Francisco, CA. Jossey-Bass. 2002. p. 99-120.
14. Kobayashi M, Chi D, Coldwell SE, Domoto P, Milgrom P. The effectiveness and estimated costs of the access to baby and child dentistry program in Washington State. *J Am Dent Assoc.* 2005;136(9):1257-1263.
15. Sohn W, Ismail AI, Tellez M. Efficacy of educational interventions targeting primary care providers' practice behaviors: An overview of published systematic reviews. *J Public Health Dent.* 2004;64(3):164-172.
16. Fisher JD, Fishwer WA. The information-motivation-behavioral skills model. In RJ, Crosby RA, Kegler MC, eds. *Emerging theories in health promotion Practice and research: Strategies for improving public health.* San Francisco, CA. Jossey-Bass. 2002. p. 40-70.
17. Cabana MD, Rand CS, Powe NR, et al. Why don't physicians follow clinical practice guidelines? A framework for improvement. *JAMA.* 1999;282(15):1458-1465.
18. Forsetlund L, Bjørndal A, Rashidian A, Jamtvedt G, O'Brien MA, Wolf FM, Davis D, Odgaard-Jensen J, Oxman AD. Continuing education meetings and workshops: effects on professional practice and health care outcomes. *Cochrane Database of Systematic Reviews* 2009, Issue 2. Art. No.: CD003030.
19. Seale NS, Casamassimo PS. Access to dental care for children in the United States: A survey of general practitioners. *J Am Dent Assoc.* 2003;134(12):1630-1640.
20. Brown A, Lowe E, Zimmerman B, Crall J, Foley M, Nehring M. Preventing early childhood caries: lessons from the field. *Pediatr Dent.* 2006;28(6):553-560.
21. Simpson DD. A framework for implementing sustainable oral health promotion interventions. *J Public Health Dent.* 2011;71(s1):S84-S94.

Critical Issues in Dental Hygiene

Building Online Learning Communities in a Graduate Dental Hygiene Program

Ellen J. Rogo, RDH, PhD; Karen M. Portillo, RDH, MS

Introduction

Online learning in higher education has increased steadily over the past 10 years, and almost one third of the student body is enrolled in at least 1 online course.¹ The use of the Internet to achieve student learning outcomes has the potential to significantly impact the future education of dental professionals.^{2,3} Dental hygiene educational programs employing online technology for learning have been reported at the entry level, for degree completion programs and at the master degree level.⁴⁻⁷ However, programs vary greatly as to the number of online courses offered; some are 100% online or are categorized as blended programs. Blended (or hybrid) educational programs provide part of the curriculum in a face-to-face environment while other coursework is offered in an online format by means of a learning management system such as Blackboard, Angel, WebCT or Moodle.

Furthermore, individual courses within a program might use a blended approach as well combining face-to-face contact with online interaction. Courses offered in their entirety online follow a synchronous or asynchronous format. Synchronous formats require students and faculty to simultaneously be online to participate in weekly class sessions, whereas an asynchronous format does not have this requirement and students have the flexibility of participating in course activities whenever they choose, generally within a specified timeframe (e.g.

Abstract

Purpose: The literature abounds with research related to building online communities in a single course; however, limited evidence is available on this phenomenon from a program perspective. The intent of this qualitative case study inquiry was to explore student experiences in a graduate dental hygiene program contributing or impeding the development and sustainability of online learning communities.

Methods: Approval from the IRB was received. A purposive sampling technique was used to recruit participants from a stratification of students and graduates. A total of 17 participants completed semi-structured interviews. Data analysis was completed through 2 rounds - 1 for coding responses and 1 to construct categories of experiences.

Results: The participants' collective definition of an online learning community was a complex synergistic network of interconnected people who create positive energy. The findings indicated the development of this network began during the program orientation and was beneficial for building a foundation for the community. Students felt socially connected and supported by the network. Course design was another important category for participation in weekly discussions and group activities. Instructors were viewed as active participants in the community, offering helpful feedback and being a facilitator in discussions. Experiences impeding the development of online learning communities related to the poor performance of peers and instructors.

Conclusion: Specific categories of experiences supported and impeded the development of online learning communities related to the program itself, course design, students and faculty. These factors are important to consider in order to maximize student learning potential in this environment.

Keywords: dental hygienists/education, education, distance, online systems, teaching/methods, learning, program development

This study supports the NDHRA priority area, **Professional Education and Development:** Evaluate the extent to which current dental hygiene curricula prepare dental hygienists to meet the increasingly complex oral health needs of the public.

weekly basis). Regardless of the format, students and faculty interact within the online environment to learn the course content and from each other. The development of online learning communities is one way to facilitate learning.

A learning community, in simplest terms, is a group of people “engaged in intellectual interaction for the purposes of learning”⁸ In an online course, members of a learning community engage in intellectual interaction and learn through communication with and collaboration among peers.⁹ The social constructivist theory maintains that all learning is an active process unique to each individual and knowledge is gained within the context of social interaction.⁹ This interaction can be maximized through the development of a community of learners to promote “active learning over passive learning, cooperation over competition, and community over isolation.”⁸ The development of a sense of community, instead of isolation, is achieved through social interaction between students and with faculty who actively engage in the course content.

Interaction in the online environment is necessary to develop social presence, teaching presence and cognitive presence. The 3 presence components interconnect and provide a theoretical framework for a Community of Inquiry.¹⁰ These components are integrated for the development of the community as well as the intellectual pursuit of inquiry.

Social presence is the ability of learners in the online environment to perceive each other as real people through interaction to establish a social and emotional identity. Factors influencing the establishment of social presence are: affective expression, open communication and group cohesion. Affective expression involves projecting oneself through self-disclosure of emotions, values and beliefs. Open communication is based on the development of trust between learners in order to reveal themselves in an environment free from risks. Group cohesion is the third factor in developing social presence and involves the collaboration of learners and the creation of a group identity.

Teaching presence is established by the faculty member who designs and organizes the learning experiences before and during the course. Another factor important for establishing a teaching presence is the facilitation of the interaction among the online participants by designing and implementing activities that extend the course content. A third factor is providing direct instruction to the learners as the subject matter expert to correct misconcep-

tions, direct the discussion and provide additional information to enhance learning to a higher level.

The third component of the Community of Inquiry framework is cognitive presence, which is important for a high level of knowledge construction and critical thinking. Learners progress through cognitive presence in phases beginning with an event to stimulate the need to learn, followed by exploration through an exchange of information, integration and connection of ideas and, lastly, the application of new ideas (resolution).

Most of the research using the inquiry framework has focused on 1 of the 3 presences;¹¹⁻¹⁴ however, more current literature considers all 3 components within the same study. Akyol and Garrison conducted an investigation to determine the relationships among the 3 components of presence and perceived learning and satisfaction in the course.¹⁵ The findings indicated significant positive relationships between social presence and satisfaction, teaching presence and cognitive presence, teaching presence and perceived learning, and teaching presence and satisfaction. Other significant relationships were found between cognitive presence and perceived learning, and cognitive presence and satisfaction. Cognitive presence, as compared to teaching presence, was more influential on learning. The researchers noted a trend over the timeframe of the semester in each of the 3 components:

1. An increase in group cohesion in social presence
2. An increase in direct instruction for teaching presence
3. Integration in cognitive presence

Another study supported the effect of these 3 presences by finding that social presence is a mediating factor between teaching presence and cognitive presence.¹⁶ Social interaction might be the precursor to deep learning, but teaching presence is important to provide structure and leadership for higher levels of learning to occur.¹⁷ In other words, teaching presence is needed to help students shift from social presence to cognitive presence.¹⁸

Most of the research on online learning communities has been conducted over the length of a course and provides a short term view of this phenomenon.¹⁹⁻²³ Several qualitative studies have been conducted to investigate this phenomenon in undergraduate and graduate online programs.²⁴⁻²⁷ However, these studies provide a limited perspective of learning community development viewed from the start of a program to its completion.

Therefore, more qualitative research needs to be conducted to understand students' experiences in online communities throughout the entire curriculum.²⁷

Studies on dental hygiene students in online programs and their experiences with building and sustaining online learning communities is not well documented in the literature. Dental hygiene educators accept the online format as a means to learn; however, little is known about the phenomenon of building communities to enhance learning. Therefore, the purpose of this qualitative inquiry was to explore graduate dental hygiene students' experiences with online learning communities. The research questions established for this inquiry were: what experiences promote and impede building online learning communities, and what experiences promote and impede the sustainability of online learning communities?

Methods and Materials

A qualitative case study method is beneficial to conduct an in-depth analysis of a phenomenon where context is important.²⁸ The phenomenon in this case study was building and sustaining online learning communities, and the context of this inquiry was an online graduate dental hygiene program at a northwestern university in the U.S. The requirements for the graduate program included core courses all students completed in: research, program development and evaluation, special needs populations, advanced dental hygiene theory, and leadership strategies. Additionally, 2 campus visits, each one lasting 1 week, were required. The first visit focused on orientation to the program, and the second visit focused on seminar course with topics in education, research and practice. Completion of a thesis was a program requirement. Students were required to complete 1 of the 2 specialty areas in education or community health consisting of 2 didactic courses, 1 elective course and a practicum. Each online course was designed with a forum for the purpose of informal postings and weekly announcements by the faculty. These discussions were named the "Coffee Shop" or "Communication Center." Course design consisted of weekly reading assignments and required discussions based on questions, group activities and projects, or peer review activities. Participation was evaluated using a rubric and was assigned a percentage of the final grade computation. Most courses required 2 or 3 projects for the summative assessment. The online program employed an asynchronous format because of the span of time zones across the nation from which the students were located.

Approval was received from the university's Internal Review Board (HSC #3618) before commencing with participant recruitment. A purposive sampling method was used to recruit participants from various strata of students enrolled in the online program as well as graduates of the program. The purposive sampling method was employed to provide a better view of experiences related to the progression of learning communities throughout the entire program. A total of 5 students were targeted from each stratum: completion of 1 year, 2 years, 3 years and graduates.

The interviewer, who was a graduate of the program, contacted students by email to invite them to participate in the study. Those students, who responded to the message and indicated an interest in participating, received an informed consent form and a questionnaire to ascertain demographic data and the stratum to which they belonged. When both of these items were completed and returned to the interviewer, a personal interview was scheduled. A list of questions was sent to participants at least 1 week prior to the interview to help prepare them for the data collection. An incentive was offered - participants' names were placed in a drawing for a \$50 VISA® gift card.

Personal interviews were conducted in-person or over the telephone because of the wide geographic distribution of students and graduates of the online program. A semi-structured interview was followed, using the questions provided to participants; however, the interviewer had the flexibility of asking follow-up questions to gain more in-depth data about the participants' experiences. Participants selected a pseudonym and this name was used during the interview to protect the individuals' confidentiality and anonymity. Interviews lasted 1 to 2 hours and audio was recorded using an Olympus™ digital voice recorder. The digital files were downloaded onto the interviewer's computer and copied onto a CD. The audio files were transposed into written documents by a transcriptionist who confirmed the written data were verbatim.

The word-processed transcripts with the participants' pseudonyms were used to analyze the interview data by a second researcher. Each transcript was read through in its entirety the first time and during the second reading the researcher coded the data using a word-by-word, line-by-line, segment-by-segment approach to deconstruct the data into small pieces.²⁹ These initial codes were considered provisional and were changed as the researcher analyzed other interviews using a constant comparative method for determining similarities and differences between participant experiences.²⁹

The second phase of data analysis was to develop categories that explained larger segments of data and incorporated several initial codes.²⁹ During this phase, categories and subcategories were created as the data were reconstructed to form broad themes of experiences emerging from the data at a higher abstract level.²⁹

Using 2 methods of verification are adequate to establish the validity of the data analysis.³⁰ The first method involved the interviewer serving as a peer reviewer during the second phase of data analysis to ensure the interpretation of the data by the second researcher was consistent with the actual data from the interviews. Another method employed to establish validity was the completion of member checks, All of the participants reviewed the data analysis and confirmed the interpretation of the data was congruent with their experiences. A drawing for a second VISA® gift card was offered to participants who completed the member check activity.

Results

A total of 17 participants completed the interviews, and all were female. The stratified sample included 2 students who had completed 1 year of the online program, 6 were second year students, 4 were third year students and 5 participants had graduated from the program. Of those, 11 did not have experience with online learning prior to enrollment in the graduate program, whereas 4 individuals had completed 1 to 2 online courses, and 2 participants had completed 5 or more online courses. The factors motivating participants to enroll in an online dental hygiene graduate program are reported in Table I.

The data analysis revealed a collective definition of an online learning community as a complex synergistic network of interconnected people who create positive energy. Characteristics of learning communities are presented in Table II.

Experiences Defined By the Participants That Promote Building Online Learning Communities

The data from the interviews were analyzed and 4 broad categories of experiences were found to promote the building of online learning communities. The categories were related to the program, learners, course design and faculty.

The participants revealed 1 experience with the program, the orientation course, was important for building online learning communities. The ori-

entation was a blended course with required on-line activities before the on-campus portion. This experience was beneficial for setting the stage to build community. Setting the stage was essential for understanding how to contribute to online learning, getting connected to peers and faculty, establishing commonality, sharing common experiences, creating a network and making online communication easier. One outcome of the orientation was for students to learn how to contribute to the online learning community, as depicted by participant "Sally":

"So for me I would say that the orientation [was important] to orient us to the program and how it works, how we (would) be using various means of technology to communicate synchronously and asynchronously; using Skype, for example to peer review each other's papers. Really knowing what was expected and knowing our role to contribute to the learning environment."

The initial interaction of students during the Getting-to-Know-You discussion in the online portion of the orientation course was beneficial for peers engaging and connecting with each other, which were important aspects of establishing the sense of community. "Teeth Geek" explained:

"The introductory forums of greetings when we told a little bit about ourselves and people interacted online and contributed a lot. For example, how to be connected and you could see the development as time went on of learners interacting very positively with one another."

Connecting with peers at the on-campus orientation was evident for establishing a commonality among students who were entering the graduate program. "Polly" explained her reluctance to being a new graduate student:

"The new student orientation...was a nice time to meet everyone because when I first stepped out of my car, I wanted to turn around and go home because I just didn't know what I was getting myself into. Meeting everybody was wonderful because we could support each other...we all found out that we had the same fears and we felt the same way about ourselves and this transition."

Setting the stage also meant meeting in person and the opportunity to connect a face with a name. These factors were important for establishing the online community as depicted by "Opal Queen":

"I would say absolutely that getting to know someone, just their face, putting a face to whom

Table I: Factors Motivating Participants to Enroll in an Online Dental Hygiene Graduate Program

Factors	Participant	Participant's Statement
Improved access to education	Katy	"I live in the middle of nowhere and this program was a great option for me because I would have to travel quite a distance to get an education."
Flexibility of working on coursework	Penelope	"...on my own time and I could move it around my family schedules, work schedule, and school schedule."
Expand career opportunities	Irma	"I practiced for four days a week and I wanted to do something more with my degree. I wanted to continue my education so I could have more opportunities in maybe teaching or I just wanted to do something besides clinical dental hygiene...I wanted a master's degree in dental hygiene or education, but I thought that because I have experience in dental hygiene, it would make sense to do a dental hygiene master's degree."
Earn a terminal degree	Steel Magnolia	"...another thing that was a draw was it's the terminal degree right now in our profession and the college [where I teach] puts extra weight on it [terminal degree in the discipline]."
Opportunity to interact with dental hygienists from a diverse geography	Orange	The online program provided the opportunity to "... meet people from different parts of the U.S. and Canada."

you are interacting with....In order to build a relationship I think you need to have that face-to-face action or interaction."

The on-campus visit was vital for sharing common experiences to establish the community, as students and faculty participated in activities outside of the formal instructional events as explained by "Bluthner":

"We had an intense period of time together where you were all together day and night. You're having dinner together and laughing and talking about things and it's the best friendship builder."

The on-campus visit with the personal interaction helped establish a network of learners who would support each other during the program. "Glory" discussed:

"I think your orientation was really big. It was something that connected a lot of us. I was close throughout orientation and we just continued to be close as friends. We still call each other. We have our [telephone] numbers from orientation and sometimes if I have a question or I need something, I feel comfortable with calling."

In addition, the on-campus visit provided the opportunity to interact with faculty members teaching online courses as indicated by Bluthner:

Table II: Characteristics of an Online Learning Community

- Learners who are passionate about their educational journey and their profession by expanding the greater body of knowledge.
- A shared vision to work together to achieve a common goal.
- A supportive community where everyone puts forth their professional best and contributes freely and generously with one another.
- People who are committed to learning and are prepared to contribute their reflective thoughts in meaningful response to other members.
- Learners who value each other sincerely and are genuinely concerned about each person succeeding.
- Learners who are empathetic to each other's situation and provide encouragement to each other.
- Opportunities for interaction and learning from each other.
- Experiences are shared to help everyone grow and change.
- A healthy exchange of ideas is fostered and improved ideas are created.
- Members express their ideas freely in a safe environment and learners are accepting of each other's perspective.
- Open and honest feedback and constructive criticism are provided.
- A supportive facilitator who is flexible is present.

Table III: Common Experiences Promoting Online Learning Communities

Common Experience	Participant	Participant's Statement
Commonality being licensed dental hygienists	Irma	This commonality provided "foundation to help build relationships."
	Whiskey	Placed everyone on an "even level" and "broke down barriers."
	Polly	"Commonality did contribute to the building of relationships by being able to share clinical experiences, share professional opinions, share clinical techniques. This sharing contributes to building trust and respect towards one another...[W]hen I feel a common bond, I feel a common thread, when I interact with my colleagues it increases my learning because I am comfortable and know I fit in. "
Commonality of being graduate students	Orange	"There is always someone else who can relate to that and provide support, but definitely I think because we are all in the online program as well. We all have the same goals and desires."
Commonality of being women managing multiple roles	Katy	"Everybody was juggling many roles from teaching to families. We were on the same page with everything...We were in the same situation and we could talk to each other and kind of work things out together."

"I think for me that the site visit's best part was seeing my professors."

The second category of experiences promoting online learning communities was related to the learners and their interaction with each other. Student experiences were based on the commonality of being dental hygienists and graduate students, yet different experiences in their education and careers provided opportunities for learning. The common thread between students was their profession, status as graduate students and females managing multiple roles. The participants' perspectives on common experiences are reported in Table III. Although these common threads helped students connect with each other, the variation in their experiences as clinicians and educators provided rich opportunities for learning by sharing alternative perspectives and ideas. "Penelope" explained:

"I made new friends through the online program and the thing I really like is that they are from different parts of the United States and Canada. I am getting input and viewpoints of people who are working in the same profession as me, but they have different ideas or different ways they approach a situation or problem and it really helps me learn. It just adds to my experience. I think it enriches the learning experience because people bring so much to the table. It is just a whole different learning experience."

Students experienced feeling socially connected to peers through the development of personal relationships as family and friends. "Penelope" commented: "I felt like I belonged to an online community and had friends there."

"Polly's" experience included: "The peers made online learning more colorful, more positive, more fulfilling and just a more positive experience....We developed friendships and family; in ways it's like family."

"Bluthner" felt as if the relationships developed online were more intimate than in a face-to-face situation:

"I think the social connection in online learning communities is just a fascinating thing for me because people are sharing really intimate details of their life....I think staying socially connected is because people share so much of their life because they are not face-to-face and they feel less guarded, so you actually get a deeper level of intimacy."

Communication that was encouraging even when peers had differing viewpoints was helpful in developing the sense of being socially connected to each other. "Whiskey" portrayed this aspect of communication:

"My class is generally diplomatic; they were all pretty encouraging. Even if someone had a differ-

ent perspective than someone else, it was always worded in a different way that was...always encouraging. I never felt challenged and they were never negative or threatening to each other...It worked really well for me coming out socially that way; otherwise, I would have crawled right back into that shell and been really careful how I answered."

Communication that was encouraging was influenced by their empathy for one another and contributed to the development of a strong network for support. "Katy" expressed her thoughts:

"I don't think I could have completed my courses without my peers. The people who were in my discussions in my courses were all in the same boat. Everybody is juggling school, their families, work commitment and it's hard...You always had someone to talk to and they would try to lift your spirits up."

Peers felt socially connected through the mutual appreciation and respect for each other that promoted open and honest communication where they felt the freedom to express differing viewpoints. "Opal Queen" identified that being adult learners contributed to learning:

"I feel like being adult learners we weren't afraid to get express our opinion or...to challenge each other somewhat and say, what about this or what about that. To help us look at different perspectives, which I would say I became very connected in that way. Everybody seemed to be open-minded to varying viewpoints...I think we all grew off of each other...So I think that really helped me connect."

Being supportive in the online learning environment was experienced as being a contributor, receiving positive feedback, and mentoring each other. Participants' statements are reported in Table IV.

Graduate students in the online program interacted with each other in a variety of ways outside of the program and online environment to socially connect and ask for guidance on coursework. Communication through personal telephone calls, e-mail messages, Skype and Facebook provided the means of informal interaction among students.

The third category of experiences influencing the promotion of learning communities was related to the online course design. The design of courses for communication and interaction among peers and with the faculty was important. Formal

communication in weekly discussions meant being an engaged learner by actively thinking, applying and analyzing the postings. In addition, the formal discussions required interacting and sharing ideas with others. This interaction was described as "enriching the learning experience" (Penelope) and forcing "you to do more in-depth thinking" (Tango). The quality of the postings were deemed important, as mentioned by "Polly":

"More in-depth postings where you get more information and ideas that you have to ponder. It makes you open to everyone when you realize there is an endless amount of ideas to help problem solve. It adds up to a higher level of knowledge and its stimulating too. When you are stimulated, it opens up your mind and you are motivated to learn more."

As "Sally" pointed out: "the online environment was nice to be able to reflect on something and post it at a later time or ask a question." "Penelope" commented: "I sound more intelligent online than I do in person because you have time to think about your response." The online discussions provided an opportunity for all students to interact with each other as described by "June":

"In a traditional classroom usually there are two or three people who dominate the conversation and everyone else keeps quiet and listens, but online, everyone has an opportunity to jump in and throw in their two cents and so for quiet people, it can help them."

Weekly discussions also helped overcome the initial feelings of isolation and intimidation, "but immediately after sharing fears and reservations among each other, we became very reassured by one another and felt we had great friendships and a family support" (Polly). Specific guidelines for postings helped establish the feeling of being a learning community. For example, "Ella" mentioned:

"Having to post a mandatory initial posting and then having to do a mandatory response to two or three other people has helped to establish that feeling of being a learning group"

Rubrics to evaluate participation in the weekly discussions helped students understand the expectations for the quality and quantity of the postings. Using proper online etiquette and emoticons to support the written word facilitated positive communication. Smaller groups were favored because "you can't interact with the whole city, you need a smaller group to interact with" (April).

Table IV: Mentorship in the Online Learning Environment

Mentorship	Participant	Participant's Statement
Providing peer support	Sally	"...it just made it a better learning experience because each person had their strengths and weaknesses, but could contribute. Sometimes it wasn't so much what others could contribute to me, but I learned so much by helping them."
	Penelope	"It's just nice to get a pat on the back and say hey, you did good on that or what about this...I just appreciated the feedback. I appreciated the guidance and the direction..."
Mentoring less experienced students in the program	Steel Magnolia	"Quite a few of my peers in their examples and their mentoring [made me feel connected]. One person in particular in our cohort is just a mentor by nature and kind of took me under her wing, which brings you into the fold and that was very helpful."
	April	"I really did [enjoy interacting with peers] and continued to learn so much from the mere experience and also just being there for some of the younger students. I know we had some younger students in our class who they were going through challenges, I guess feeling insecure and feeling a lack of confidence about their skills and they would share some of their concerns and those with a little more experience were there and could give them some good advice. I think it was just great and I learned a lot from the advice they gave the younger students too."

Experiences with informal chatter in the courses' Coffee Shop or Communication Center contributed to sharing personal information and getting to know peers better to build relationships and provide a strong supportive network. "Teeth Geek" summed up this interaction:

"I am glad we have the coffee shop and people post information about their new puppies or personal things. That also helps build character; I mean it fills out that person. We learn more about each other and can share illnesses and losses. It's important to make an effort to support our peers."

Experiences with group activities and assignments were beneficial for building learning communities when responsibilities were divided among group members and everyone contributed to the collective assignment. Having the same high standards for completion of group activities was also important. When peer review of assignments was used as an activity in the weekly discussion, it provided an opportunity for guiding each other and gaining different perspectives. "Penelope" found peer review beneficial: "You are getting feedback from different sources."

The last category of experiences to build online learning communities related to the faculty. Faculty were viewed as members of the learning community and their role was to facilitate learning. Their role was a strong influence on the building of community. From "Sally's" perspective:

"Faculty members helped build the learning communities by facilitating dialog, class activities and exercises within the coursework...the instructor was a strong variable in the learning environment."

"Glory" commented: "Yes, I do think they should be part of the learning community by providing examples of their own experiences and ideas, supporting and approaching issues or students or patients in theory or practice."

"Whiskey" commented: "[the faculty's role was to] provide insight and difference perspectives." "Tango" felt: "[faculty should] be active in the course and be active in discussions. They should have a presence within the course and help build those relationships and keep everyone connected."

From "Penelope's" perspective:

"They are there to mentor you and help you along the way with their postings." Irma identified faculty as a "guide....when they are supportive of you and what your peers have to say and helping to build the community."

"Bluthner" reported: "be a guide on the side, but don't disappear and when students start going off in the wrong direction, re-guide them." Another role of faculty in discussions was to "moderate if things got a bit heated between people" (Online RDH).

Faculty have to be "aware of online teaching principles, having a capacity, being an expert in the material to teach the course, having the course prepared the first day of class and you see everything is organized..." (Bluthner). "Teeth Geek" provided thoughts on faculty: "most instructors have been very open to diverse learning styles of their students." Another aspect of managing the course was "encouraging preparation, asking thought provoking questions for discussion, giving good preparatory assignments and then asking reflective thought provoking questions based on the required reading" (Online RDH). "Glory" indicated: "[some faculty members] have been motivational and encouraging students to engage in critical thinking instead of giving you the answer." Encouragement also extended to "students to work in collaboration....Having us interact with people who have different viewpoints that we can learn from..." (April). Other course management experiences were faculty providing helpful feedback and suggestions, being available to answer questions and responding in a timely manner.

Faculty members who were attentive to adult learning principles influenced learning in a positive manner. "As adult learners we come in with a lot of experience that we can offer and contribute. It was nice when instructors gave you that opportunity" (June). Presenting lessons using adult learning principles, requiring reflection activities, being less prescriptive and having the freedom to "think outside the box" (Sally) contributed to this positive situation.

Experiences Impeding the Building of Online Learning Communities

The same 4 categories of experiences impeded the building of learning communities: program, learners, course design and faculty. Program factors that presented as obstacles related to student experiences after they left campus and entered the first week of core courses. These challenges included feeling isolated and on your own, "getting

acclimated to the program and getting to know the expectations of the program" (Sally), and learning the technology, navigation in the online system and the "language of online communication" (Polly). In addition, "the fears of being in graduate school because it is intimidating. It's a different type of learning and the [discussion] questions we get are more thought provoking and not requiring black and white answers and that was intimidating because we didn't know if our answers were right or wrong" (Polly). Writing postings for the weekly discussions was viewed as a "challenge being articulate in the discussions without taking an inordinate amount of time" (Sally) "because you want to say something meaningful and thoughtful to contribute to the community" (Teeth Geek).

The second category of experiences impeding development related to the peer community of learners. The weekly discussions and the manner in which peers responded to each other was a source of not feeling supported. "Katy commented: "[peers sometimes] were late posters and procrastinated" and "sometimes people would be minimalist and never get a response to their post." Postings that lacked constructive criticism and sensitivity were interpreted as critical and confrontational and did not contribute to the development of community. Misinterpreted postings because of the lack of visual and auditory cues also were a source of problems: "learning in online groups you can't see each other's face and don't always know what tone the posting is carrying" (Bluthner).

The lack of dental hygiene experience was another factor impeding the development of learning communities. Graduate students with less experience in practice felt they had less to contribute to discussions, as expressed by "Katy": "Sometimes people would bring up an example and I couldn't contribute as much just because I didn't haven't had that experience." The lack of practical experience was a source of frustration for more seasoned dental hygienists, as depicted by "Patsy":

"It wasn't about me learning, it was about me teaching these people who were too inexperienced to be in graduate work. They were too young. You have to have some life experiences, but when they come in straight from an undergrad degree, it takes a lot to get them to understand."

Participants who identified themselves as predominately individual learners faced challenges within the online learning environment. "Tango" felt: "being an individual learner gives you more vulnerability because you are out there blazing

ahead without a whole lot of support." This type of learner found the development of community challenging because "I don't need to develop those close ties. It helps, but it's bad in that I was out there on my own" (Tango).

The third category of experiences that impeded the development of online learning communities was related to course design. Some students felt as if the hours spent preparing for the course were not consistent with the credit hours. "There were a couple of courses in meaning well and it was great course content, but it was just overwhelming" (Sally). "Bluthner" had similar feelings "I felt a little overwhelmed by all the reading and typing and reading and typing and reading and typing."

One core course not taught by a dental hygiene faculty member did not use a discussion format or peer review during weekly activities, only lectures, reading assignments, quizzes and a final assignment. Lectures were posted as Adobe presentations and students listened to the presentation while following the PowerPoint slides. "A disconnect from the rest of my class" and feeling "pretty isolated" were some themes expressed (Ella). In addition, discussions requiring students to summarize information from the reading did not "spark interest or opinions" (Orange) about the course content. The length of required discussion was viewed as a problem by "Glory": "We actually had to do a mini research paper every week for the discussion and it is taking 8-10 hours; that's not reading or anything else."

Large group discussions were problematic "when there were too many people posting and interacting, it became overwhelming and you may not get that bonded feeling" (Bluthner). Group projects were experienced as challenges "to get everybody on the same page and coordinated and working in different time zones and if someone's heart wasn't in it, it was hard to get people together as a group" (Sally). "Online RDH" offered this comparison with a traditional classroom setting:

"When you are in a face-to-face classroom, everyone has the same face-to-face time, but in an online course, you don't and that's....why there is a problem with group projects because you have to accommodate everyone else's schedule."

Other challenges experienced by groups were members riding on "the coat tails of others" when responsibilities were not equally divided among members. When group members did not adhere to the same high standards and expectations as

other group members, this too was a disconcerting point for group activities.

The last category of negative experiences revealed by the data analysis was related to faculty's lack of preparation for teaching an online course, lack of course management and lack of interaction with students. The lack of preparation included "no online teaching experience" and "the biggest hindrance would be the lack of experience when the instructor didn't know how to use the technology" and "the instructor would ask me, how do you do this and how do you do that, because the instructor hadn't done it before and that class was horrible" (Irma). In another instance, a faculty member taught another instructor's course and used the same content in the previous course. The new instructor "didn't know what the other instructor was expecting for the assignments and she was flying by the seat of her pants" (Irma).

Experiences with the management of the course related to "links did not work and we couldn't access information that we were supposed to read and had to be posted [in the discussion]. That was frustrating and you think you're not going to know what you need to know" (April). Other frustrating experiences occurred when the wrong syllabus was posted in an online course, weekly course modules were not available for viewing and papers were not graded in a timely fashion.

Challenges in the online learning community were experienced when interaction between the faculty and students did not happen on a timely basis or was infrequent and did not support the content of the discussion. "It was an emotionally draining time for me because I was not able to communicate with the instructor" (Glory). Negative postings and favoritism to some students' postings also challenged the building of community. Students did not feel supported when feedback on assignments was not provided and faculty failed to fulfill the mentor and facilitator role. "Polly" felt: "Instructors hindered the learning community and when you have negative feelings, that hinders learning because you are not motivated."

Interestingly, when the faculty did not fulfill their responsibilities, "I was fortunate to have supportive peers who made it doable for me" (Teeth Geek) and "we bound together as a class... and supported each other. If there had not been a sense of community within the class, I don't know that we would have learned anything" (Online RDH). "Polly" summarized: "We did learn from one another and we learned the power and impact of supporting each other."

Experiences Influencing the Sustainability of Online Learning Communities

As students progressed through the curriculum, several experiences influenced the phenomenon of building or impeding the sustainability of online learning communities. The dynamic composition of students within the online courses was an experience that both promoted and impeded building community. As students progressed through the curriculum, they interacted with peers who were not members of the initial support network established at orientation. Students developed an awareness that some "learning groups were strong and then a new group didn't have the same synergy or energy and it was different" (Sally). Even though students did not meet face-to-face, the interaction in the courses made "Whiskey": "Feel like I know them, none the less, and I can talk freely with them and we know each other's styles." Other experiences promoting community stemmed from the "ability to communicate did get stronger" (Sally) throughout the program and "relationships continue" when students meet again "at some future point" (Penelope). Maintaining peer relationships was easier when interaction occurred in multiple courses because students were "more engaged" and "the more apt you were to continue the relationship" (Patsy). Being more relaxed and less formal interacting with each other helped people connect on a higher level and feel closer to each other. "Penelope" observed: "You grow as you go," representing the intellectual development of the community and a higher connection among peers.

The dynamic nature of community membership also presented challenges to developing learning communities. Some students felt it took longer to understand these peers and delayed the community development. "Irma" indicated: "There really wasn't a relationship." Another aspect of interacting with others outside of the initial support network was influenced by taking courses out of the order of the recommended sequence.

The second summer campus visit and coursework in the emphasis areas (dental hygiene education or community/rural health) helped sustain the learning communities. Students viewed the second on-campus visit as a reunion with peers who attended the same orientation. This face-to-face opportunity also was important to personally interact with those who did not attend the same orientation, but were familiar from interaction in previous courses. "Polly" commented "It was like having a pen pal who you had gotten to know so well and then you were able to see them face-to-

face and that helped strengthen the relationship all the more." The second on-campus visit "cemented the friendship and took it to another level" (Polly) by interacting and connecting through group learning and sharing common experiences outside of the course. The emphasis area courses presented opportunities for peers to develop closer relationships because they had the same goals.

During this phase of the program challenges also existed. Competing responsibilities with careers and family made it difficult to put full effort into completing coursework. In addition, as students progressed through the curriculum, peers in the initial supportive network progressed at different rates and students lost contact with each other. As "Tango" lamented: "The longer you are in the program, the further you're spread out from people.... As time went on, I lost a lot of my classmates who I felt close with." From "Ella's" perspective:

"I lost pace with my cohort...Seeing new faces I hadn't met was detrimental to the progression of relationship building over the semesters...So I think that aspect of everyone being on their own time tables is detrimental in maintaining relationships throughout the program."

As students enrolled in online elective courses in other disciplines, they were faced with multiple obstacles for building learning communities. Dental hygiene students did not feel connected with students in other disciplines because they perceived the other students were not interested in dental hygiene and there was a lack of commonality (feeling like an outsider). The large class size in elective courses presented challenges to interacting with everyone in the course, working more independently to learn and posting just enough to get by. This phase of the program was viewed as very different from their positive experiences in the dental hygiene courses.

As students entered the thesis and practicum phase of the program, they also felt disconnected with their supportive peer network. "Online RDH" commented: "I miss everybody. I really do. The only people I am speaking to are my thesis advisor and my practicum advisor." Students entered the thesis course at different times and progressed at different rates through the thesis process. There were no required weekly discussions for peers to interact; however, personal communication outside of the program helped people feel connected, but not as much as when they were in the core courses during the mandatory weekly discussions. Thesis work was viewed as an independent learning situation. "Sally's" perspective on thesis was

that the learning community dynamic changed: "Everybody is in their own mode and there was less communication and dialog in the thesis classes." Faculty who were members of the thesis committee interacted individually with each student. "Tango" remarked: "...the only lifeline you have... [is] your connection with your [thesis] advisor."

Discussion

The findings of this qualitative case study provide insight into students' experiences influencing the development and sustainability of online learning communities. These experiences were categorized into program, learners, course design and faculty influences. Each category has implications for designing and implementing an online graduate program.

Students valued an online program for the improved access to higher education because of being location bound and not having institutions offering advanced dental hygiene degrees in close geographic proximity. In addition, the flexibility of an asynchronous format provided the opportunity to participate in coursework while being active with their family and employment responsibilities. The online program also provided a means to expand career opportunities and gain a terminal degree in dental hygiene, an important factor for individuals who were already teaching in dental hygiene programs.

Participants in this study were able to clearly articulate a definition and characteristics of an online learning community. They also valued the community as a means to learning. A possible explanation of this finding is that most of the participants were focused on dental hygiene education as their emphasis area in the program. Other researchers have found conflicting perspectives on the meaning and value of learning communities. Conrad noted that students had difficulty articulating a clear meaning of community; however, they felt a community developed over time.³¹ Students and faculty can have limited community awareness and place little value on community development, citing the investment of extra time and effort as a downfall.²⁷ On the other hand, students can place a high value on community as an essential element for learning and clearly articulate the meaning of community focusing on being a member of a group.²⁶

Participants' experiences with the program's orientation course contributed to setting the stage for the development of social presence within the online learning community.¹⁰ Personal interaction during formal and informal group activities seemed

to build a foundation for developing a sense of group cohesion - an important factor in the development of subsequent communities within the online courses.¹⁰ Other researchers have reported students in online programs find a face-to-face encounter during an orientation before classes begin very important for building community.^{26,31} Program administrators need to be mindful of mechanisms in place for students to share professional and personal information to gain a sense of identify within the online community. When face-to-face meetings are not planned, activities within the online environment should be used. For instance, each student can design a profile, including pictures, on a secure online site and release the site for other students and faculty to view. Another strategy is for each course to have a Getting-to-Know-You activity during the first week of the semester to establish social presence through the development of a personal and professional identity among learners and the faculty member. This strategy would assist new students entering the cohort an opportunity to establish their presence in the community.

The first few weeks of online courses appeared to present some challenges as learners felt isolated and navigated the online learning environment on their own. Students who experienced these challenges initially felt vulnerable and intimidated; however, a strong peer network helped them overcome these obstacles. The literature reports challenges that learners face within the online environment. One challenge is feeling isolated and disconnected from peers and faculty.³² Other challenges relate to frustration using technology and trying to complete collaborative learning activities.^{24,33} When feelings and frustrations are not rectified, students' performance in a course might suffer, and withdrawal from an online program can result. One way to overcome these challenges is through the development of online learning communities to keep students connected with peers and faculty members and to provide a strong support system to reduce attrition.^{27,34}

The second on-campus visit was a program factor that contributed to the sustainability of online learning communities. This face-to-face experience was important to take existing relationships and social presence to a higher level by engaging in shared activities.¹⁰ Lee et al also found that a second on-campus visit in the middle of the program contributed to maintaining a sense of belonging to a community.²⁶ In the present study, peer relationships did get stronger as students progressed through the program and interacted in multiple courses. Students felt an investment in

the community as they realized the importance of each other contributing to their own learning. However, students had different experiences with new learning communities consisting of students who did not complete the orientation course together. Sometimes the communities did not have the same synergy as previous communities, whereas other communities connected with new students. One detrimental aspect to sustaining community was identified as the ability to progress through the program at different rates, thereby losing contact with the original cohort. As administrators design online programs, they should consider whether a cohort of students will complete coursework together as a group or whether students can progress at their own rate with a flexible program of study. Perhaps the cohort approach to an online program enhances the social presence of the learning community by sustaining the same group of students over the entire curriculum.

Sustained social presence with peers was a problem identified by participants during the thesis and practicum phase of the graduate program. Although these courses were independent learning experiences, students felt a need to remain connected to a learning community and maintain a social presence among peers. Administrators need to develop mechanisms to continue opportunities for social presence throughout the entire program in practicum, thesis and capstone courses. For instance, weekly discussions could be established in an online course for students enrolled in independent learning experiences.

The second category of experiences related to the learners and the development of social presence.¹⁰ Positive interaction built the community through encouraging communication, providing emotional support, valuing different viewpoints, gaining mutual appreciation and respect for each other, and communicating openly and honestly. Students felt the learning community developed as personal relationships reached a level of kinship as family or friends. This social connection was possible through feeling a common bond as being dental hygienists and graduate students, having common goals and juggling many roles. A network of learners was formed when students felt competence in the online learning environment and established a professional identity that allowed them to contribute to learning. One contribution was guiding and mentoring that occurred among the students to help each other be successful in the coursework. Students who lacked practical dental hygiene experience were viewed as not contributing to the learning community, possibly due to the lack of establishing a professional identity. For

this reason, program administrators should decide whether clinical experience should be a requirement for admission to a graduate dental hygiene program.

Peers developed a supportive network through back channel communication. This form of communication is an informal means of connecting with each other outside of the formal course technologies to construct social presence.³⁵ The technologies used for back channel communication mirrored those the dental hygiene participants identified: personal telephone calls, email, Skype and social networking sites. Additional technologies reported by at least 50% of the students were blogging, texting on cellular telephones, using RSS feed readers and use of websites for collaborative authoring and editing.³⁵ Peers communicated with each other to receive help with course assignments and technology difficulties, and provide social interaction and emotional encouragement.³⁵

Some experiences with peers negatively impacted the cognitive presence to develop higher levels of learning and community development.¹⁰ Peers who contributed poorly by late, minimal or insensitive postings in discussions provided challenges to the learning environment. These challenges should be addressed in the design of the course to prevent or at least minimize their occurrence.

Course design was the third category of experiences revealed as important to developing online learning communities. The formal weekly discussions provided opportunities for students to interact with each other. The use of small groups fostered collaboration without requiring large numbers of postings. Changing the membership of group members was deemed important to work with everyone in the course over the semester. Large group discussions were viewed as overwhelming. One explanation is the focus on quantity of postings over the quality of postings. Students preferred thought provoking discussions that required higher level cognitive functioning including analyzing, synthesizing and creating. These activities stimulated a sharing of ideas that enriched the learning experience and established a cognitive presence.

Parameters for the formal discussions were important to set in order to help students understand the expectations for their participation related to the quantity and quality of postings. Ground rules for establishing a cognitive and social presence in an online course are important.³⁶ The rules for cognitive presence include deadlines for the initial

posting and the end of the discussion timeframe, quantity and quality of postings, and the number of individuals with whom to interact.³⁶ Expectations for each online course can be articulated in a rubric within the course syllabus. Each rule of cognitive presence can be one criterion on the rubric. The evaluation of students' performance in the weekly discussions should be used as the computation of a participation grade for the course. The rules for social presence encompass providing a safe environment for taking risks, fostering a relaxed environment, and promoting a supportive and collegial environment where individuals can disagree and ask questions.³⁶ Furthermore, informal communication within the online course is important for developing and maintaining a social connection among students and faculty.

Group activities and assignments contributed to building community when each member equally contributed to the effort with high standards of performance. These activities impeded community development when group members' responsibilities were unequal or standards of performance were lower than the other group members. Another challenge to group requirements was different time zones that made working together difficult.

As faculty design online courses, they need to be mindful of providing ongoing opportunities for learners to interact with the course content and among each other to learn. Use of group activities and assignments must be carefully planned to foster the development of critical thinking through cognitive presence.¹⁰ Peer review is a learning strategy where students can support each other by providing constructive feedback on each other's work. This small group activity helps build learning communities as learners support each other in their coursework.

The fourth category of factors related to faculty who taught the online courses. Students felt faculty were members of the online community and had a significant role in developing the community. Their role was viewed as having a presence in the course to provide support for the content (i.e. cognitive presence) and building relationships (i.e. social presence). Faculty who understood online teaching principles and adults learning principles influenced learning in a positive way, whereas those individuals who were not prepared to teach in an online environment and were not familiar with the technology impeded the development of the community. Students did not feel supported when faculty failed to interact with them on a regular basis, initiated poor postings, and failed to provide feedback and fulfill the role as mentor and facilitator.

One significant finding related to the absence of faculty presence was that a strong learning community comprised of graduate students can direct and support their own learning in a course.

The results of this study confirm the interrelatedness of social presence, teaching presence and cognitive presence established by the Garrison et al framework.¹⁰ However, this analysis established course design and faculty as 2 separate entities that influenced students' experiences with building and sustaining online learning communities. In addition, learners were deemed a key element in the online environment. This finding is supported by recent evidence that adds an additional component to the original Community of Inquiry framework, namely a learning presence.³⁷ Learning presence refers to the control students have over their thoughts, behaviors, motivations, emotions and strategies to be effective in the online environment.³⁷ When considering a learner-centered approach to teaching, it seems plausible to have learners as an essential element in the development and sustainability of online learning communities and the construction of knowledge.

The limitations of this inquiry include the case study of 1 graduate dental hygiene program, an all-female sample and a small number of participants. Future research might investigate other online graduate dental hygiene programs and those with no campus visitations to determine how the students develop and sustain learning communities. It might be interesting to investigate if degree completion students enrolled in an online program have similar experiences.

Conclusion

Learning communities in an online graduate program were created and maintained by the complex interaction among experiences with the program and course design, and interaction among faculty and learners. The most influential feature of program design was the week long on-campus visit required for orientation and the second graduate seminar visit. Important aspects of course design were weekly discussions and collaborative activities that implemented social constructivism where students were actively engaged in learning. Communication via small groups was preferred as well as opportunities for informal conversation. Faculty interaction with learners on a regular basis was vital to guide, direct and extend knowledge construction. Learner interaction displaying sensitive, honest and respectful communication helped establish a strong network of interconnected learners supportive of each other. Furthermore, establishing

commonality was important for creating a personal and professional identity to develop social presence. In a learner-centered online environment, learners' actions, values and commitment are essential to the success and effectiveness of learning communities and knowledge construction.

A learning community is a complex network of interconnected people who create positive energy through synergy. Synergy can be generated to facilitate higher levels of learning, greater than the sum of the individuals in the community, when members rely on each other for motivation and learning, and value the investment in building relationships and knowledge together.

Ellen J. Rogo, RDH, PhD is an Associate Professor and a graduate faculty member in the Dental Hygiene Department at Idaho State University in Pocatello, Idaho. Karen M. Portillo, RDH, MS is an Assistant Professor and Community Outreach Coordinator in the Dental Hygiene Department at Idaho State University in Pocatello, Idaho.

Disclosure

Funding for this project was provided through the American Dental Hygienists' Association's Institute for Oral Health.

References

1. Allen IE, Seaman J. Changing course: ten years of tracking online education in the United States. Babson Survey Research Group [Internet]. 2013 [cited 2013 January 9]. Available from: <http://www.onlinelearningsurvey.com/reports/changingcourse.pdf>
2. Mattheos N, Stefanovic N, Apse P, et al. Potential of information technology in dental education. *Eur J Dent Educ*. 2008;12(Suppl.1):85-92.
3. Schonwetter DJ, Reynolds PA, Eaton KA, De Vries J. Online learning in dentistry: an overview of the future direction for dental education. *J Oral Rehabil*. 2010;37(12):927-940.
4. Grimes EB. Use of distance education in dental hygiene programs. *J Dent Educ*. 2002;66(10):1136-1145.
5. Portillo KM, Rogo EJ, Calley KH, Cellucci LW. A survey of degree completion programs in dental hygiene education. *J Dent Educ*. 2013;77(5):554-563.
6. Online programs: degree completion programs. American Dental Hygienists' Association [Internet]. 2012 [cited 2013 January 8]. Available from: https://www.adha.org/resources-docs/71615_Bachelors_Online_Distance_Programs.pdf
7. Online programs master of science degree in dental hygiene or related disciplines. American Dental Hygienists' Association [Internet]. 2012 [cited 2013 January 8]. Available from: <http://www.adha.org/dental-hygiene-programs>
8. Cross KP. Why learning communities? Why now? About Campus [Internet]. 1998. Available from: <http://www.nhcuc.org/pdfs/CrossLC.pdf>
9. Swan KA. A constructivist model for thinking about learning online. Elements of Quality Online Education: Engaging Communities [Internet]. 2005 [cited 2013 January 8]. Available from: http://www.rcet.org/research/publications/constructivist_theory.pdf
10. Garrison DR, Anderson T, Archer W. Critical inquiry in a text-based environment: computer conferencing in higher education. *Internet and Higher Educ*. 1999;2(2-3):87-105.
11. Garrison DR, Anderson T, Archer W. Critical thinking, cognitive presence and computer conferencing in distance education. *Amer J Dist Educ*. 2001;15(1):7-23.
12. Anderson T, Rourke L, Garrison DR, Archer W. Assessing teaching presence in a computer conferencing context. *JALN*. 2001;5(2):1-17.
13. Shea P, Li CS, Pickett A. A study of teaching presence and student sense of learning community in fully online and web-enhanced college courses. *Internet and Higher Educ*. 2006;9(3):175-190.
14. Darabi A, Arrastia MC, Nelson DW, Cornille T, Liang X. Cognitive presence in asynchronous online learning: a comparison of four discussion strategies. *J Computer Assist Learn*. 2010;27(3):216-227.

15. Akyol Z, Garrison DR. The development of a community of inquiry over time in an online course: understanding the progression and integration of social, cognitive and teaching presence. *J Asynch Learn Networks*. 2008;12(3-4):3-22.
16. Shea P, Bidjerano T. Community of inquiry as a theoretical framework to foster "epistemic engagement" and "cognitive presence" in online education. *Computers and Education*. 2009;52(3):543-553.
17. Garrison DR, Cleveland-Innes M. Facilitating cognitive presence is online learning interaction is not enough. *American J of Dist Educ*. 2005;19(3):133-148.
18. Hudson B, Owen D, van Veen K. Working on educational research methods with masters students in an international online learning community. *Br J Educ Technol*. 2006;37(4):577-603.
19. Bikowski D. Internet relationships: building learning communities through friendship. *J Interact Online Learn*. 2007;6(2):131-141.
20. Dawson S. A study of the relationship between student communication interaction and sense of community. *Internet Higher Educ*. 2006;9:153-162.
21. Falvo DA, Solloway S. Constructing community in a graduate course about teaching with technology. *TechTrends*. 2005;48(5):56-64,85.
22. Nagel L, Blignaut, Cronje JC. Read-only participants: a case study for student communication in online classes. *Interact Learn Envir*. 2009;17(1):37-51.
23. Yeh YC. Analyzing online behaviors, roles, and learning communities via online discussions. *Educ Techno Society*. 2010;13(1):140-151.
24. Gallagher-Lepak S, Reilly J, Killion CM. Nursing student perceptions of community in online learning. *Contemp Nurse*. 2009;32(1-2):133-146.
25. Conrad D. Deep in the hearts of learners: insights into the nature of online community. *J Distance Educ*. 2002;17(1):1-19
26. Lee J, Carter-Wells J, Glaeser B, Ivers B, Street C. Facilitating the development of a learning community in an online graduate program. *Quart Review Dist Educ*. 2006;7(1):13-33.
27. Liu X, Magjuka RJ, Lee S. Does sense of community matter? *Quart Review Dist Educ*. 2007;8(1):9-24.
28. Yin RK. *Case Study Research: Design and Methods*. Thousand Oaks, CA. Sage Publications Inc. 2009. p. 1-24.
29. Charmaz K. *Constructing Grounded Theory*. Thousand Oaks, CA. Sage Publications Inc. 2006. p. 24-50.
30. Creswell JW, Miller DL. (2000). Determining validity in qualitative inquiry. *Theory into Practice*. 2000;39(3):124-130.
31. Conrad D. Deep in the hearts of learners: insights into the nature of online community. *J Distance Educ*. 2002;17(1):1-19
32. Conrad RM, Donaldson JA. *Engaging the Online Learner*. San Francisco, CA. Jossey-Bass. 2011. p. 1-14.
33. Capdeferro N, Romero M. Are online learners frustrated with collaborative learning experiences? *Internat Rev Res Open Dist Learn*. 2012;13(2):26-44.
34. Rovai AP. Building classroom community at a distance: a case study. *Educ Tech Res Develop*. 2001;49(4):33-48.
35. Kearns LR, Frey BA. Web 2.0 technologies and back channel communication in an online learning community. *TechTrends*. 2010;54(4):41-51.
36. Wang Y, Chen D. Promoting spontaneous facilitation in online discussions: designing object and ground rules. *Educ Media Internat*. 2010;47(3):247-262.
37. Shea P, Hayes S et al. Learning presence: additional research on a new conceptual element within the community of inquiry (CoI) framework. *Internet Higher Educ*. 2012;15(2):89-95.

Endoscopic vs. Tactile Evaluation of Subgingival Calculus

Joy B. Osborn, RDH, MA; Patricia A. Lenton, RDH, MA; Scott A. Lunos, MS; Christine M. Blue BSDH, MS

Introduction

The ability to detect subgingival calculus is paramount to the successful treatment of periodontal disease. Historically, dental professionals have used conventional (manual) explorers to feel the root surfaces for residual calculus when assessing scaling and root-planing procedures. Difficulties cited have included working in a subgingival environment without vision, clinical judgment in distinguishing between calculus and root morphology, and individual variations in acuity with tactile sensations.¹⁻⁶ Development of the Perioscope™ (Perioscopy Inc., Oakland, Cali) purports to provide some relief to these concerns because it offers sight into the subgingival environment.^{1,2,6-8} The Perioscope™ uses endoscopic technology, where a fiber optic tip inserted into the periodontal pocket is used to relay images of the subgingival environment to a monitor adjacent to the patient chair.⁸ The ability to visually inspect the root surfaces for calculus may improve detection, and thereby removal, of these deposits.^{1,2,6,7}

Calculus has been an ongoing source of study and debate regarding its clinical importance in the periodontal disease process.^{2,9-13} Historically, the role of residual calculus in disease progression has shifted precariously in the literature.^{2,10,12,14} The need for absolute subgingival calculus removal came into question with reports of improved periodontal tissues in spite of remaining deposit.^{9,10,12,14,15} While clinicians were not advocating the intentional leaving behind of calculus, doing so appeared to still have positive, although perhaps temporary, gingival outcomes. The idea of what was an "acceptable" level of smoothness appeared to chal-

Abstract

Purpose: Endoscopic technology has been developed to facilitate imagery for use during diagnostic and therapeutic phases of periodontal care. The purpose of this study was to compare the level of subgingival calculus detection using a periodontal endoscope with that of conventional tactile explorer in periodontitis subjects.

Methods: A convenience sample of 26 subjects with moderate periodontitis in at least 2 quadrants was recruited from the University of Minnesota School of Dentistry to undergo quadrant scaling and root planing. One quadrant from each subject was randomized for tactile calculus detection alone and the other quadrant for tactile detection plus the Perioscope™ (Perioscopy Inc., Oakland, Cali). A calculus index on a 0 to 3 score was performed at baseline and at 2 post-scaling and root planing visits. Sites where calculus was detected at visit 1 were retreated. T-tests were used to determine within-subject differences between Perioscope™ and tactile measures, and changes in measures between visits.

Results: Significantly more calculus was detected using the Perioscope™ vs. tactile explorer for all 3 subject visits ($p < 0.005$). Mean changes (reduction) in calculus detection from baseline to visit 1 were statistically significant for both the Perioscope™ and tactile quadrants ($p < 0.0001$). However, further reductions in calculus detection from visit 1 to visit 2 was only significant for the Perioscope™ quadrant ($p < 0.025$), indicating that this methodology was able to more precisely detect calculus at this visit.

Conclusion: It was concluded that the addition of a visual component to calculus detection via the Perioscope™ was most helpful in the re-evaluation phase of periodontal therapy.

Keywords: dental calculus/diagnosis, calculus detection, residual calculus, periodontal endoscope, perioscope™ technology

This study supports the NDHRA priority area, **Clinical Dental Hygiene Care:** Assess how dental hygienists are using emerging science throughout the dental hygiene process of care.

lenge conventional wisdom. However, this theory had a relatively short life span as research better delineated the structure of calculus and the role of plaque biofilm covering its surface.^{2,16,17} There is presently greater advocacy toward eliminating as much root roughness as necessary in order to achieve a smooth root surface and gingival health. Pattison warns that clinicians, educators and researchers may have shifted too far in the opposite

direction without justification, and that a greater focus on the root surface is again necessary for long-term periodontal management of disease.²

In spite of a philosophical desire for total calculus removal, studies have identified several aspects of clinical practice limiting the clinician's ability.^{1,3-6,9,14} Periodontal pocket depth has often been a point of discussion as researchers have found that a greater level of residual calculus is present in deeper vs. shallower pocket depths.^{5,18} Anatomy such as furcations, cemento-enamel junctions and multi-rooted teeth can pose additional problems.³⁻⁵ Some researchers have questioned the promise of total calculus removal in closed debridement,^{5,10,19} or without surgical procedures.^{4,20} Other factors to consider are location of the deposit (facial/lingual vs. proximal),¹ operator experience,^{4,6} inability to visualize the subgingival root surface^{1,2} and overall ability of practitioners to clinically detect residual calculus.¹

Studies evaluating residual calculus post-scaling and root planing via tactile and visual means have often relied on extraction of hopeless teeth as an end point in their methodology.^{1,3-5,8,9} Sherman et al compared visual and tactile calculus detection of 101 periodontally involved teeth.¹ In this study, tactile evaluation occurred before and after scaling and root planing *in vivo*, and at 2 re-evaluation appointments scheduled 1 week apart using a periodontal probe as well as an explorer. After extraction, visual evaluation used a scanning electron microscope at 10x magnification. Both evaluations used a presence or absence format for calculus determination. Results showed that the microscopic (visual) identification of calculus was always higher than the tactile detection. Additionally, of the total number of tooth surfaces scored microscopically as having calculus, 77.4% were scored as calculus free using the explorer.

Periodontal endoscopic technology has attempted to address many of the concerns related to conventional calculus detection by providing a visual alternative in the clinical setting.⁸ The endoscope uses a fiber optic bundle covered by a sterile sheath mounted into an instrument referred to as an explorer.⁷ The instrument tip gently pushes the free gingiva away during subgingival insertion.⁷ The subgingival video image is then displayed on an adjacent monitor. Images are magnified 24 to 48x their original size, depending on the location of the lens in relation to the object viewed.⁸ Potential advantages of using the endoscope have included real-time video viewing of the subgingival environment, high magnification of tooth structure, artifacts, caries, gingival attachment and sulcus wall,

and detection of calculus on the root surface.⁸ Pilot research of this technology has indicated that clinicians could accurately detect subgingival calculus and caries on 95% of all root surfaces.⁸ This was determined by comparing findings before (via subgingival endoscopic magnification) and after (via direct magnified vision) tooth extraction. By using an endoscope, clinicians were able to accurately locate calculus and caries over a wide spread tooth surface area.

Since calculus is conventionally detected with an explorer in a clinical setting, it was of interest to compare the use of the endoscope (visual) with an explorer (tactile) in degree of overall accuracy of detection. As a companion article to clinical effectiveness of using the periodontal endoscope, Geisinger et al examined root surface area of residual calculus with and without the aid of this technology during scaling and root planing.⁶ Fifty tooth pairs of single-rooted teeth with a hopeless prognosis were used in this study. One of each pair was randomly assigned to either the test group, where calculus was visually detected with the endoscope, or a control group, where calculus was tactilely detected using an explorer. Following standard periodontal measurements, indices and scaling and root planing, these teeth were extracted and processed for stereomicroscope viewing and photography of individual surfaces. An image processing program was then used to obtain the total root surface area of each tooth surface, as well as the root surface area still containing calculus. Results demonstrated that a statistically significant decrease in surface area of residual calculus occurred when using the endoscope during scaling and root planing vs. scaling and root planing with the explorer alone. Additionally, the endoscope facilitated calculus removal in deeper pocket areas.

While Geisinger et al used single-rooted teeth to test their hypothesis,⁶ Michaud et al used multi-rooted teeth.³ In the latter study, teeth were again randomly assigned to test or control groups (endoscope or no endoscope, respectively), and extracted after debridement.³ Calculus was assessed in terms of absence or presence after scaling and root planing. In this study, use of the endoscope resulted in significantly less calculus at interproximal sites, but not on buccal/lingual surfaces, or at sites with deep furcations or pocket depths. Authors speculated that viewing difficult areas subgingivally is one aspect of removal. The other is to have access at actual removal. Some subgingival sites are consistently difficult to access because of complex root anatomy.

Another approach to understanding the clinical

usefulness of an endoscope has been considered through investigation of subgingival inflammatory changes.^{13,17} Wilson et al used an endoscope to determine whether or not a relationship existed between subgingival deposits and tissue inflammation.¹⁷ An endoscope was used to measure plaque biofilm, calculus and subgingival pocket wall inflammation in 26 subjects with moderate to severe periodontitis. Findings of this study revealed that the presence of subgingival inflammation was significantly related to the presence of calculus and plaque together vs. calculus alone. In a companion study, Wilson et al used an endoscope during scaling and root planing of 6 teeth cited for extraction.¹³ At the 6 month post-treatment extractions, chronic inflammation was not present upon histological biopsy.¹³ While subgingival calculus was not the primary point of inquiry, these studies indicated that inflammation is more prevalent when calculus is present and that its removal in association to plaque attachment is an important step toward tissue health.^{13,17}

Literature was not available that compared endoscopic and tactile calculus detection in patients without the use of tooth extraction as an aid in evaluation. Since this does not model the typical approach to current dental hygiene patient care, it was the intention of this study to use available calculus detection methodologies. Therefore, the purpose of this study was to compare the level of subgingival calculus detection using a periodontal endoscope with that of conventional tactile explorer in periodontitis subjects. This article addresses the calculus component of the study; a companion article addresses the periodontal outcome of using a periodontal endoscope.²¹

Methods and Materials

This study was one component of a clinical trial comparing the periodontal outcomes with and without the use of a Perioscope™ to treat subjects presenting with sites of periodontitis.²¹ A randomized split mouth design was used to determine periodontal and calculus changes before and after scaling and root planing. The control group received scaling and root planing with the aid of the Perioscope™, while the experimental group received the same treatment without the aid of the Perioscope™.

Thirty adult subjects with chronic moderate periodontitis were recruited from the University of Minnesota School of Dentistry clinics for this study. Based on a 2-sided paired t-test with a 0.05 level of significance, a sample size of 30 subjects was determined to be sufficient to detect a pocket depth

effect size of 1.0 (mean difference=1.25 mm, standard deviation=1.25 mm) with greater than 90% power. For study participation, each subject was required to have a minimum of 4 individual periodontal sites of pocket depth measurement >5 mm in 2 separate quadrants. One quadrant of each subject was randomized to be evaluated using tactile calculus detection alone, and the other quadrant with tactile detection plus the Perioscope™. Tables of randomized pairings of possible quadrant combinations were used to assign quadrants. All subjects went through a consent process for participation. The study received IRB approval via the University of Minnesota Human Research Protection Program, Code Number 0902M60301.

Instrumentation used to conduct the calculus detection portion of this study involved the Perioscope™ and the 11-12 ODU Explorer (Hu Freidy, Chicago, Ill). The Perioscope™ incorporated visual magnification and fiber optic technology so that the subgingival environment could be viewed. The 11-12 ODU explorer was used as the standard tactile methodology for calculus detection and as a means of comparison to the visual perspective offered by the Perioscope™. Two dental hygiene faculty members at the University of Minnesota underwent training sessions to learn the Perioscope™ technique. A periodontist experienced in using the Perioscope™ led practice sessions in appropriate tip selections, monitor viewing vs. direct intraoral vision, viewing at high magnification, and practice with models as well as patients. A post-training calibration session of 6 periodontal subjects with subgingival calculus determined intra- and inter-examiner reliability using both the Perioscope™ and 11-12 explorer. A high percent of agreement within and between examiners was achieved for both methods of calculus detection. Percent inter-examiner agreement or repeated tactile measures ranged from 96.1 to 96.7%, and 93.2 to 92.2% for repeated Perioscope™ measures. These were not significantly different, indicating consistency between examiners using these detection methods.

Once subjects were recruited into the study, clinical measurements of pocket depth, attachment level, bleeding, gingival health and calculus were taken at study sites in both quadrants before treatment and at specific re-evaluation intervals. In the treatment group, the level of calculus was assessed using the Endoscopic Calculus Index developed by Checchi et al.²² As an attempt to maintain similarities in calculus indices, a modified version of this index was used for tactile calculus detection with the ODU 11-12 explorer in both the treatment and control groups (Figure 1). Both calculus indices were based on a 0 to 3 range in scor-

Figure 1: Tactile Calculus Index*

0 = absence of calculus
 1 = subgingival isolated flecks of calculus
 2 = moderate explorably detectable subgingival calculus
 3 = moderate to heavy ledge of subgingival calculus

*Modified from the Endoscopic Calculus Index

ing. After baseline measurements were obtained, subjects underwent full mouth scaling and root planning with ultrasonic and hand instruments. The Perioscope™ facilitated calculus removal in the treatment quadrant but was not used in the control quadrant. Subjects returned for 2 subsequent 6 to 8 week re-evaluation appointments (visits 1 and 2) where re-measurement of all periodontal and calculus parameters occurred. Examiners measured the same subjects throughout the study where possible.

Statistical Analysis

Baseline measures calculated were descriptive in nature (mean and standard deviation). For the 2 successive re-evaluation visits, the average within-site differences were calculated for each patient. T-tests were used to determine whether there were within-subject differences between Perioscope™ and tactile measures, and changes in Perioscope™ and tactile measures between visits. A p-value < 0.05 was declared to be statistically significant. P-values were not adjusted for multiple comparisons. SAS V9.1.3 (SAS Institute Inc) was used for the analysis.

Results

The 26 subjects completing the study presented with 202 Perioscope™ study sites and 162 non-Perioscope™ study sites. The median number of study sites per subject was 7 (range 4 to 27 sites) and 5 (range 2 to 20 sites) for the Perioscope™ and non-Perioscope™ quadrants, respectively. Table I indicates subjects' baseline periodontal measures in study sites for quadrants in each group. In general, subjects had a mean quadrant pocket depth between 5 and 6 mm, approximately 4 mm of clinical attachment loss, and generalized inflammation noted via the gingival index and bleeding on probing. For most of the clinical parameters, there were no significant differences between Perioscope™ and non-Perioscope™ sites, indicating that similar periodontal conditions were present when using both types of calculus detection methodologies. However, the Perioscope™ sites tended to have higher gingival index scores (p=0.005).

Table I: Subject Mean (SD) Periodontal Measures in Perioscope™ and Non-Perioscope™ Sites (n=26)

	Perioscope™ Sites x̄(SD)	Non-Perioscope™ Sites x̄(SD)	p-value*
Pocket Depth (mm)	5.29 (0.35)	5.39 (0.53)	0.3080
Clinical Attachment Loss (mm)	3.74 (1.07)	3.88 (0.93)	0.3725
Gingival Index	1.88 (0.41)	1.66 (0.40)	0.0047
Bleeding on Probing	0.88 (0.23)	0.87 (0.31)	0.8161

*t-test (paired)

For the 3 subject visits where measurements were taken, reductions in calculus were detected at each successive appointment using both the Perioscope™ and tactile methods of calculus detection. The greatest reduction occurred from baseline to visit 1, where the first re-evaluation took place after scaling and root planing (Table II). This was expected since subjects generally presented at baseline with moderate or heavy levels of calculus, based on the mean calculus index scores. Significant differences in calculus detection occurred between the Perioscope™ and explorer at all visits (p<0.005). Overall, a higher level of calculus was consistently detected using the Perioscope™.

Table III shows the mean change in Perioscope™ calculus index scores between each visit. Again, the largest change occurred between baseline and the first re-evaluation appointment (visit 1; p<0.0001). While a 0.19 change on the Perioscope™ calculus index scale is quite small, a statistically significant level of calculus reduction was observed from visit 1 to visit 2 (p=0.025).

Changes in tactile calculus index scores are demonstrated in Table IV for sites in both the Perioscope™ and non-Perioscope™ quadrants. Similar results occurred in these quadrants with the explorer for calculus detection. There were statistically significant differences in calculus detection from baseline to visit 1 (p<0.0001), but not from visit 1 to visit 2. In comparison to the Perioscope™ results (Table III), the explorer did not facilitate calculus detection between the 2 re-evaluation appointments.

Additional analyses were completed to allow comparison of the Perioscope™ and explorer cal-

Table II: Comparison of Perioscope™ and Tactile Calculus Index Scores in Perioscope™ Sites

	Perioscope™ Calculus Index x̄(SD)	Tactile Calculus Index x̄(SD)	p-value*
Baseline	2.21 (0.52)	1.81 (0.75)	0.0046
Visit 1	0.68 (0.35)	0.25 (0.23)	<0.0001
Visit 2	0.48 (0.45)	0.18 (0.22)	0.0020

*t-test

culus detection in relation to pocket depth, tooth rootedness and tooth surface (Table V). In most situations, the Perioscope™ detected significantly more calculus than the explorer (p-values range from 0.0001 to 0.0465). In comparing these calculus detection methods in shallow and deep pockets (≤ 5 mm vs. ≥ 6 mm), the Perioscope™ allowed detection of a higher level of calculus than the explorer except in deeper pockets at visit 2. Additionally, the Perioscope™ facilitated calculus detection on multi-rooted teeth more so than single-rooted teeth, and proximal surfaces vs. buccal/lingual surfaces in comparison to the explorer.

Discussion

This study compared subgingival calculus detection with 2 methodologies: the conventional explorer and Perioscope™ subgingival visual technology. The Perioscope™ was found to have benefit over the explorer, particularly at the re-evaluation appointment when study examiners using the explorer did not completely locate the residual calculus. The difficulty of tactile location of minute deposits has been previously discussed in the literature.^{1,2,19} Authors point out the practical impossibility of exploring the entire subgingival root surface area, and findings of this study support that contention.^{1,19} Visual support of locating subgingival deposits facilitates their removal more so than explorer detection alone.

In a similar study examining the effectiveness of calculus detection and removal with and without a periodontal endoscope, Geisinger et al performed scaling and root planning with subsequent extraction for visual evaluation of remaining calculus.⁶ Taking that aspect into consideration, the results of this study were similar to the Geisinger study in that a periodontal endoscope generally provided a statistically significant benefit over the explorer in calculus detection. In deeper pocket depths, both studies indicated that using an endoscope resulted in significantly less residual calculus than the explorer after periodontal therapy (i.e. the point of

Table III: Changes in Perioscope™ Calculus Index Scores Over Time For Perioscope™ Sites

	Perioscope™ Calculus Index Change x̄(SD)	p-value*
Baseline to Visit 1	-1.53 (0.64)	<0.0001
Visit 1 to Visit 2	-0.19 (0.41)	0.0248

*t-test

extraction in the Geisinger study or visit 1 in the current study). However, the Geisinger study found significant differences between the 2 detection methodologies for interproximal as well as buccal/lingual sites. Significant differences for the current study were primarily found for interproximal sites. Regarding tooth rootedness, findings reported by Michaud et al indicated that the endoscope provided no additional benefit to the scaling and root planning process and calculus removal on multi-rooted teeth specifically.³ In contrast, the Perioscope™ provided significant benefit on multirooted teeth in the current study. Overall, it appears that the periodontal endoscope offers a visual component to calculus detection to minimize these various challenges in periodontal instrumentation.

In comparison to these endoscopic clinical studies,^{3,6} residual calculus data was collected in vivo. There were no extractions of hopeless teeth to obtain information about total percentages of root surface areas containing residual calculus. While the advantage could be better viewing of the entire tooth, the benefit of the current study protocol is that it more closely follows that of periodontal treatment in clinical practice. However, it was interesting to note the number of sites where calculus was detected with the Perioscope™ but not with the explorer. This particular analysis offers insight into visual vs. tactile senses when exploring. For instance, at baseline there were 188 calculus sites as determined with the Perioscope™, but 13 (6.9%) of those were calculus free with the explorer. At visit 1, this comparison was 127 calculus sites with the Perioscope™ vs. 93 (73%) explorer free, and then at visit 2, 85 calculus sites with the Perioscope™ vs. 63 (74%) explorer free. These numbers speak to the difficulty of clinically determining residual calculus with the explorer alone. Visual and tactile methodologies together can potentially reduce residual calculus that may perpetuate periodontal disease.

In spite of the visual support, areas of residual calculus remained in study sites at the 2 re-eval-

Table IV: Changes in Tactile Calculus Index Scores Over Time For Perioscope™ and Non-Perioscope™ Sites

	Perioscope™ Sites		Non-Perioscope™ Sites	
	Tactile Calculus Index Change \bar{x} (SD)	p-value*	Tactile Calculus Index Change \bar{x} (SD)	p-value*
Baseline to Visit 1	-1.55 (0.74)	<0.0001	-1.43 (0.88)	<0.0001
Visit 1 to Visit 2	-0.07 (0.25)	0.1687	-0.07 (0.34)	0.3252

*t-test

uation visits for the Perioscope™ group. This was also the case in the other endoscopic clinical studies.^{3,6} There were continued reductions at each visit, but the calculus level still did not reach total absence for the experimental group. Geisinger discussed possible factors related to this issue.⁶ There are varying degrees of calculus coloration when using an endoscope, and tissue inflammation, plaque and bleeding can impact subgingival visibility.⁶ For instance, in the present study, calculus was detected with the explorer but not with the Perioscope™ during approximately 5% of the total number of Perioscope™ measurements taken at all visits. Bleeding was noted about half the time in these situations. Additionally, examiners felt that the level of subgingival plaque often present in this population of subjects could account for some difficulty in perception of calculus. Lastly, there is a learning curve for the operator in mastering the technique for best results.⁶ While anecdotal evidence appears favorable toward the use of periodontal endoscopy, clinical practice changes are best made on evidence.^{2,5,23} Continued clinical research and validation of the Perioscope™ with multiple patient types and clinical situations would be beneficial.

Practical aspects for clinicians to consider with endoscopic use are the time and cost of such technology. Geisinger et al considered the time involved in scaling and root planing each study tooth with and without the use of the an endoscope, finding significant differences between the 2 groups.⁶ These authors noted that this difference decreased as study clinicians became more comfortable and efficient with the endoscope.⁶ The present study did not incorporate time keeping into the clinical treatment of subjects. However, examiners would concur that initial work with the Perioscope™ was more time-consuming and, as the study progressed, became more equivalent to scaling and root planing without it. Financing this type of technology may be an initial concern for some clinicians. The original cost of the DV2 Perioscope™ system was approximately \$15,000, which included a day of training. Used systems can range between \$2,000 and \$4,000.²⁴ A new prototype is currently under development and can be viewed at the company's website.

Table V: Comparison of the Perioscope™ and Explorer Calculus Indices Based On Pocket Depth, Tooth Rootedness and Tooth Surface

	Perioscope™ Calculus Index	Tactile Calculus Index	p-value*
Pocket depth (1 to 5 mm) (n=26)			
Baseline	2.21 (0.54)	1.85 (0.74)	0.0188
Visit 1	0.63 (0.37)	0.22 (0.23)	<0.0001
Visit 2	0.47 (0.43)	0.16 (0.21)	0.0025
Pocket depth (6+ mm) (n=20)			
Baseline	2.15 (0.74)	1.70 (0.93)	0.0245
Visit 1	0.90 (0.48)	0.25 (0.37)	0.0003
Visit 2	0.51 (0.64)	0.25 (0.40)	0.0966
Rootedness – single (n=20)			
Baseline	2.03 (0.75)	1.85 (0.81)	0.2814
Visit 1	0.75 (0.38)	0.26 (0.37)	0.0001
Visit 2	0.37 (0.44)	0.09 (0.18)	0.0046
Rootedness – multiple (n=25)			
Baseline	2.27 (0.53)	1.94 (0.80)	0.0229
Visit 1	0.70 (0.49)	0.27 (0.34)	0.0005
Visit 2	0.57 (0.51)	0.24 (0.31)	0.0056
Surface – buccal/lingual (n=7)			
Baseline	1.98 (0.85)	1.26 (0.38)	0.0465
Visit 1	0.55 (0.81)	0.26 (0.38)	0.1723
Visit 2	0.33 (0.47)	0 (0)	0.1106
Surface – proximal (n=26)			
Baseline	2.22 (0.51)	1.83 (0.77)	0.0070
Visit 1	0.70 (0.35)	0.25 (0.24)	<0.0001
Visit 2	0.49 (0.45)	0.19 (0.22)	0.0026

*t-test

Limitations of the study include:

1. Subject selection: while subjects met the inclusion criteria set forth in the study, varying levels of periodontal disease would have been of clinical interest.
2. Although the 2 calculus indices were a means of comparing the calculus outcomes between the Perioscope™ and the explorer, by virtue of their criteria, the indices are measuring differing concepts (visual vs. tactile). For example,

a score of 2 on the tactile index is virtually not the same as a score of 2 on the Perioscope™ index. An attempt was made to correlate the wording so that examiners could be as consistent as possible between the 2 indices.

3. Examiner experience: training and calibration using the Perioscope™ occurred prior to the study. However, some of the manipulation takes ongoing experience for a higher degree of mastery, which could have affected results.

In this study, the Perioscope™ offered a visual advantage to facilitate calculus reduction especially at the re-evaluation visits. Removal of initial moderate to heavy deposits did not require visual assistance, although it was still of benefit. From a clinical practice viewpoint, using this technology with patients who are not responding to periodontal therapy may be a primary point of intervention. More research is needed to know if the calculus reductions translate to improved periodontal outcomes using the Perioscope™.

Conclusion

The Perioscope™ improved calculus detection over the explorer at each subject visit, indicating that a visual component is a positive adjunct to tactile evaluation of subgingival calculus. Significantly more calculus was detected using the Perioscope™ than the explorer at each visit. Additionally, the Perioscope™ facilitated calculus detection between the reevaluation appointments, where the explorer did not. Overall, the Perioscope™ outperformed the explorer in residual calculus detection.

Joy B. Osborn RDH, MA, Associate Professor, Division of Dental Hygiene, School of Dentistry, University of Minnesota. Patricia A. Lenton, RDH, MA, Director, Oral Health Clinical Research Clinic, School of Dentistry, University of Minnesota. Scott A. Lunos, MS, Research Fellow, Biostatistical Design and Analysis Center, Clinical and Translational Science Institute, University of Minnesota. Christine M. Blue BSDH, MS, Associate Professor and Director, Division of Dental Hygiene, School of Dentistry, University of Minnesota.

References

1. Sherman PR, Hutchens LH Jr, Jewson LG, Moriarty JM, Greco GW, McFall WT Jr. The effectiveness of subgingival scaling and root planning. I. Clinical detection of residual calculus. *J Periodontol.* 1990;61(1):3-8.
2. Pattison AM, Pattison GL. Periodontal instrumentation transformed. *Dimensions of Dental Hygiene.* 2003;1(2):18-22.
3. Michaud RM, Schoolfield J, Mellonig JT, Mealey BL. The efficacy of subgingival calculus removal with endoscopy-aided scaling and root planing: a study on multirrooted teeth. *J Periodontol.* 2007;78(12):2238-2245.
4. Brayer WK, Mellonig JT, Dunlap RM, Marinak KW, Carson RE. Scaling and root planing effectiveness: the effect of root surface access and operator experience. *J Periodontol.* 1989;60(1):67-72.
5. Rabbani GM, Ash MM Jr, Caffesse RG. The effectiveness of subgingival scaling and root planing in calculus removal. *J Periodontol.* 1981;52(3):119-123.
6. Geisinger ML, Mealey BL, Schoolfield J, Mellonig JT. The effectiveness of subgingival scaling and root planing: An evaluation of therapy with and without the use of the periodontal endoscope. *J Periodontol.* 2007;78(1):22-28.
7. Kwan JY. Enhanced periodontal debridement with the use of micro ultrasonic, periodontal endoscopy. *J Calif Dent Assoc.* 2005;33(3):241-248.
8. Stambaugh RV, Myers G, Ebling W, Beckman B, Stambaugh K. Endoscopic visualization of the submarginal gingiva dental sulcus and tooth root surfaces. *J Periodontol.* 2002;73(4):374-382.
9. Sherman PR, Hutchens LH Jr, Jewson LG. The effectiveness of subgingival scaling and root planing. II. Clinical responses related to residual calculus. *J Periodontol.* 1990;61(1):9-15.
10. Kepic TJ, O'Leary TJ, Kafrawy AH. Total calculus removal: an attainable objective? *J Periodontol.* 1990;61(1):16-20.

11. Cobb CM. Clinical significance of non-surgical periodontal therapy: an evidence-based perspective of scaling and root planing. *J Clin Periodontol*. 2002;29(Suppl 2): 6-16.
12. Meissner G, Kocher T. Calculus-detection technologies and their clinical application. *Periodontol 2000*. 2011;55(1):189-204.
13. Wilson TG Jr, Carnio J, Schenk R, Myers G. Absence of histologic signs of chronic inflammation following closed subgingival scaling and root planing using the dental endoscope: human biopsies – a pilot study. *J Periodontol*. 2008;79(11):2036-2041.
14. Fujikawa K, O’Leary TJ, Kafrawy AH. The effect of retained subgingival calculus on healing after flap surgery. *J Periodontol*. 1988;59(3):170-175.
15. Greenstein G. Nonsurgical periodontal therapy in 2000: a literature review. *J Am Dent Assoc*. 2000;131(11):1580-1592.
16. Tan BT, Mordan NJ, Embleton J, Pratten J, Galgut PN. Study of bacterial viability within human supragingival dental calculus. *J Periodontol*. 2004;75(1):23-29.
17. Wilson TG, Harrel SK, Nunn ME, Francis B, Webb K. The relationship between the presence of tooth-borne subgingival deposits and inflammation found with a dental endoscope. *J Periodontol*. 2008;79(11):2029-2035.
18. Stambaugh RV, Dragoo M, Smith DM, Carasali L. The limits of subgingival scaling. *Int J Periodontics Restorative Dent*. 1981;1(5):30-41.
19. Jones WA, O’Leary TJ. The effectiveness of in vivo root planing in removing bacterial endotoxin from the roots of periodontally involved teeth. *J Periodontol*. 1978;49(7):337-342.
20. Caffesse RG, Sweeney PL, Smith BA. Scaling and root planing with and without periodontal flap surgery. *J Clin Periodontol*. 1986;13(3):205-210.
21. Blue CM, Osborn J, Lenton P, Lunos S, Poppe K. A pilot study comparing the outcome of scaling/ root planing with and without Perioscope™ technology. *J Dent Hyg*. 2013;87(3):152-157.
22. Checchi L, Montevicchi M, Checchi V, Zappulla F. The relationship between bleeding on probing and subgingival deposits. An endoscopical evaluation. *Open Dent J*. 2009;3:154-160.
23. Forrest JL, Miller SA. Evidence-based decision making in action: Part 1 – finding the best clinical evidence. *J Contemp Dent Pract*. 2002;3(3):10-26.
24. Osborn, Joy (Division of Dental Hygiene, University of Minnesota, Minneapolis, MN). E-mail to: John Kwan (President/CEO, Perioscopy Incorporated, Oakland, CA). 2013 Jan 15.

Microbial Contamination of Power Toothbrushes: A Comparison of Solid-Head Versus Hollow-Head Designs

Donna W. Morris, RDH, MEd; Millicent Goldschmidt, MS, PhD; Harris Keene, DDS; Stanley G. Cron, MSPH

Introduction

Studies have reported that toothbrushes become contaminated with microorganisms during use, and the amount of these organisms increases with repeated use.¹⁻⁴ The microorganisms which survive on toothbrushes can be transmitted back to the user during subsequent brushings with the potential for causing further infections.^{1,2,5,6} In one study, 70% of toothbrushes were found to be heavily contaminated with pathogenic microorganisms after use.⁷ Most microbial contamination was reported to be within the tufts of bristles/filaments of the multi-tufted toothbrushes tested. Bacterial survival was dependent upon the type of bacteria (aerobic versus anaerobic) as well as the toothbrush design and bristle/filament type.^{8,9} Multi-tufted toothbrushes that had the anti-microbial ingredient, Triclosan, added to the heads were not shown to reduce residual contamination, but use of a dentifrice containing Triclosan did reduce it significantly.¹⁰⁻¹² Mehta et al found that retention of moisture and oral debris in the bristles, as well as the use of a cap on the brush, increased microbe survival and retention.⁷

While no studies to date have demonstrated that bacterial growth on toothbrushes can lead to systemic health effects, several microorganisms have been associated with systemic diseases.^{4,5} For instance, *Fusobacterium nucleatum* frequently serves as a "bridge bacterium," promoting plaque formation with other oral pathogens, especially between early and late colonizing bacteria in the oral cavity.¹³ It has been found in colorectal tumor samples and is being studied for its role in carcinoma, inflammatory bowel disease and early-stage adenomatous polyp lesions, precursors of

colorectal cancer.¹⁴ Studies have also looked at this organism's role in pre-term birth and stillbirth since it has been found in the amniotic fluids of pregnant women who have miscarried.^{15,16} *Candida* species can cause mild to severe infections of the mouth, throat, esophagus and even the brain. In immunocompromised individuals, this infection can even be fatal.¹⁷ *Streptococcus sanguis* and *Porphyromonas gingivalis* have been shown to induce platelet aggregation, which leads to thrombus formation and the potential for a heart attack or stroke due to an embolus.¹⁸ Quantification of oral bacteria has been demonstrated through the

Abstract

Purpose: Microbial contamination of manual toothbrushes relative to their design has been documented for decades, citing concern for cross contamination and self-infection with microorganisms. A pilot study of different power toothbrushes was conducted, to compare a solid-head brush to 2 hollow-head brushes for residual contamination with commonly occurring oral microorganisms.

Methods: Participants who met inclusion criteria were enrolled and brushed twice daily for 3 weeks with 1 of 3 randomly assigned power toothbrushes. Brush heads were vortexed and cultured using 5 appropriate media for oral microorganisms: anaerobes and facultative microorganisms, yeast and mold, oral streptococci and oral enterococci anaerobes, *Porphyromonas gingivalis*, and *Fusobacterium* species. Analysis of covariance was used to compare the brush groups for transformed microbial counts after adjusting for any demographic variables that may have confounded the results.

Results: The solid-head power toothbrush was found to have significantly less microbial contamination than either of the 2 hollow-head power toothbrushes for all the bacteria tested and less than 1 of the hollow-head brushes for yeast and mold.

Conclusion: The solid-head power toothbrush studied had significantly less residual microbial contamination than the 2 hollow-head power toothbrushes after 3 weeks of twice daily brushing with non-antimicrobial toothpaste.

Keywords: *porphyromonas gingivalis*, fusobacterium species, *candida* species, streptococci, anaerobes, toothbrush

This study supports the NDHRA priority area, **Clinical Dental Hygiene Care:** Assess the use of evidence-based treatment recommendations in dental hygiene practice.

use of rapid adenosine triphosphate (ATP) driven bioluminescence.¹⁹

No studies were found to-date reporting on residual microbial contamination of various types of power toothbrushes with different head designs. The purpose of this in-vitro study was to compare the residual microbial contamination of a power toothbrush designed with a solid head with 2 power toothbrushes designed with hollow heads.

Methods and Materials

Approval to conduct this study was obtained from the Committee for the Protection of Human Subjects at the University of Texas Health Science Center at Houston. A convenience sample of 40 subject volunteers were recruited from the dental clinics at the University of Texas School of Dentistry at Houston, were enrolled in the pilot study and agreed to participate by signing the consent form. All participants met inclusion criteria and were stratified by ATP scores and systematically assigned to brush with 1 of the 3 test power toothbrushes shown in Figure 1: 2 hollow-head toothbrushes, Sonicare® DiamondClean (H1) (Philips Electronics, Andover, MA) and Oral-B® ProfessionalCare Smart Series 5000 (H2) (Procter and Gamble, Cincinnati, Ohio) or the solid-head toothbrush, Broxo® Orabrush™ (S) (Advance Response Corp, NY). Due to limits in laboratory resources, the brushes of the first 10 subjects assigned to each group, representing an equal distribution of brush types, were ultimately cultured and included in the final analysis resulting in a sample size of 30.

Inclusion Criteria

- Had received an oral prophylaxis within the previous 12 months, but not within the last 4 months
- Had not taken a systemic antimicrobial compound for the past 6 months
- Had not used a prescription antibacterial mouth rinse in the last 6 months and agreed to abstain from using any mouth rinses during the study
- Agreed to brush twice daily with 1 designated toothpaste
- Had an ATP driven bioluminescence meter score in the range of 800 to 1000 (CariScreen® Oral BioTech, Albany, Ore)
- Was between the ages of 25 to 70 years
- Had a minimum of 6 teeth in each quadrant

Protocol

Participants agreed to brush for 2 minutes, twice a day, for a period of 3 weeks. All subjects were

Figure 1: Power Toothbrush Heads



Sonicare® DiamondClean, Oral-B® ProfessionalCare Smart Series 5000 and Broxo® Orabrush™

instructed to use the assigned toothbrush with designated toothpaste (Crest Cavity Protection®, Procter and Gamble, Cincinnati, Ohio) and to refrain from using any other dental products, such as toothpastes or mouth rinses, for the study duration. No further oral hygiene instructions were offered. Participants were also advised to contact the primary investigator in the event they were prescribed an antibiotic for a medical condition as this would eliminate their results from the study. One participant was withdrawn due the use of an antibiotic nasal spray. All participants were allowed to keep the power brush at the end of the study after submitting the 1 used toothbrush head for testing.

Toothbrush heads were placed in numbered sterile tubes by the participants at the conclusion of 3 weeks and transported to the lab for testing. Participants from each brush group were tested independently at the beginning and end of the 3 week brushing period using a sterile swab and an ATP driven bioluminescence meter (CariScreen®, Oral BioTech, Albany, Ore) for the purpose of balancing groups for oral hygiene levels. Intact toothbrush heads from each of the 3 brush groups were cultured independently after collection at set times to avoid cross contamination by a research technician blind to study design. The tubes containing the brush heads were allowed to air-dry (25°C) for 4 hours prior to processing to simulate regular home use. Ten ml of sterile peptone-saline buffer solution (1% peptone, 7.5% saline, pH 7.0) were added to each of these tubes which were thoroughly agitated for 2 minutes at high speed using a Vortex mixer (Troemner-Henery, Thorsfare, NJ). Serial 10-fold dilutions were made in PBS and specimens were plated and incubated in

Brewer jars at appropriate temperatures and atmospheres (AnaeroGen Saachets: Fische-Thermo Scientific that lower oxygen content to no less than 1% within 30 minutes and add 7 to 9% CO₂) on 5 different solid microbiological medium:

- Brain Heart Infusion agar (Difco, Becton Dickinson and Co., Sparks, MD), a general, non-selective microbial medium for anaerobes and facultative microorganisms (A/FA);
- Yeast Mold agar (Difco, Becton Dickinson and Co., Sparks, MD), a selective medium for yeast and mold (Y/M)
- Mitis-Salivarius agar (Difco, Becton Dickinson and Co., Sparks, MD), a selective medium for oral anaerobic streptococci and oral enterococci anaerobes (S/EC)
- PGING AS 6422 (Anaerobe systems, INC, Morgan Hill, Cali) a selective medium for Porphyromonas gingivalis (PGING)
- FSA AS 6427 (Anaerobe Systems, Inc, Morgan Hill, Cali), a selective medium for anaerobic Fusobacterium species. (Fuso)

Because a general count was desired, a selective media was chosen for fastidious anaerobes. Media were checked for quality control with the designated microorganisms. If deemed necessary, 0.1 ml was plated directly from the specimen tubes for PGING and aerobes. Petri plates were appropriately incubated until colonies were large enough to be easily counted. All bacterial media were incubated at 35°C and the yeast/mold media at 30°C. Plates containing 100 to 300 colony forming units (CFU) were selected for counting. Values of 0 for the microbial counts were converted to 1 prior to log₁₀ transformation. This resulted in transformed values of 0 for those with no recoverable colonies. On occasion, Gram-stained slides of organisms from colonies were observed. After use, all experimental materials were disposed of according to the University Infection Control policy.

Statistical Analysis. Prior to statistical analysis, total microbial counts (in the 10 ml specimen) were converted to log₁₀ to approximate a normal distribution for the data. Descriptive statistics in the form of means and standard deviations were calculated for the transformed data. Comparisons of the 3 brush groups for demographic characteristics were conducted with one-way analysis of variance (ANOVA) for continuous variables and Fisher's exact test for categorical variables. Analysis of covariance was used to compare the brush groups for transformed microbial counts after adjusting for any demographic variables that may confound the results.

Results

Comparisons of the 3 groups by age and baseline ATP measure using ANOVA, as shown in Table I, indicated that there were no significant differences between the groups with regard to age and baseline ATP measure ($p=0.78$ and 0.74 , respectively). Group comparisons by gender and race using Fisher's Exact Test found there was no significant difference by gender ($p=0.66$), but there was a significant difference between groups by race ($p=0.045$). Because of this, further between groups comparisons included race as an independent variable to account for its possible effect as a confounder.

Table II shows group means and standard deviations (in log₁₀) for the microorganisms studied in the 3 brush groups (10 brushes each). Mean microbial counts were lower in the S group than in the H1 or H2 groups in 9 out of 10 comparisons. Microbial levels were higher in the H2 group than in the H1 group in 4 out of 5 comparisons.

Table III shows results of a statistical comparison of the 3 brush head groups for each of the 5 microbial groups. Counts in the S group were significantly lower than in the 2 H groups in 8 out of 10 comparisons ($p<0.05$). The mean value for the Y/M microbe group was significantly lower for the H1 brush group than in the H2 and S groups. The findings are as follows:

- A/FA: Group S significantly lower than H1(13x) and H2 (115x)
- S/EC: Group S was significantly lower than H1 (48x) and H2(138x)
- Fuso: Group S was significantly lower than H1 (3162x) and H2 (550x)
- PGING: Group S was significantly lower than H2 (50x)
- YM: all 3 groups were significantly different from each other, with H1 the lowest, S in the middle, and H2 the highest

Data are reported as the total number of microorganisms found in the initial 10 ml tube containing the toothbrush head after vortexing. Statistical significance was set at $p<0.05$ for the intergroup comparisons.

Discussion

The results of the study indicate that the solid-head power brush had fewer residual microorganisms in general than the brushes with hollow heads. Perhaps the hollow heads provided more surface area for the microorganisms to form biofilms. Less microbial growth on the solid-head power tooth-

Table I: Demographic Group Comparisons For Mean Age, ATP, Sex And Race

Age/Sex/Race	SONICARE (H1)	ORAL B (H2)	BROXO (S)
Mean Age (SD)	41.64 (8.98)	38.85 (11.07)	41.62 (14.61)
Mean ATP (SD)	3,855.79 (2515.07)	3,111.77 (3121.70)	3,241.77 (2421.03)
Female (%)	12 (85.71)	10 (76.92)	12 (92.31)
Male (%)	2 (14.29)	3 (23.08)	1 (7.69)
Asian (%)	1 (7.14)	2 (15.38)	2 (15.38)
African-American (%)	6 (42.86)	3 (23.08)	3 (23.08)
Other (%)	1 (7.14)	0 (0.00)	0 (0.00)
Hispanic (%)	2 (14.29)	6 (46.15)	0 (0.00)
White (%)	4 (28.57)	2 (15.38)	8 (61.54)

Table II: Group Means and Standard Deviations (Log10) For Microbial Counts

Brush Group	Microbe*	n	Mean	Standard Deviation
Sonicare (H1)	A/F	10	8.11	0.60
	S/EC	10	7.45	0.71
	Fuso	10	5.28	2.22
	PGING	10	5.70	2.22
	Y/M	10	2.60	2.61
Oral B (H2)	A/F	10	9.06	1.06
	S/EC	10	7.91	1.36
	Fuso	10	4.52	1.83
	PGING	10	6.22	1.58
	Y/M	10	8.52	0.73
Broxo (S)	A/F	10	7.00	0.97
	S/EC	10	5.77	1.40
	Fuso	10	1.78	2.13
	PGING	10	4.52	1.12
	Y/M	10	4.11	1.03

*A/F=Anaerobes and Facultative microbes
 S/EC=Streptococci and Enterococci
 Fuso=Fusobacterium species
 PGING=Porphyromonas Gingivalis
 Y/M=Yeast/Mold

brush could offer a simple solution to the residual microbial contamination problem cited in previous studies.⁷⁻⁹ This information could be especially important for immunosuppressed patients who are extremely vulnerable to pathogenic microorganisms such as *Fusobacterium nucleatum* that have been shown to contaminate toothbrushes.¹³

Additionally, even though the results did not indicate a statistically significant difference between H1 and S with regard to *Porphyromonas gingivalis* levels ($p=0.051$, reflected in the 95% confidence interval, -0.004, 3.47, where 0 is contained within the interval), the data indicate a "borderline significance" with a trend for S to be lower than H1 for *Porphyromonas gingivalis*.

The limitations of this study include the fact that the convenience sample size was small, participant compliance may have been an issue and toothbrush head design factors could have had effects on the outcomes as stated in previous studies.^{8,9} Participants were advised and given written instructions to avoid the use of other dental products and to brush twice a day, but as with most clinical studies, compliance could only be monitored through self-reports. The toothbrush head design factors which could have contributed to the results may have included the overall number of filaments and number per tuft, the filament construction and material, the size of the head, the storage of the toothbrush and the use of a cap on the brush after brushing. Another factor may have been the total plaque actually removed by each

Table III: Statistical Comparison of Microbial Counts For the 3 Toothbrush Heads In Each of the 5 Microbial Groups

Microbe	Brush Group Comparison*	p-Value	95% CI For Mean Difference (Log10)
Anaerobes and Facultative microbes	H1 vs. S	0.014	0.27, 2.16
	H2 vs. S	0.001	0.96, 2.98
	H1 vs.H2	0.097	-1.66, 0.15
Streptococci/Enterococci	H1 vs. S	0.011	0.44, 3.07
	H2 vs. S	0.003	0.81, 3.62
	H1 vs. H2	0.454	-1.72, 0.79
Fusobacterium species	H1 vs. S	0.001	1.54, 5.23
	H2 vs. S	0.009	0.75, 4.70
	H1 vs. H2	0.447	-1.11, 2.43
Porphyromonas Gingivalis	H1 vs. S	0.051	-0.004, 3.47
	H2 vs. S	0.007	0.81, 4.53
	H1 vs. H2	0.254	-2.60, 0.72
Yeast/Mold	H1 vs. S	0.015	-3.70, -0.44
	H2 vs. S	<0.0001	2.59, 6.09
	H1 vs. H2	<0.0001	-7.97, -4.84

*H1: Sonicare
H2: Oral B
S: Broxo

type of toothbrush, but no plaque assessment was performed to affirm or negate. Additionally, had one brush removed more bacteria on a daily basis, there would have been fewer bacteria in the mouth to contaminate the brush. Future studies could control for these variables when comparing residual microbial contamination of solid-head manual with solid-head power toothbrushes and compare the reduction in levels of intra-oral microorganisms as well.

Conclusion

The solid-head power toothbrush studied had significantly less residual microbial contamination than the 2 hollow-head power toothbrushes after 3 weeks of bi-daily brushing with non-antimicrobial toothpaste.

Donna W. Morris, RDH, MEd, is a Professor in the Department of Periodontology and Dental Hygiene at the University of Texas Health Science

Center School of Dentistry at Houston, Texas. Millicent Goldschmidt, MS, PhD, is a Professor Emerita in the Department of Diagnostic and Biomedical Sciences at the University of Texas Health Science Center School of Dentistry at Houston, Texas. Harris Keene, DDS, is a retired Professor from the Department of Head and Neck Surgery at the M.D. Anderson Cancer Center at the University Of Texas Health Science Center at Houston, Texas. Stanley G. Cron, MSPH, is a Research Instructor, Center for Nursing Research, School of Nursing, the University of Texas Health Science Center at Houston.

Disclosure

This study was funded in part by a grant from Advance Response Corp., NY, NY who provided both products and funding for laboratory supplies. The authors acknowledge that there are no conflicts of interest to report associated with this study.

References

1. Mobin M, Borba Cde M, Filho CA, et al. Analysis of fungal contamination and disinfection of toothbrushes. *Acta Odontol Latinoam*. 2011;24(1):86-91.
2. Karibasappa GN, Nagesh L, Sujatha BK. Assessment of microbial contamination of toothbrush head: an in vitro study. *Indian J Dent Res*. 2011;22(1):2-5.
3. Bonten MJ, Hayden MK, Nathan C, et al. Epidemiology of colonisation of patients and environment with vancomycin-resistant enterococci. *Lancet*. 1996;348(9042):1615-1619.
4. Centers for Disease Control and Prevention. The use and handling of toothbrushes. Centers for Disease Control and Prevention. 2002.
5. Toothbrush care: cleaning, storage and replacement. American Dental Association [Internet]. 2009 [cited 2014 July 31]. Available from: <http://www.ada.org/1887.aspx>
6. Caudry SD, Klitorinos A, Chan EC. Contaminated toothbrushes and their disinfection. *J Can Dent Assoc*. 1995;61(6):511-516.
7. Mehta A, Sequeira PS, Bhat G. Bacterial contamination and decontamination of toothbrushes after use. *NY State Dent J*. 2007;73(3):20-22.
8. Bunetel L, Tricot-Doleux S, Agnani G, Bonnaure-Mallet M. In vitro evaluation of the retention of three species of pathogenic microorganisms by three different types of toothbrush. *Oral Microbiol Immunol*. 2000;15(5):313-316.
9. Wetzel WE, Schaumburg C, Ansari F, Kroeger T, Sziegoleit A. Microbial contamination of toothbrushes with different principles of filament anchoring. *J Am Dent Assoc*. 2005;136(6):758-765.
10. Efstratiou M, Papaioannou W, Nakou M, et al. Contamination of a toothbrush with antibacterial properties by oral microorganisms. *J Dent*. 2007;35(4):331-337.
11. Warren DP, Goldschmidt MC, Thompson MB, Adler-Storthz K, Keene HJ. The effects of toothpastes on the residual microbial contamination of toothbrushes. *J Am Dent Assoc*. 2001;132(9):1241-1245.
12. Goldschmidt MC, Warren DP, Keene HJ, Tate WH, Gowda C. Effects of an antimicrobial additive to toothbrushes on residual periodontal pathogens. *J Clin Dent*. 2004;15(3):66-70.
13. Lee HJ, Kim JK, Cho JY, Lee JM, Hong SH. Quantification of subgingival bacterial pathogens at different stages of periodontal diseases. *Curr Microbiol*. 2012;65(1):22-27.
14. Kostic AD, Gevers D, Pedamallu C S, et al. Genomic analysis identifies association of *Fusobacterium* with colorectal carcinoma. *Genome Res*. 2012;22:299-306.
15. Castellarin M, Warren RL, Freeman JD, et al. *Fusobacterium nucleatum* infection is prevalent in human colorectal carcinoma. *Genome Res*. 2012;22:299-306.
16. Gauthier S, Tetu A, Himaya E, et al. The origin of *Fusobacterium nucleatum* involved in intra-amniotic infection and preterm birth. *J Matern Fetal Neonatal Med*. 2011;24(11):1329-1332.
17. Han YW, Fardini Y, Chen C, et al. Term stillbirth caused by oral *Fusobacterium nucleatum*. *Obstet Gynecol*. 2010;115(2 Pt 2):442-445.
18. Akpan A, Morgan R. Oral Candidiasis. *Postgrad Med J*. 2002;78(922):455-459.
19. Dhadse P, Gattani D, Mishra R. The link between periodontal disease and cardiovascular disease: How far we have come in last two decades? *J Indian Soc Periodontol*. 2010;14(3):148-154.

The Use of Social Media in Dental Hygiene Programs: A Survey of Program Directors

Rachel K Henry RDH, MS; Jennifer A Pieren RDH, MS

Introduction

The use of social media and social networking sites has become increasingly common by the current generation of students.¹ Social media is commonly defined as “web-based services that allow individuals to construct a public or semi-public profile and articulate a list of other users with whom they share a connection and view their list of connections within the system.”² Colleges and universities are using interactive media and social networking sites to advertise to, engage and recruit students.^{3,4} Higher education institutions use multiple types of interactive media including blogs, LinkedIn, Flickr, Twitter and Facebook to interact with students. These forms of communication are used by colleges and universities because of their ease of use and instant impact on students.^{1,3}

At the same time, more employers are using social networking sites to screen potential candidates for employment, searching for unethical or questionable conduct on social media sites to further evaluate applicants beyond their professional qualifications. Career Builder reports that in 2009, 45% of employers are screening potential candidates using social networking sites.⁵ Based on the limited research available, the same trend is happening in education as colleges and universities are using the Internet and social networking sites as a screening tool. More prospective candidates and students are being evaluated on their digital footprint in addition to traditional criteria. Since many professional programs consider experience, character and professionalism

Abstract

Purpose: The use of social media and social networking sites has become increasingly common by the current generation of students. Colleges and universities are using social media and social networking sites to advertise, engage and recruit prospective students. The purpose of this study was to evaluate how social media is being used in dental hygiene program admissions and policy.

Methods: Researchers developed a survey instrument investigating the use of social media. The survey included questions about demographic information, personal use of social media, program use of social media, social media use in admissions and social media policies. An email was sent to 321 dental hygiene program directors asking them to complete the survey. All participants were provided 4 weeks to complete the survey, and 2 reminder emails were sent.

Results: A total of 155 responses were received (48.3% response rate). While 84% of respondents indicated their program had a web page, only 20% had an official Facebook page for the program and 2% had a Twitter page. Thirty-five percent had a program policy specifically addressing the use of social media and 31% indicated that their university or institution had a policy. Only 4% of programs evaluate a potential student’s Internet presence, mostly by searching on Facebook. Statistically significant differences ($p \leq 0.05$) were noted between those respondents with more personal social media accounts and those with fewer accounts, as those with more accounts were more likely to evaluate a potential student’s Internet presence. Open ended responses included concern about social media issues, but some uncertainty on how to handle social media in the program. The concern for social media and professionalism was evident and more research and discussion in this area is warranted.

Conclusion: Social media is currently being used in a variety of ways in dental hygiene programs, but not in the area of admissions. There is some uncertainty about the role social media should play in a professional environment.

Keywords: social media, technology, policy, professionalism, admissions

This study supports the NDHRA priority area, **Professional Education and Development:** Evaluate the extent to which current dental hygiene curricula prepare dental hygienists to meet the increasingly complex oral health needs of the public.

as part of the admissions process, professional schools are seeing an even greater incidence of this type of review. Some schools are even rejecting otherwise qualified applicants based on social media content.^{3,6-9}

A longitudinal study reports that in 2007 and 2008, universities were using social media and the Internet to research potential students.³ A 2011 survey of general college admissions officers identifies an increase in the amount of social media used in the admissions process, as general college admissions officers report using social media 24% of the time when evaluating potential applicants.⁶ Professional schools report even more use, with business schools researching applicants online 27% of the time and law schools using Google to search applicants 41% of the time and looking at 37% of applicants' Facebook profiles.⁷⁻⁹ These surveys report that these numbers have increased during the period they have been tracking this data.¹⁰

As college admissions and professional programs are increasingly using the Internet and social networking sites in the admissions process, little research has been completed regarding the impact of social media in dental professional schools.¹¹ Although a 2012 article in the *Journal of Dental Education* called for robust research and action in the area of social media "based on the lack of professional discourse in the dental education literature regarding the use of social media...," a literature search of Pubmed revealed only 1 article discussing using social media in dental hygiene program recruitment.⁴

Dental educators are charged with making students competent in professionalism and ethics per the Commission on Dental Accreditation standards, and as ethical dilemmas arise through the increasing use of social media, it is important to understand how social media is used in dental hygiene admissions.¹² The purpose of this study was to determine how social media is used in dental hygiene program admissions and policy.

Methods and Materials

A descriptive survey research design was employed, and the 27 question survey contained multiple choice and open-ended questions related to the use of social media in the admissions process and social media policies within the program. Validity and readability were established through a peer review by a panel of 6 faculty. The panel received access to the online survey and reported any problems, confusion or clarification of the questions to the researchers. The survey was modified related

to those recommendations. The research protocol was submitted to the Institutional Review Board at The Ohio State University and approved with exempt status.

The sample population included dental hygiene directors of all accredited entry level dental hygiene programs in the U.S. listed on the American Dental Hygienists' Association website. A total of 321 email addresses were used. Researchers sent an initial email to program directors with a cover letter and a link to the electronic survey. Qualtrics software (Provo, Utah) was used to administer the survey. Reminder emails were sent to all program directors 1 week after the initial email and again 2 weeks after the initial email. Respondents had 4 weeks to respond to the survey. All answers were submitted confidentially and identifying data were removed prior to analysis. An exploratory analysis including measures of central tendencies, descriptive frequencies, t-tests, Chi-squared tests and correlations examining different group variables were completed using SPSS 20 (Chicago, Ill). Qualitative data was summarized and reported.

Results

A total of 155 surveys were completed, with a response rate of 48.3%. Since not all respondents answered every question, the number of responses to each question varies. Demographic information about survey respondents were collected (Table I). Demographic information about the programs the survey respondents represent were also collected (Table II).

Admissions

Most survey respondents (n=101, 70.6%) reported being very involved in the program's admission process. Most commonly, respondents reported that the GPA of pre-requisite courses was used as criteria for evaluating applicants to the program (n=102, 67.1%). Ninety-eight programs (64.5%) also use overall GPA and science GPA in admission criteria. Other criteria were also reported, including standardized test scores, interviews, personal statements, references and other criteria (Table III). Only a small number of programs (n=6, 4.2%) evaluate a potential student's Internet presence. Of the 6 respondents that indicated this, all of them use social networking sites to evaluate Internet presence. In addition to social networking sites, 3 use Google or other search engines. Of these respondents, 4 indicated that the information found on social networking sites has some influence on admissions decisions. Statistically significant differences ($p \leq 0.05$) were noted between

Table I: Demographics of Survey Respondents

	n (%)
Age	
25 to 34	1 (0.7%)
35 to 44	16 (10.5%)
45 to 54	61 (40.1%)
55 to 64	66 (43.4%)
65 or over	8 (5.3%)
Gender	
Male	12 (8.0%)
Female	138 (92.0%)
Years as Program Director	
0 to 5 years	60 (39.5%)
5 to 10 years	42 (27.6%)
Greater than 10 years	50 (32.9%)
Personal social media accounts	
Facebook	110 (72.4%)
MySpace	4 (2.6%)
LinkedIn	66 (43.4%)
Twitter	17 (11.2%)
Google+	16 (10.5%)
Professional Blog	3 (2.0%)
Personal Blog	4 (2.6%)
Other	1 (0.7%)
None	30 (19.7%)

those respondents with more personal social media accounts and those with fewer accounts, as those with more accounts were more likely to evaluate a potential student's Internet presence. Of those respondents that do not evaluate Internet presence in applicants, most are not considering adding this to admissions criteria (n=79, 57.2%). Others are considering it (n=54, 39.1%) and a small number (n=5, 3.6%) plan to implement this in the future.

Policy

Most respondents indicated that their program has a code of conduct or professionalism policy for students (n=146, 96.7%), while only 55 (36.2%) have a policy that specifically addresses the use of social media (Table IV). Of those respondents that indicated they do not have a policy specifically addressing the use of social media, over half (n=53, 55.8%) indicated that they are considering implementing a policy that will address social media use.

An open-ended question asking about the social media policy revealed various answers. Fifteen respondents had a clear policy in place, 11 were drafting a policy at the time of the survey, 2 indicated they had nothing official and 1 identified that the code of conduct covers this area.

Respondents were also asked about university or institutional policies related to social media. Forty-

Table II: Demographics of Dental Hygiene Programs

	n (%)
Degree awarded	
Certificate/Diploma	6 (3.9%)
Associate Degree	120 (79.0%)
Bachelor Degree	35 (23.0%)
Master Degree	16 (10.5%)
Type of institution	
Community College	92 (60.9%)
4-year college or university	40 (26.5%)
Technical college	9 (6.0%)
Other	10 (6.6%)
College or University has a DDS or DMD program	
Yes	19 (12.6%)
No	131 (87.3%)
Type of Admissions	
Competitive	128 (84.8%)
Non-competitive	22 (14.6%)
Other	1 (0.66%)
Program social media	
Web page	128 (84.2%)
Official Facebook Page	30 (19.7%)
Unofficial Facebook Page	32 (21.0%)
Official Twitter Page	4 (2.6%)
Unofficial Twitter Page	0 (0%)
Other official social media page	14 (9.2%)
Other Unofficial social media page	1 (0.66%)
No social media page	31 (20.4%)

eight (32.4%) responded that their university or institution has a social media policy, with 54.2% (n=26) of these respondents indicating that they also had a social media policy specific to the dental hygiene program in addition to the general university or institution social media policy. Of these affirmative responses, 52.1% (n=25) were community colleges, 25.0% (n=12) were four-year colleges or universities, and 22.9% (n=11) described themselves as other. The remainder indicated that they do not have one or do not know of one (Table IV). An open-ended question asking about the social media policy of the university or institution revealed somewhat similar results to the previous open-ended question about the policy. Nine had a clear policy in place, 1 was drafting a policy, 1 indicated the professionalism code for students covered this area and 1 was not sure of the contents of the policy.

Violations of a social media policy or violations of other policies through social media were also reported. Most often violations were committed by students and were in the area of unprofessional comments to or about the school, faculty, staff or other students (Table V). The violation classified as "other" indicated academic dishonesty to describe

Table III: Reported Admission Criteria

	n (%)
Overall GPA	98 (64.5%)
Science GPA	98 (64.5%)
GPA of pre-requisite courses	102 (67.1%)
Standardized test scores	76 (50.0%)
Interviews	45(29.6%)
Personal Statement/Essay	40 (26.3%)
References	30 (19.7%)
Other	30 (19.7%)

the violation. Of the 6 reported faculty violations, 83.3% (n=5) occurred at community colleges, and the other one occurred at an institution which described itself as other. Of the respondents reporting student violations, 12 (54.6%) were community colleges, 5 (22.7%) were four-year colleges or universities, and 5 (22.7%) described themselves as other types of institutions.

Finally, an open-ended question let respondents provide any other comments about the topic of social media in dental hygiene programs and admissions. These comments were varied and particular themes were difficult to find. Most commonly, respondents wrote about negative feelings or bad experiences related to social media. Four respondents indicated that they address the issue once students are admitted to the program, while 2 indicated that they talk about social media presence during the interview process. Two respondents felt that the code of conduct in their program addresses the issue of social media professionalism. Three respondents commented that their institution has restrictions related to the use of social media and therefore they cannot make decisions related to this area. Three respondents indicated that they are struggling with this issue and are in the process of addressing it in various ways. Three more indicated they had no interest in social media and its use in admissions and within a dental hygiene program.

Discussion

Admission

Only 4.2% (n=6) of dental hygiene programs reported using a potential student's Internet presence as criteria for admission. When researching a student's internet presence, all 6 used a social networking site, and 3 additionally used Google or

Table IV: Reported Policy Information

	n (%)
Professionalism policy or code of conduct (n=151)	
Yes	146 (96.7%)
No	5 (3.3%)
Program policy addressing social media (n=152)	
Yes	55 (36.2%)
No	96 (63.2%)
I don't know	1 (0.7%)
University or institutional social media policy (n=148)	
Yes	48 (32.4%)
No	46 (31.1%)
I don't know	54 (36.5%)

another search engine. Dental hygiene does not utilize social networking sites in the admissions process as much as undergraduate admissions, where 24% of colleges report using it.⁶ This is also less than in other professional fields such as business, law and graduate programs.⁷⁻¹⁰ This difference could be a unique characteristic of health profession admissions, as a literature review yielded no results for the use of social media in admissions in any health-related field. With the increased use of social media in the admissions process in other fields,¹⁰ it is interesting to note that most dental hygiene program directors (57.2%) are not considering adding an Internet presence critique to their evaluation for admission. It should be noted that some (39.1%) are considering it, and an even smaller group (3.6%) plan to implement it in the future. It is not likely that unfamiliarity with social networking sites is the reason for the low use of social media sites, as 72.4% of respondents reported having a personal Facebook account. In contrast, only 19.7% of programs reported having an official Facebook page for their program. This data seems to imply that dental hygiene programs are struggling with moving social networking into a professional environment.

The role of social networking in the admissions process is also subject to legal and ethical considerations. There is an increasing body of case law and literature related to employment applicant evaluation through social networking sites, but little related to the use of social media in admission of students.¹³ This uncertainty about how to properly use social media in the admissions process creates a barrier to implementing this type of evaluation in a dental hygiene program. Further research and discussion should explore the legal and ethical issues of using social media in admissions and best practices on implementing it as part of admission criteria.

Table V: Number of Violations of Social Media Policy or Other Policies Through Social Media

Description of Violation	Faculty	Student
HIPAA/Patient Privacy Violations	0	4
Personal conduct issues (i.e. vulgar language, inappropriate photographs)	1	12
Unprofessional comments to or about the school, faculty, staff, or other students	5	13
Illegal activity (i.e. underage drinking, drug abuse)	0	2
Discriminatory remarks (i.e. racism, sexism)	0	1
Other	0	1

Policies

Fifty-five respondents (36.2%) indicated they have a policy that specifically addresses the use of social media. This is a much higher amount than a 2010 study conducted by Kind et al that found only 10.2% of medical schools had a policy that specifically addressed social media.¹⁴ The time difference in data collection may be the reason for such a large difference, as these studies were conducted 2 years apart. Another difference may be attributed to the way data was collected. In our study, the presence of a policy addressing social media was reported by the program directors; conversely in Kind's study the presence of a policy related to social media was determined by searching the medical school's webpage.¹⁴ The data in Kind's study may have left out schools that had these policies but did not publish them on their webpage.

Even though only 36.2% of programs reported having a social media policy, 39 incidents of violating any policy through the use of social media was reported. Not surprisingly, a majority of the violations were by students, but there were also 6 reports of faculty violating policies through the use of social media. Most of the violations related to unprofessional comments about the school, faculty, staff or other students, and the second most common violation involved personal conduct issues. Patient privacy violations were reported 4 times. This data related to violations makes it clear that there is a need to have a discussion about the proper use of social media in a professional environment in dental hygiene programs. Over half of those who currently did not have a policy are considering implementing one. This is promising to see, as allied health education has experienced litigation that has sided both for students and for institutions. But one thing is clear - a well written policy and following due process are essential.¹⁵⁻¹⁷ Creating a social media policy that meets professional and legal standards can be a challenging

process and case law and the literature have not examined this topic to its full extent. A study by Williams et al concluded that the implementation of a social media policy had a significant positive effect on pharmacy student Facebook pages.¹⁸ Future research should include looking at the effect a social media policy has on dental hygiene and dental student's use of social media.

While implementing proper policies is important, it is not the sole solution or strategy to address the issue of social media professionalism. Incorporating social media and digital professionalism into existing ethics and professionalism curriculum is an important step in raising the awareness of using this medium as a dental hygienist. A 2006 study by Kacerik et al showed that a mean of 20 hours of didactic instruction covers ethics in dental hygiene programs.¹⁹ It is essential to begin to incorporate social media professionalism into the ethics and professionalism discussions and content that already exist in dental hygiene education. Future research should look at setting standard content and evaluating outcomes of incorporating social media professionalism into the curriculum.

With a 48.3% response rate, a limitation of this study is that it is unclear as to how the non-respondents are utilizing social media within their dental hygiene programs. Along with the response rate, this study is also limited in that it only addressed dental hygiene programs. It did not address dental, dental assisting or dental laboratory programs. Further investigation into these areas is necessary to provide a consistent message of social media professionalism across the entire dental team. Another limitation is that only a small number of respondents use social media in the admissions process, so comparative analyses were not fruitful. The final limitation surrounds the self-reported nature of this study. Program directors were asked to report the status of their policy and admissions procedures and violations of these policies. With all

self-reported data the validity and accuracy must always be questioned. Self-reports are potentially unreliable because participants may not always report their actual occurrences or may be estimating to the best of their knowledge. Future research should focus on policy guidance, curriculum integration and the effectiveness of both policy and curriculum initiatives. Other investigation should be done on how dental hygiene students utilize social media related to their education.

Conclusion

The results of this study indicate that some dental hygiene programs are utilizing social media through Facebook and Twitter pages. There are

very few dental hygiene programs that evaluate applicants by evaluating social media sites. Thirty-six percent of dental hygiene programs have a policy specifically addressing social media and programs report that faculty and students have violated other policies through the use of social media. There is some uncertainty about the role social media should play in a professional environment. Further research and discussion should enhance the role social media should play in professional education.

Rachel K. Henry RDH, MS, Assistant professor, Division of Dental Hygiene, College of Dentistry, The Ohio State University. Jennifer A. Pieren, RDH, MS, faculty member, Dr. Madeleine Haggerty Dental Hygiene Program at Youngstown State University.

References

1. Dubose C. The social media revolution. *Radiol Technol.* 2011;83(2):112-119.
2. Boyd DM, Ellison NB. Social network sites: definition, history, and scholarship. *Journal of Computer-Mediated Communication.* 2007; 13:210-230.
3. Barnes NG, Mattson E. Social media and college admissions: the first longitudinal study. Center for Marketing Research University of Massachusetts Dartmouth [Internet]. 2009 [cited 2013 Feb 13]. Available from: <http://www.neacac.org/docs/uploads/files/amc2010/2010%20AMC%20Web%20Social%20Media%20and%20College%20Admissions%20The%20First%20Longitudinal%20Study.pdf>
4. Ennis RS. Use of social networking for dental hygiene program recruitment. *J Dent Hyg.* 2011;85(3):177-180.
5. Press Release: Forty-five percent of employers use social networking sites to research job candidates, CareerBuilder survey finds. Careerbuilder.com [Internet]. 2009 August 19 [cited 2013 February 13]. Available from: <http://www.careerbuilder.com/share/aboutus/press-releasesdetail.aspx?id=pr519&sd=8/19/2009&ed=12/31/2009>
6. Highlights from the Kaplan test prep's 2011 college admissions officers survey. Kaplan Test Prep [Internet]. 2011 September [cited 2013 February 13]. Available from: <http://press.kaptest.com/wp-content/uploads/2011/09/Kaplan-Test-Preps-2011-Survey-of-College-Admissions-Officers.pdf>
7. Highlights from Kaplan test prep's 2011 survey of business school admissions officers. Kaplan Test Prep [Internet]. 2011 October [cited 2013 February 13]. Available from: <http://press.kaptest.com/wp-content/uploads/2011/10/Kaplan-Test-Prep-2011-Survey-of-Business-School-Admissions-Officers1.pdf>
8. Highlights from the Kaplan's 2011 graduate school admissions officers survey. Kaplan Test Prep [Internet]. 2011 August [cited 2013 February 13]. Available from: <http://press.kaptest.com/wp-content/uploads/2011/08/KTP-Grad-School-Survey-20112.pdf>
9. Highlights from Kaplan test prep's 2011 survey of law school admissions officers. Kaplan Test Prep [Internet]. 2011 November [cited 2013 February 13]. Available from: <http://press.kaptest.com/wp-content/uploads/2011/11/Kaplan-Test-Preps-2011-Survey-of-Law-School-Admissions-Officers.pdf>

10. Press Release. Facebook checking is no longer uncharted territory in college admissions: percentage of admissions officers who visited an applicant's profile on the rise. Kaplan Test Prep [Internet]. 2011 September 21 [cited 2013 February 13]. Available from: <http://press.kaptest.com/press-releases/facebook-checking-is-no-longer-unchartered-territory-in-college-admissions-percentage-of-admissions-officers-who-visited-an-applicant%E2%80%99s-profile-on-the-rise>
11. Oakley M, Spallek H. Social media in dental education: a call for research and action. *J Dent Educ*. 2012;76(3):279-287.
12. Accreditation standards for dental hygiene education programs. American Dental Association [Internet]. [cited 2013 February 13]. Available from: <http://www.ada.org/sections/education-AndCareers/pdfs/dh.pdf>
13. Social Media: Considerations and Implications in College Admission. Research to Practice Brief. National Association for College Admission Counseling [Internet]. 2009 [cited 2013 February 3]. Available from: http://www.nacacnet.org/research/PublicationsResources/Marketplace/Documents/RPTBrief_SocialMedia.pdf
14. Kind T, Genrich G, Sodhi A, Chretien KC. Social media policies at US medical schools. *Medical Education Online* [Internet]. 2010 [cited 2013 Feb 3]. Available from: http://med-ed-online.net/index.php/meo/article/view/5324/pdf_31.
15. 816 N.W.2d 509; 2012 Minn. LEXIS 246. LexisNexis Academic. Web. Date Accessed: 2013 Feb 3.
16. 2009 U.S. Dist. LEXIS 67241. LexisNexis Academic. Web. Date Accessed: 2013 Feb 3.
17. 2011 U.S. Dist. LEXIS 5105. LexisNexis Academic. Web. Date Accessed: 2013 Feb 3.
18. Williams J, Feild C, James K. The effects of a social media policy on pharmacy students' facebook security settings. *Am J Pharm Educ*. 2011;75(9):177.
19. Kacerik MG, Prajer RG, Conrad C. Ethics instruction in the dental hygiene curriculum. *J Dent Hyg*. 2006;80(1):e9.

Smiles Over Time: An Older Adult Oral Health Survey in Illinois

Sherri M. Lukes, RDH, MS, FAADH; Julie A. Janssen, RDH, MA; Kathleen K. Thacker, RDH, MPH; Sangeeta Wadhawan, DDS, MPH

Introduction

According to the U.S. Census Bureau, the older adult population is increasing dramatically, with researchers expecting the population of U.S. residents ≥ 65 years old to increase from 40 million in 2010 to 89 million by 2050, with the population ≥ 85 years old expected to triple from 5.8 million to 19 million during the same time period.¹ Projections indicate 1 in 5 U.S. residents will be 65 or older by 2050, compared with 13% today.¹ Demographic data in Illinois mirrors national data, with 13% of the 12.9 million Illinois residents aged 65 and older in 2010.^{2,3} Surveillance is an integral part of the planning and implementation process for public health intervention;⁴ therefore, data is needed as an assessment for this rapidly increasing population in all areas of health, not the least of which is oral health.

Identifying the needs of the older adult population, and obtaining a viable database depicting these needs, can help evaluate the current level of and need for oral health services in this population and guide public health policy. The oral health report issued in 2000 by the Surgeon General contained a call for continued research among older Americans and the various oral health issues affecting them.⁵ At the National Coalition Consensus Conference on Oral Health of Vulnerable Older Adults and Persons with Disabilities,⁶ the American Dental Association recommended to promote continued research on oral health issues of older adults, as well as the widespread use of surveillance tools like the Association of State Territorial Dental Directors (ASTDD) Basic Screening Survey (BSS) for Older Adults.⁷

Abstract

Purpose: The purpose of the project was to identify the oral health status and needs of the older adult population ≥ 60 years old in Illinois for policy decisions and to help identify possible need for oral health interventions. No baseline data has previously been collected on this population in Illinois.

Methods: A public/private collaboration was formed, which included the Illinois Department of Public Health, the IFLOSS Coalition and dental and dental hygiene schools in Illinois. The screening tool was developed based on methods outlined by Association of State and Territorial Dental Directors for Basic Screening Surveys. Questionnaires and in-mouth screenings were conducted at selected sites statewide. Data was collected by dental and dental hygiene students and faculty at onsite clinics and community outreach sites.

Results: A total of 437 seniors were screened statewide. Of this population, 81% had no dental insurance, 13% were edentulous and 58% claimed to have had a dental visit in the last year. A total of 26% rated their oral health as fair or poor, while 29% had untreated caries. Suspicious oral lesions were present in 14% ($n=308$ for the oral lesions indicator), 19% needed immediate dental care and 41% required referral.

Conclusion: This study revealed that surveillance can be accomplished by the collaboration among entities with focus on a specific population. Additional surveillance efforts are warranted among older adults in Illinois in an effort to plan and to implement appropriate interventions for addressing the oral health needs of this population.

Keywords: older adults, oral health, Basic Screening Survey

This study supports the NDHRA priority area, **Health Promotion/Disease Prevention:** Validate and test assessment instruments/strategies/mechanisms that increase health promotion and disease prevention among diverse populations.

Developing policies and procedures to ensure states engage in appropriate programming for older adults depends upon assessment data to serve as a baseline. Since 2002, Illinois has been developing their Oral Health Surveillance System (IOHSS),⁸ modeled after the National Oral Health Surveillance System.⁹ Data was gathered on workforce, decay, sealants, oral cancer and other indicators for the state. However, no oral health surveillance data

were gathered for the older adult population. In 2007, Illinois updated an earlier version of its oral health plan to be used as a “roadmap” for future programming in the state.¹⁰ Several of the policy goals, recommendations and strategies specifying the older adult population as an underserved group needing specific oral health interventions were referenced in both the Illinois 2007 Oral Health Plan⁸ and the updated 2012 recently published. Baseline oral health data collection is a necessity for older adults throughout Illinois in order to plan and develop these interventions.

In response to the need to determine a baseline for the senior population, the Illinois Department of Public Health (IDPH), Division of Oral Health (DOH), partnered with IFLOSS (Statewide Oral Health Coalition) and the Illinois dental and dental hygiene schools to compile oral health data on its older adult population. This collaboration developed Smiles Over Time (SOT) 2009-2010, an oral health basic screening survey targeting the 60 years and older population in Illinois. Due to the absence of statewide dental programs addressing this population, this survey was the first step in identifying the oral health status and needs of older adults in Illinois. These data will provide a snapshot of the challenges and opportunities existing in this population and the ability to track oral health trends for those 60 years of age and older. The assessment report can be used to educate decision makers about oral health needs for senior constituencies, develop policies, plan interventions, leverage resources and implement effective actions.

Methods and Materials

A letter from the IDPH, DOH was sent to the deans, program directors and the community health faculty of the 2 dental and 13 dental hygiene schools in Illinois, inviting them to participate in the surveillance project as a service learning experience in dental public health. The DOH regional oral health consultants followed up with phone calls to schools to answer questions and to verify participation. Many of the dental and dental hygiene schools have established ongoing outreach programs and visit local centers to provide screenings for older adults. The DOH embraced this opportunity to standardize the outreach efforts by the educational institutions. All participation of the schools was voluntary. Institutional Review Board approval to conduct the screenings and compile the data was secured at the state and the educational institution levels.

The SOT survey instrument was based on the methods outlined in the ASTDD 1999 publication

Basic Screening Surveys: An Approach to Monitoring Community Oral Health.⁷ A team consisting of an epidemiologist, IDPH staff and 1 dental faculty developed the screening form for data collection. This form included a questionnaire and an in-mouth screening. The screening form and protocol were sent to all participating schools. Training for all faculty members was accomplished through telephone conferences, and then faculty trained their respective dental and dental hygiene students in basic screening survey protocol.

Each school was allowed to target and select their own older adult service site(s) for survey implementation, as well as including it in their existing curriculum at on-campus clinics to make it easier to add this surveillance-related learning experience to current procedures. The DOH assisted in planning, and the schools contacted the sites to seek permission to perform the surveys. Once the site agreed to participate, the schools integrated the survey into their event planning to assure appropriate notification and permission could be completed by the facilities prior to the screening date. Consent was obtained from all participants prior to screening. Over the course of 5 months, 16 facilities were used as the screening sites for the students and faculties of the respective educational institutions.

Dental and dental hygiene students provided the screenings for the older adults and then the various schools shared the collected data with the DOH. Data was collected on oral hygiene, caries experience, untreated decay, edentulism, soft tissue lesions and the need for urgent care/referral. This project is focused on the data collected on older adults throughout the state excluding participants from the city of Chicago.

The screeners asked the older adults a series of questions and then performed an oral screening. Basic screening survey protocol stipulates a light source and mouth mirror as the only instruments to be used for conducting screenings.⁷ Criteria for documenting oral hygiene are outlined in Table I.

Untreated Decay

Untreated decay is detected when a screener can readily observe 2 things:

- A loss of at least 0.5 mm of tooth structure at the enamel surface (for reference, the ball at the tip of a World Health Organization (WHO) periodontal probe is 0.5 mm in diameter)
- Brown to dark-brown coloration of the walls of the lesion

Teeth that meet both of these criteria are considered untreated decay, even if a restoration is also present. If a root is retained, it is assumed that the whole tooth was destroyed by caries.

Treatment Urgency

After assessing each participant according to decay status, 1 of 3 treatment urgency codes was assigned for follow-up care. This was an estimate of how quickly the participant should visit the dentist for clinical diagnosis and any necessary treatment (Table II).

Those participants with no obvious dental problems observed were given a code "0," which means that they should receive routine dental examinations as recommended by their dentist. The screener could override a code "0" and assign a code "1" if it was believed the participant needed to see a dentist sooner than their next periodic examination.

The screening form was formatted for scanning to facilitate faster input and increase accuracy of recorded information. The name appeared on the survey form to ease tracking documents through the survey process. SOT data was collected by the schools on the standard survey forms provided by the DOH in the spring/summer of 2010. Identifiers were removed from the data. Completed forms were mailed to the DOH. The DOH's data manager scanned the forms into the Teleform software. The MS Access data file was imported to Statistical Package for the Social Sciences (SPSS) for editing and analysis by the epidemiologist. Upon completion, the forms were placed in locked files, stored for 2 years, and then ultimately shredded.

Results

One dental school and 11 dental hygiene schools participated to conduct the oral screenings. A total of 437 older adults were screened at 16 different sites. The sites varied, but 68.6% were screened in a dental hygiene clinic at the various schools. The remainder of the screening sites were a combination of retirement/congregate meal sites, assisted living centers, adult day centers and long term care facilities. The counties in which clients were screened are shown in Figure 1. The average age of participants screened was 75 years, and 67% of the sample was female. Most of the older adults were white. The racial breakdown was 85% white, 6% African-American, 2% Asian and 5% unknown. Screening sites, age distribution, gender and racial breakdown are included in Table III.

All participants were asked a set of questions be-

Table I: Criteria For Assessing Oral Hygiene Status

Category	Code
Excellent	Little or no plaque, tissue is healthy in appearance with no inflammation present.
Good	Small amounts of plaque and slight inflammation of tissue.
Fair	Heavy amounts of plaque with severe inflammation of the tissue, calculus is present.
Poor	Material alba with no signs or indications that teeth are being cleaned. Gross amounts of inflammation are present with bleeding.
Not Applicable	No teeth are present

Table II: Category and Code to Determine Treatment Urgency

Category	Code
Code 0=No obvious problem	No problems observed.
Code 1=Early dental care is needed	Cavitated lesion without accompanying signs or symptoms. Suspicious white or red soft tissue areas.
Code 2=Immediate dental care is needed	Signs or symptoms that include pain, infection, or swelling.

fore the intraoral screening took place. The questions served to document the hygiene habits, frequency of dental care sought by older adults and their access to dental care. Due to the level of dementia affecting older adults, the survey contained a question about the cognizance level of the client as perceived by the survey administrators. A total of 90% were believed to be sufficiently cognizant to provide accurate answers (n=393). The remaining 10% were included in data collection for survey items screeners could assess in spite of limited participant cognitive ability. A total of 53% (211 seniors, n=401), reported having a dentist they visit every year, while 80.8%, (333 seniors, n=412) reported having no dental insurance (Table III). The types of dental insurance carriers reported by the seniors were highly variable and included Medicaid and Medicare.

Older adults were asked when they last saw a dentist either at a private office or at the facility

where the screening took place. Of those, 58% (243, n=422) reported a dental visit within the last year. The most common reason for the visit was for a check-up, exam or scaling. Approximately 33% (140, n=423) of the clients screened claimed to have some type of denture, and 85% (n=90) claimed they actually wear the denture. Only 40% stated they had received an oral cancer screening in the last 12 months.

Figure 2 shows the older adults' perception of their oral health status (n=400), with 74% (n=295) rating it as good or better, and 26% (n=105) rating it fair or poor. The most commonly reported site of oral pain (15%) was the gums, with teeth the second most common. A total of 47 of 405 seniors (11.6%) reported bleeding gums in the last week, and 20% reported problems eating or chewing. The majority of clients, 68.6% (n=275), did not notice changes in salivary flow, while 24% (n=96) found it to be too little and 7.5% (n=30) felt an increase. Most of the seniors claimed they were able to brush their own teeth; however, brushing frequency revealed 6% (n=24) brushed less than daily, 37% (n=148) brushed 1 time per day, 47% (n=192) 2 times per day and 9% (34) 3 or more times per day (n=398).

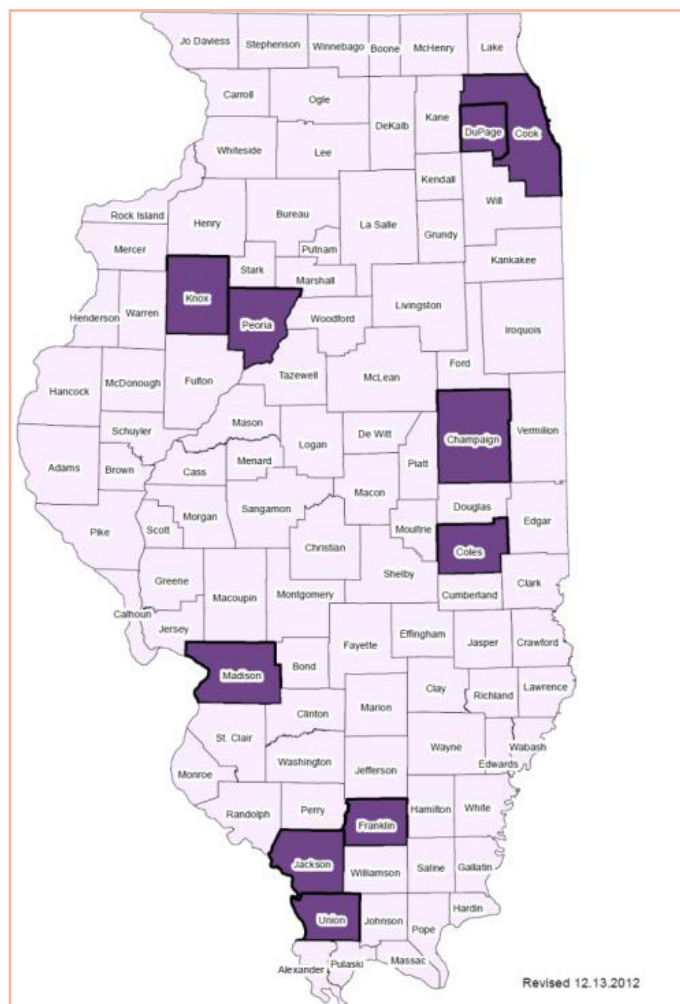
Intraoral health indicators assessed by the screeners were oral hygiene status, untreated decay, soft tissue lesions, edentulism, and the percentage of seniors in need of early and immediate dental treatment. Results are illustrated in Table IV. Screeners rated oral hygiene status (n=414) as excellent for 13.3% (n=55) of participants, good for 38.9% (n=161), fair for 27.5% (n=114) and poor for 18.4% (n=76).

A total of 29% (n=114) had untreated decay (n=394). Suspicious oral lesions were noted for 14.3% (n=44) of the seniors (n=308), and 13% (n=56) of the participants were edentulous (n=430). Nearly 12% had full dentures, 18.8% had a full maxillary denture and 12.4% had a full mandibular denture. Maxillary and mandibular partial dentures were documented for 10.3% and 11%, respectively. For treatment urgency (n=398), 20.6% (n=82) needed early dental care, and 19.3% (n=77) needed immediate dental care. Nearly 41% (n=154) required referral (n=379).

Discussion

The survey instrument developed in Illinois was similar to what has since been developed by ASTDD for states to use for oral health surveillance in older adult populations.⁷ Results of the assessment provide a good first step in working toward regular

Figure 1: Counties Where Screenings Took Place



basic screening survey efforts among seniors in Illinois.

These findings revealed more women than men participated in the screenings. Because it was not a random sample, no conclusions can be drawn by this result; however, this number is consistent with nationwide demographics of older adults in that there are more older adult women than men in the U.S.¹¹ In Illinois, the 2010 older adult census data revealed 12.5% of the population was over 65, with 7.3% women and 5.3% men.¹²

Based on the 2004 to 2006 IOHSS results, 71% of Illinois adults over age 65 do not have dental insurance.⁸ The SOT data revealed 81% of those surveyed had no dental insurance. Of those insured, Medicare was listed as one of the carriers, although Medicare does not offer routine dental benefits. It appears the older adults may not fully understand the range of services covered by Medicare or are confused regarding their insurance coverage in general. This could mean the actual number hav-

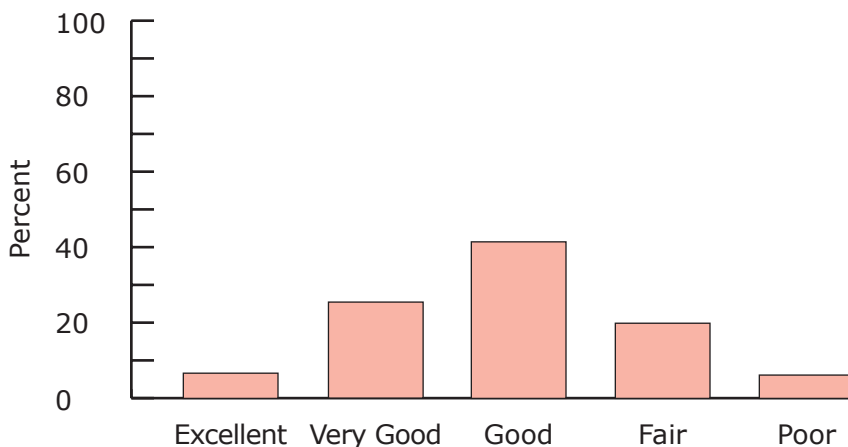
Table III: Older Adult Characteristics by Age, Race, Gender, Type of Screening Facility and Dental Insurance

Age Distribution n=422	Race n=437	Dental Insurance n=412	Type of Screening Facility n=437	Gender n=412
50 to 59 years 6 (1.4%)	White/Caucasian 372 (85.1%)	Yes 54 (13.1%)	Clinic Setting 266 (60.8%)	Male 133 (32.8%)
60 to 69 years 121 (28.7%)	Black/African American 28 (6.4%)	No 333 (80.8%)	Non Clinic Setting 171 (39.1%)	Female 273 (67.2%)
70 to 79 years 153 (36.3%)	Asian 10 (2.3%)	Unknown 25 (6.1%)	-	-
80 to 89 years 117 (27.7%)	Multiracial 5 (1.1%)	-	-	-
90 to 99 years 25 (5.9%)	Unknown 22 (5%)	-	-	-

ing dental insurance is even lower than demonstrated by the data. The literature is replete with references regarding the lack of dental insurance coverage for older adults.^{5,13-17} In a 2003 report by Oral Health America, Illinois was given an overall grade of D concerning dental coverage for seniors.¹³ This grade was issued when Illinois had limited adult dental Medicaid coverage. In 2012, adult Medicaid benefits were reduced even further to primarily emergency and extraction services.¹⁸ Lack of insurance coverage is a significant access barrier for older adults across the country and in Illinois.

Utilization of dental services by older adults has increased over the past 50 years and the trend is expected to continue.^{16,19} Various surveys in 1999, 2002 and 2008 indicate that 50 to 54% of older adults nationally reported having had a dental visit in the previous year.^{14,16,17} This SOT Illinois assessment showed 58% of older adults claimed to have had a dental visit within the last year compared to IOHSS results of approximately 64%. However, all older adults need an annual dental visit. Several of the Healthy People 2020 oral health objectives speak to decreasing oral disease in older adults.²⁰ Utilization of dental services must increase to move toward achieving the 2020 objectives. This is especially true in respect to oral cancer. Its increased prevalence in older adults makes it imperative for all seniors to access dental services regularly. The dental community must discover how to improve access and enable older adults to utilize dental services to the greatest extent possible.

Figure 2: Self Perceived Oral Health Status (n=400)



The number of older adults who are edentulous has declined over the past several years. Based on Illinois Behavioral Risk Factor Surveillance Survey 2003 data, 19% of those 65 years and older had lost all of their teeth, compared to 13% in SOT. Nationally, 18% of 65 years and older were edentulous in 2008.⁹ The lower rate of edentulism in the Illinois assessment could be due to the fact that 85% of the sample were Caucasian/white older adults. The older adult population is becoming more ethnically diverse. Tooth loss and most other dental diseases are more prevalent in minority populations.^{5,19,21} Results of the National Health and Nutrition Examination Survey (NHANES) 1999 to 2004 showed African-Americans had a higher prevalence of missing teeth and edentulism than whites and Mexican-Americans. Mexican-Americans had the lowest rate of edentulism of the 3 groups which was contrary to what would be expected for a minority group. The prevalence of edentulism is influenced by multiple factors, including socioeconomic

Table IV: Intraoral Screening Results

Oral Hygiene n=414	Untreated Decay n=394	Edentulous n=430	Suspicious Oral Lesions n=308	Treatment Urgency n=398	Referral Needed n=379
Excellent 55 (13.3%)	Yes 114 (28.9%)	Yes 56 (13%)	Yes 44 (14.3%)	No Obvious Problems 239 (60.1%)	Yes 154 (40.6%)
Good 161 (38.9%)	No 280 (71.1%)	No 374 (87%)	No 264 (85.7%)	Early Dental Care 82 (20.6%)	No 225 (59.4%)
Fair 114 (27.5%)	-	-	-	Immediate Care 77 (19.3%)	-
Poor 76 (18.4%)	-	-	-	-	-
Not Applicable 8 (1.9%)	-	-	-	-	-

status and the presence of other chronic illnesses.^{14,21,22} Edentulism varies greatly by state as well. In the 1993 Health Interview Survey, 14 and 16% of older adults in Hawaii and Oregon, respectively, were edentulous, as opposed to West Virginia and Kentucky, which had rates of 44 and 48%, respectively.²² Further research is warranted to determine reasons for edentulism in Illinois older adults.

When asked to rate their oral health status, 26% rated it as fair or poor. Studies have indicated older adults tend to perceive their oral health to be better than what it actually is, therefore this may be an underestimation of fair/poor oral health status.²³ Several studies also have examined self-perceived oral health status in relation to how it affects quality of life.²³⁻²⁶ Gift and Atchison's research concluded: "oral health is an integral part of general health and contributes to overall health-related quality of life,"²⁴ Locker, Clarke and Payne had similar conclusions.²⁵ A significant proportion of Illinois' older adults may indeed have a lower quality of life due to oral health issues.

It is concerning that 29% (114) of the older adults in this Illinois assessment, most of whom were still mobile, had untreated dental caries. Although caries rates are declining nationally in children, coronal and root caries rates in older adults are increasing.^{22,27,28} Caries prevalence is even greater in older adult minority populations.^{5,13,17,22,28} Nationally, minority older adults tend to have more untreated decay than their white counterparts. The SOT untreated decay data was lower than national trends possibly due to the greater proportion of whites than minorities in the sample. As with edentulism, the reasons for increased caries in older adults are many and varied. Efforts to address increased caries in Illinois older adults need further exploration.

The in-mouth survey included an indicator for detecting suspicious oral lesions. Older adults are at increased risk for a variety of oral lesions associated with systemic disease as well as those of oral cancer.²⁹ The American Cancer Society Guidelines for the early detection of oral cancer recommend yearly examinations of the head and neck and oral cavity by health care providers in all asymptomatic men and women age 40 and older.³⁰ In addition, at least once yearly head and neck and oral examinations by dental professionals are required to identify early symptoms of cancers, infections, salivary glandular dysfunctions, oral mucous lesions, bony pathoses and temporomandibular disorders. Older adults with physical and cognitive impairments are more susceptible to developing oral facial pathoses, therefore they must have access to more frequent professional care.³¹ An interesting finding in this Illinois assessment was of the 437 participants screened, only 308 surveys had the indicator marked for suspicious soft tissue oral lesions. Of those marked, 14.3% or 44 older adults had suspicious lesions as noted by the screeners. The indicator called for a simple yes/no answer on the screening form, not specifying the types of lesions included. Perhaps the persons conducting the screening did not feel comfortable answering for this particular indicator or doubted their skill level of identifying the extent of suspicious lesions. The indicator is not specific for lesions suspected of oral cancer; however, research suggests oral health clinicians do not believe they are well prepared to detect or manage early stage oral cancers and precancers.^{32,33} This assessment needs follow up with additional screening for Illinois older adults, and screeners should be well trained in lesion identification, especially those suspect for oral cancer.

Other findings of the assessment necessitate

comment. For example, 65% had no problems with eating or chewing, but the remaining 35% reported sometimes having difficulty. A portion of the difficulty could be partially from xerostomia, which was reported by 24% and is well documented as an oral health issue in this population.³⁴ Ervin and Dye examined results of NHANES 1999 to 2002 and found a functional dentition (21 or more teeth) did not contribute substantially to nutrient intakes.³⁵ It is not known how the SOT older adults interpreted the question nor what the reasons may have been for their answers. Another finding of SOT was 15% also reported oral pain. This finding could affect results of the question relating to the difficulty with eating/chewing. It could also relate to oral health related quality of life, a relationship that has been the focus of previous research as well.²⁴ Difficulty eating/chewing can be interpreted a number of different ways and requires employing more rigorous methods to determine causes and implications.

The treatment urgency results further emphasize the need for additional research among older adults in Illinois. It is concerning that 19% needed immediate dental care and 41% required referral. This illustrates that possibly the oral health needs and issues of older adults in Illinois are not being addressed sufficiently and should be examined more closely to encourage policy changes and health promotion, disease prevention and reduction interventions.

Results of the SOT project require cautious interpretation when considering the many limitations of the project. Data was collected by dental and dental hygiene students and checked for accuracy by faculty at most sites. This was not a standard practice for all screenings. When scanned in by IDPH staff, data was missing for several items on the forms. This was partly due to the cognizance level of the older adults, and partly by incomplete data acquisition on the part of the screeners. Self-reported data is often open to scrutiny and especially so in a population identified as having varying degrees of dementia. Nearly all (90%) of the screeners considered the older adults cognizant to answer questions; however, cognitive level of the participants could have been compromised by dementia or memory loss more than what was evident to the screeners during the short time spent with them. This further limits the results of the questionnaire portion of the survey.

Funding was not available for the data collection process, so it was determined that no restrictions could be imposed on those participating to ensure uniformity. All screeners donated their time and services to the project without compensation. The convenience sample results cannot be broadly generalized to include all older adults in Illinois. A small portion of the sample was older adults in long term care facilities, further limiting the generalizability of the results.

Conclusion

The older adult population is increasing with significant oral health issues. Additional surveillance efforts are warranted among older adults in Illinois to be able to plan and implement appropriate interventions for serving their oral health needs. Though not without limitations, this project exemplifies how states without funding earmarked for surveillance activities can still accomplish data collection through collaborative efforts of multiple entities that are concerned with older adult oral health issues. The DOH has routinely designed projects that can be used by schools to enhance dental public health service learning experiences. The SOT project was intended to follow this model. This serves as a good first step in documenting the oral health challenges of and opportunities for planning and implementing programs with the goal of ensuring optimal oral health among all older adults in Illinois.

Sherri Lukes, RDH, MS, FAADH, is an Associate Professor Emeritus, Southern Illinois University Dental Hygiene Program, and is also President-elect and Public Health Committee Chair of the Illinois Dental Hygienists' Association. Julie A. Janssen, RDH, MA, is a recent retiree of the Illinois Department of Public Health after 27 years of service. She currently volunteers for IFLOSS, the state wide oral health coalition and is chair of the Central counties health center board of directors. Kathleen K. Thacker, RDH, MPH, is an oral health consultant for the Illinois Department of Public Health, Office of Health Promotion, for the Peoria/Rockford Regions. Sangeeta Wadhawan, DDS, MPH, is a dentist/epidemiologist in Northern Illinois, formerly with the Illinois Department of Public Health.

References

1. Vincent GK, Velkoff VA. THE NEXT FOUR DECADES, The older population in the United States: 2010 to 2050. US Department of Commerce, Economics and Statistics Administration, US Census Bureau. 2010.
2. U.S. Census Bureau. 2010 Census of Population, Public Law 94-171 Redistricting Data File. Updated every 10 years. U.S. Census Bureau. 2010.
3. U.S. Department of Health and Human Services. Synopses of state and territorial dental public health programs. U.S. Department of Health and Human Services. 2009.
4. Beltran-Aguilar ED, Malvitz, DM, Lockwood, SA, Rozier, GR, Tomar, SL. Oral health surveillance: Past, present, and future challenges. *J Public Health Dent.* 2003;63(3):141-149.
5. U.S. Department of Health and Human Services. Oral Health in America: A Report of the Surgeon General. U.S. Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institutes of Health. 2000.
6. American Dental Association, Council on Access, Prevention and Interprofessional Relations. Proceedings of the National Coalition Consensus Conference on Oral Health of Vulnerable Older Adults and Persons with Disabilities. American Dental Association. 2010 November [cited 2014 July 31]. Available from: <http://www.ada.org/en/education-careers/events/national-coalition-consensus-conference>
7. Older adults. Basic Screening Surveys: an Approach to Monitoring Community Oral Health. Association of State and Territorial Dental Directors [Internet]. [cited 2012 December 3]. Available from: http://www.astdd.org/docs/BSS_Seniors_Manual_5.6.2011.pdf
8. The Illinois Oral Health Surveillance System (IOHSS) Burden Document 2004-2006. Illinois Department of Public Health [Internet]. [cited 2012 December 3]. Available from: http://www.idph.state.il.us/HealthWellness/oralhlth/BurdenDoc_04-06.pdf
9. U.S. Department of Health and Human Services. National Oral Health Surveillance System. Centers for Disease Control and Prevention. 2010.
10. Illinois Department of Public Health, IFLOSS Coalition. Illinois Oral Health Plan II. IFLOSS Coalition [Internet]. 2007 [cited 2014 July 31]. Available from: <http://ifloss.org/illinois-oral-health-plan-ii/>
11. Howden LM, Meyer JA, U.S. Census Bureau, U.S. Department of Commerce. Age and sex composition 2010. U.S. Census Bureau. 2010.
12. U.S. Census Bureau. Profile of General Population and Housing Characteristics: 2010. U.S. Census Bureau. 2010.
13. Oral Health America. A State of Decay: the Oral Health of Older Americans. Oral Health America [Internet]. 2003 [cited 2014 July 31]. Available from: <http://www.oralhealthamerica.org/pdf/StateofDecayFinal.pdf>
14. Griffin SO, Jones JA, Brunson D, Griffin PM, Bailey WD. Burden of oral disease among older adults and implications for public health priorities. *Am J Public Health.* 2012;102(3):411-418.
15. Lamster IB. Oral health care services for older adults: a looming crisis. *Am J Public Health.* 2004;94(5):699-702.
16. Dolan TA, Atchison K, Huynh TN. Access to dental care among older adults in the United States. *J Dent Educ.* 2005;69(9):961-974.
17. Kiyak AH, Reichmuth M. Barriers to and enablers of older adults' use of dental services. *J Dent Educ.* 2005;69(9):975-985.
18. Illinois Department of Healthcare and Family Services. Change in adult dental benefits. Illinois Department of Healthcare and Family Services [Internet]. 2012 [cited 2012 December 10]. Available from: <http://www.hfs.illinois.gov/html/061312n.html>
19. Holtzman JM, Berkey AB, Mann J. Predicting utilization of dental services by the aged. *J Public Health Dent.* 1990;50(3):164-171.

20. U.S. Department of Health and Human Services. Healthy People 2020. U.S. Department of Health and Human Services. 2010.
21. Dolan TA, Gilbert GH, Duncan RP, Foerster U. Risk indicators of edentulism, partial tooth loss and prosthetic status among black and white middle-aged and older adults. *Community Dent Oral Epidemiol.* 2001;29(5):329-340.
22. Vargas CM, Kramarow EA, Yellowitz JA. The Oral Health of Older Americans. Aging Trends; No.3. Hyattsville, Maryland: National Center for Health Statistics. 2001.
23. Drake CW, Beck JD, Strauss RP. The accuracy of oral self-perceptions in a dentate older population. *Spec Care Dentist.* 1990;10(1):16-20.
24. Gift HC, Atchison KA. Oral health, health, and health-related quality of life. *Med Care.* 1995;33(11):NS57-NS77.
25. Locker D, Clarke M, Payne B. Self-perceived oral health status, psychological well-being, and life satisfaction in an older adult population. *J Dent Res.* 2000;79(4):970-975.
26. MacEntee MI. Quality of life as an indicator of oral health in older people. *J Am Dent Assoc.* 2007;138:47S-52S.
27. Ettinger RL. Oral health and the aging population. *J Am Dent Assoc.* 2007;138:5S-6S.
28. Wu B, Liang J, Plassman BL, Remle RC, Bai L. Oral health among white, black, and Mexican-American elders: an examination of edentulism and dental caries. *J Public Health Dent.* 2011;71(4):308-317.
29. Silverman S Jr. Mucosal lesions in older adults. *J Am Dent Assoc.* 2007;138:41S-46S.
30. Smith RA, Mettlin CJ, Davis KJ, Eyre H. American Cancer Society Guidelines for the early detection of cancer. *CA Cancer J Clin.* 2000;50(1):34-49.
31. Ship JA. Improving Oral Health in Older People. *J Am Geriatr Soc.* 2002;50(8): 1454-1455.
32. Ashe TE, Elter JR, Southerland JH, Strauss RP, Patton LL. North Carolina dental hygienists' assessment of patients' tobacco and alcohol use. *J Dent Hyg.* 2005;79(2):9.
33. Horowitz AM, Drury TF, Goodman HS, Yellowitz JA. Oral pharyngeal cancer prevention and early detection. Dentists' opinions and practices. *J Am Dent Assoc.* 2000;131(4):453-462.
34. Turner MD, Ship JA. Dry mouth and its effects on the oral health of elderly people. *J Am Dent Assoc.* 2007;138:15S-20S.