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OCTOBER 2020 · VOL. 54, NO. 3

**Dental hygiene diagnosis: A qualitative descriptive study
of dental hygienists**

**Oral health knowledge and practice among orthodontic
clients in China and New Zealand**

**Perceptions of access to oral care at a community
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criminal justice system**

**The state of the evidence of a causal relationship
between periodontal microbes and respiratory diseases**

**Barriers to environmentally sustainable initiatives in
oral health care clinical settings**

EDITORIAL

The race for a COVID-19 vaccine



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The *Canadian Journal of Dental Hygiene* is the official peer-reviewed publication of the Canadian Dental Hygienists Association (CDHA). Published in February, June, and October, the journal invites submissions of original research, literature reviews, case studies, and short communications of scientific and professional interest to dental hygienists and other oral health professionals. Bilingual *Guidelines for Authors* are available at www.cdha.ca/cjdh.

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The race for a COVID-19 vaccine

Salme E Lavigne*, PhD, RDH

Although Canada has done relatively well in comparison to numerous other countries throughout the world in controlling the number of cases and deaths from SARS-CoV-2, the bad news is that, sadly, the virus is still with us and the pandemic is not over. We are very fortunate in Canada to have not only excellent government leadership and support in managing this pandemic, but also the most well-developed public health care system in the world! Yes! In a January 2020 survey conducted by the *US News and World Report*, Canada was ranked first in having the best public health care system in the world, followed by Denmark, Sweden, Norway, and Germany.¹ We should definitely be very proud of our health care system and the work of Health Canada and the Public Health Agency of Canada (PHAC), both of which are part of Canada's Health Portfolio headed by the federal minister of health.

Over the past several months we have seen a flattening of the epidemic curve across Canada, which has permitted most provinces to enter "Phase 3" of reopening and enabled dental offices to offer non-essential oral care services again, of course with very strict guidelines from both Health Canada as well as our professional and regulatory organizations. This re-entry has been challenging for many and very disheartening as we have begun to see our infection numbers climb once again in recent weeks, reminding us we are not yet "back to normal," nor will we be until there is a vaccine. The race now seems to be on throughout the world to develop a vaccine and, in most cases, at "warp speed." The first human vaccine trial began in March 2020. Normally, it takes between 5 and 10 years to develop a vaccine, yet there are already predictions by many researchers and scientists that there may be one available by the end of this year or certainly early next year! The speed at which these vaccines are being developed is unprecedented and, in some cases, has led to uncertainty and concern over the rigour with which the safety and efficacy of these vaccines will be established.



Salme E Lavigne

As health care professionals, we may be asked questions by our clients about how these vaccines are made, what the testing process involves, if they will be safe, and why it's taking so long. Just a quick recall of microbiology 101: a vaccine is made from either a dead (inactivated) organism or a component of that organism, or from a live but attenuated (weakened) microbe. In both cases, your immune system will recognize it as something foreign and begin to prime memory T-cells, which activate B-cells to produce antibodies against it. Once developed, those antibodies are stored as immunoglobulins within the immune system and, if the individual is exposed to that particular microbe, the antibodies will be activated and will fight off the particular microbe, preventing the disease from occurring.

There are currently several strategies being used to develop a vaccine for the novel coronavirus in addition to the ones already mentioned. For example, some companies are genetically engineering either the DNA or the RNA of the coronavirus to stimulate the creation of antibodies. In May 2020, the World Health Organization reported that there were 110 potential vaccines being clinically evaluated throughout the world. One of those under evaluation was approved by Health Canada for a Phase 1 trial in Halifax.² Currently there are 3 vaccine trials approved in Canada, with the Halifax trial now in Phase 3.

You may ask what does that mean? The process for getting approval to commence the development of a vaccine begins first with research; then with a preclinical evaluation not involving humans; then 3 separate phases of human clinical trials, which are all randomized controlled trials (RCTs) that have both a test group and a control group.

Research

In this initial phase, the manufacturer must first map the genome of the virus and then test different approaches for vaccine development. In the case of COVID-19, researchers

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had a head start as the genome had already been sequenced and they were able to follow similar approaches to previous research on other vaccines.

Preclinical phase

This phase is conducted in the lab and involves testing for safety and efficacy on animals. Typically, this preclinical phase can take up to 6 months. If results show promise and pass the safety and efficacy tests, the research then moves into human clinical trials to see if the vaccine is safe and effective to use on humans.

Phase 1 clinical trials

Phase 1 involves testing the vaccine on 1 to 100 human volunteers for both safety and effectiveness for 6 to 12 months. Side effects and their seriousness are assessed. The trials usually recruit healthy volunteers rather than people who may be health compromised just in case there are serious side effects. This phase is very important as animals do not necessarily respond in the same way that humans do. Often there may be no efficacy found in this first phase of human trials, in which case the vaccine study is ended. However, if the drug shows some efficacy and most importantly seems safe, Phase 2 trials can begin earlier.

Phase 2 clinical trials

In this phase, 50 to 500 healthy volunteers are recruited. This phase checks for safety and measures the immune response. At this stage, there is also the determination of what the best dosage would be and whether more than 1 dose is required to achieve the desired level of immunity. Typically, these trials in Canada take 6 months.

Phase 3 clinical trials

Phase 3 is the final “real world” check across a much broader population to measure both safety and efficacy. Between 300 and 30,000 volunteers are recruited and, in the case of COVID-19, volunteers from more susceptible high-risk population groups are included to see if the vaccine can prevent infection and even severe infection within the community as a whole. This phase is lengthy, potentially lasting years. However, if both safety and efficacy are found to be high, then an early release of the vaccine could occur in cases such as pandemics. It is well known that efficacy of any vaccine is never 100%. In fact, the annual flu vaccine efficacy ranges between 40% and 60%. Both the US Food and Drug Administration and Health Canada typically require at least 50% efficacy before approving a vaccine. Final vaccine approval is granted by Health Canada after rigorous scrutiny, and the vaccine continues to be monitored by Health Canada for side effects and safety even after initial approval and distribution.

The biggest challenge yet to come in the current pandemic will be the management of the supply and distribution of the vaccine to the population at large. Questions may arise such as when will the vaccine be available and who

will get the vaccine first? Dr. Theresa Tam, chief public health officer of Canada, recently indicated that PHAC is working on a priority list, which will soon be released to the public. She also indicated that “widespread vaccine uptake is Canada’s best shot at regaining any semblance of pre-pandemic normalcy.”³ The good news is that living in the country with the best public health care system in the world offers advantages! A plan is already in place for procuring the necessary supplies, such as alcohol swabs, bandages, gauze, manufacturing and packaging materials, as well as enough vaccines for the entire population of Canada at no cost to individuals. The federal government has already signed contracts with 4 of the leading vaccine pharmaceutical companies to secure a minimum of 88 million doses of COVID-19 vaccines—enough to provide 2 doses for every Canadian. They are currently working on securing contracts from 2 more companies to ensure that, regardless of who releases the vaccine first, Canada will be among the first in line.

To address public concerns about the safety and efficacy of these vaccines given the speed at which they are being developed, the chief executive officers of 9 vaccine manufacturing companies have signed a pledge to “uphold the integrity of the scientific process.”⁴ These companies include all of those with which Health Canada has contracts. We will be well protected! In the meantime, have patience, stay safe, wash your hands, wear a mask, keep physically distant, and continue to avoid large crowds.

The Chinese use two brush strokes to write the word “crisis.” One brush stroke stands for danger; the other for opportunity. In a crisis, beware of the danger but recognize the opportunity!

—John F Kennedy

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ISSUE AT A GLANCE

We are pleased to feature 3 original research articles in this issue. **Darlene Swigart, JoAnn Gurenlian, and Ellen Rogo** explore the use of the dental hygiene diagnosis in 3 American states to understand its impact on clinical practice and client engagement (pp. 113-123). **Jun Guo, Lulu Li, Guangzhao Guan, Florence Bennani, and Li Mei** examine orthodontic clients' oral hygiene behaviours, brushing techniques, and oral hygiene awareness, identifying a need for enhanced oral hygiene instruction during treatment (pp. 124-132). **Kathleen Herlick, Ruth Elwood Martin, Mario Brondani, and Leeann Donnelly** study how a community-based dental hygiene clinic influenced access to oral health care for women involved with the criminal justice system (pp. 133-143).

In addition, this issue includes a position paper and statement from the Canadian Dental Hygienists Association, written by **Salme Lavigne and Jane Forrest**, on the state of the evidence of a causal relationship between periodontal microbes and respiratory diseases (pp. 144-155). You will also find this year's winning entry in the fourth annual CJDH Student Essay Award competition, written by **Mystica Lopez de Leon**, a recent graduate of the University of British Columbia (pp. 156-160). Finally, the keyword and author index to volume 54 (2020) begins on page 163.

PLAIN LANGUAGE ABSTRACTS

Swigart DJ, Gurenlian JR, Rogo EJ. Dental hygiene diagnosis: A qualitative descriptive study of dental hygienists. *Can J Dent Hyg.* 2020;54(3):113-123.

Diagnosis is an essential step in the dental hygiene process of care and guides the creation of dental hygiene care plans. Ten practising dental hygienists in the United States were interviewed about their experiences in making dental hygiene diagnoses in clinical practice. Study participants revealed that their expertise and confidence in diagnosing clients grew over time. They also noted that discussing the diagnosis with their clients improved client understanding of their oral health status and allowed them to engage more fully in the decision-making process. A unique finding of this research was the trust that developed between clients and dental hygienists, and between dental hygienists and dentists based on the dental hygiene diagnosis.

Guo J, Li L, Guan G, Bennani F, Mei L. Oral health knowledge and practice among orthodontic clients in China and New Zealand. *Can J Dent Hyg.* 2020;54(3):124-132.

This study investigated the oral hygiene habits, brushing techniques, and oral health awareness of 184 orthodontic clients in China and New Zealand to better understand their oral care needs. The study participants completed a 47-item survey questionnaire, revealing that most brushed their teeth twice daily (80%) with a soft manual toothbrush (60.2%) and fluoridated toothpaste (88.6%), but only one-third (31.4%) received professional dental hygiene care during orthodontic treatment. While most respondents (79.4%) thought their oral hygiene was good, 51.0% reported bleeding gums during toothbrushing. These results show that clinicians must reinforce oral hygiene instruction in all cases to improve their clients' awareness of their oral hygiene during orthodontic treatment.

Herlick KM, Martin RE, Brondani MA, Donnelly LR. Perceptions of access to oral care at a community dental hygiene clinic for women involved with the criminal justice system. *Can J Dent Hyg.* 2020;54(3):133-143.

Women who are involved with the criminal justice system face many barriers when trying to access oral care services. This study explored the impact of a dental hygiene clinic, based in a drop-in centre run by the Elizabeth Fry Society and staffed by dental hygiene students and faculty, on this vulnerable population. Through focus groups and interviews, clinic clients and society staff revealed the importance of the clinic's location and services, for which the women did not need to pay out-of-pocket. The participants also said they valued the respectful, attentive, and non-judgmental person-centred care provided. However, access to care was hindered at times by clinic aesthetics, limited advertising, and communication between the students and women receiving care. Understanding how to provide appropriate oral care to women involved with the criminal justice system may improve dental hygiene services and access for this marginalized and vulnerable population.

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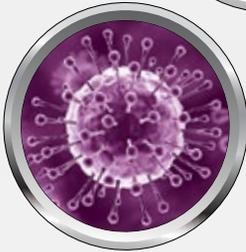
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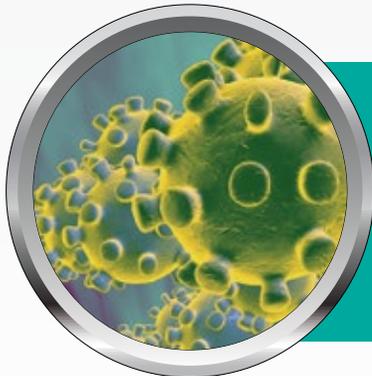
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Dental hygiene diagnosis: A qualitative descriptive study of dental hygienists

Darlene J Swigart*, MS, EPDH; JoAnn R Gurenlian[§], PhD, RDH;
Ellen J Rogo*, PhD, RDH

ABSTRACT

Purpose: The purpose of this qualitative descriptive study was to explore dental hygiene diagnosis (DHDx) to gain an understanding of how dental hygienists experience this phenomenon while providing dental hygiene care. **Methods:** A qualitative descriptive research design was employed using purposive sampling. Data were collected from semi-structured interviews with 10 dental hygienists actively practising in California, Oregon or Colorado. The interviews were audiorecorded, transcribed verbatim, and verified for accuracy. Data analysis included open coding and axial coding to determine larger, related segments of data called categories providing an overall descriptive summary of DHDx. Two independent peer examinations and member checks established validity of the data analysis. **Results:** Four categories emerged from the study: expertise and confidence; client communication; dental hygiene care plan; and dentists' trust. Participants revealed that expertise and confidence in performing the DHDx was gained through clinical practice. During client care, discussing the DHDx with clients helped to make them aware of their health condition. The development of the dental hygiene care plan was based on the results of the assessment data and the DHDx. Participants stated that their employer/dentist trusted them to diagnose. **Conclusions:** A qualitative descriptive study was conducted to summarize dental hygienists' experiences with DHDx in 3 US states; 4 categories emerged. The DHDx informs the client, increases understanding, and engages the client in the decision-making process. Further study is warranted to identify a more contemporary definition of DHDx and to compare how DHDx is utilized by dental hygienists in other countries.

RÉSUMÉ

Objectif : Le but de cette étude descriptive et qualitative était d'explorer le diagnostic d'hygiène dentaire (DxHD) pour bien comprendre comment les hygiénistes dentaires vivent ce phénomène, tout en fournissant des soins d'hygiène dentaire. **Méthodologies :** Une méthodologie de recherche descriptive et qualitative a été employée au moyen d'un échantillonnage choisi à dessein. Les données ont été recueillies à partir d'entrevues semi-structurées avec 10 hygiénistes dentaires qui exercent activement en Californie, en Oregon ou au Colorado. Un enregistrement sonore des entrevues a été effectué et les entretiens ont été transcrits textuellement et leur exactitude a été vérifiée. L'analyse des données comprenait un codage ouvert et un codage axial pour déterminer les segments de données plus volumineux et connexes appelés catégories, produisant un résumé descriptif global du DxHD. Deux examens indépendants effectués par les pairs et des vérifications effectuées par les membres ont permis d'établir la validité de l'analyse des données. **Résultats :** Quatre catégories sont ressorties de l'étude : expertise et confiance, communication avec le client, plan de soins d'hygiène dentaire, et confiance des dentistes. Les participants ont révélé que l'expertise et la confiance dans la performance du DxHD ont été acquises par l'exercice clinique. Au cours des soins du client, le fait de discuter du DxHD avec les clients a aidé à leur faire prendre conscience de leur état de santé. L'élaboration du plan de soins d'hygiène dentaire a été fondée sur les résultats des données d'évaluation et sur le DxHD. Les participants ont déclaré que leur employeur ou dentiste leur faisait confiance pour poser un diagnostic. **Conclusions :** Une étude descriptive et qualitative a été menée pour résumer les expériences de DxHD des hygiénistes dentaires dans 3 états américains et 4 catégories en sont ressorties. Le DxHD guide le client, augmente la compréhension, et incite le client à participer au processus de prise de décisions. Une étude plus approfondie permettrait de cibler une définition plus contemporaine du DxHD et pour comparer comment le DxHD est utilisé parmi les hygiénistes dentaires dans d'autres pays.

Keywords: care plan; dental hygiene diagnosis; dental hygienist; qualitative research; referral
CDHA Research Agenda category: risk assessment and management

PRACTICAL IMPLICATIONS OF THIS RESEARCH

- Dental hygiene diagnosis is an essential step in the dental hygiene process of care and guides the creation of dental hygiene care plans.
- Graduates of entry-level programs develop expertise and confidence in implementing the dental hygiene diagnosis through clinical care experiences.
- Dentists trust dental hygienists to perform a dental hygiene diagnosis.

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INTRODUCTION

Diagnosis refers to the identification of a disease based on the presentation of signs and symptoms.¹ Health care professionals in all fields use diagnosis as a means to identify and discuss diseases with patients and formulate a plan for treatment. Dental hygienists incorporate diagnosis, specifically called dental hygiene diagnosis (DHDx), into clinical practice to assist in the prevention and treatment of oral diseases.²

Historically, various models of DHDx began to appear in dental hygiene textbooks in the early 1990s. Gurenlian³ introduced a model for dental hygiene diagnostic decision making in 1993, which was followed in 1995 by the first method for formulating a DHDx by Mueller-Joseph and Peterson.⁴ At that same time, Darby and Walsh presented a DHDx model based on the Human Needs Conceptual Model.⁵ This version of the DHDx has appeared in subsequent editions of their textbook. Swigart and Gurenlian proposed a practical approach for integrating the DHDx for clinical care.^{6,7}

Both the Canadian Dental Hygienists Association (CDHA) and the American Dental Hygienists' Association (ADHA) have included DHDx in their respective standards of practice for dental hygienists.^{8,9} The CDHA reference to DHDx is found in Standard 2: "Dental Hygiene Process: Assessment." Item 2.5 states, "Analyze all information to formulate a decision or dental hygiene diagnosis"^{8 p.9}. The ADHA standard for DHDx appears in Table 1.⁹ Table 2 displays the similarities in DHDx definitions between these

2 associations; both require the dental hygienist to think critically about assessment data and formulate conclusions to address clients' needs.^{10,11} A DHDx is paramount to providing individualized, appropriate client education, dental hygiene care planning, disease prevention, and therapeutic and re-evaluation procedures.⁶

In health care globally, there has been a focus on person-centred care, which is an individualized, holistic approach to care where the decision making is shared by the clinician and the client, and at times, includes the client's family or caregiver.^{12,13} Instead of viewing the client as a collection of symptoms, person-centred care fosters communication to take into consideration the client's values and goals.^{12,13} Dental hygienists have an ethical responsibility to provide opportunities for clients to make informed decisions about their treatment.¹⁴ Communicating the DHDx to the client is part of that responsibility.⁹

In 2018, Gurenlian, Sanderson, Garland, and Swigart surveyed dental hygiene clinic coordinators in the United States to ascertain opinions regarding the importance of a DHDx and to understand how the DHDx is incorporated into educational programs.¹⁵ Of 188 survey respondents, 98% confirmed that the DHDx is a necessary component of dental hygiene care and determines dental hygiene interventions.¹⁵ Program administrators consider a DHDx a valuable and necessary element of client care.

Health care professionals in other disciplines recognize the importance of the DHDx to client overall health and collaborative care. In 2012, Jones and Boyd investigated whether a dental hygienist would be a valuable member of an interdisciplinary pediatric feeding team by assessing the importance of the dental hygiene process of care, advocacy, and health education and promotion.¹⁶ Team members surveyed included registered dietitians, speech-language pathologists, occupational therapists, registered nurses, and advanced registered nurse practitioners. The 4 areas pertaining to DHDx in the study were 1) identifying existing or potential oral problems associated with teeth,

Table 1. American Dental Hygienists' Association: Standard 2

ADHA Standard 2: Dental Hygiene Diagnosis
The ADHA defines dental hygiene diagnosis as the identification of an individual's health behaviors, attitudes, and oral health care needs for which a dental hygienist is educationally qualified and licensed to provide. The dental hygiene diagnosis requires evidence-based critical analysis and interpretation of assessments in order to reach conclusions about the patient's dental hygiene treatment needs. The dental hygiene diagnosis provides the basis for the dental hygiene care plan. Multiple dental hygiene diagnoses may be made for each patient or client. Only after recognizing the dental hygiene diagnosis can the dental hygienist formulate a care plan that focuses on dental hygiene education, patient self-care practices, prevention strategies, and treatment and evaluation protocols to focus on patient or community oral health needs.
I. Analyze and interpret all assessment data.
II. Formulate the dental hygiene diagnosis or diagnoses.
III. Communicate the dental hygiene diagnosis with patients or clients.
IV. Determine patient needs that can be improved through the delivery of dental hygiene care.
V. Identify referrals needed within dentistry and other health care disciplines based on dental hygiene diagnoses.

Source: American Dental Hygienists' Association. *Standards for clinical dental hygiene practice*. Rev. ed. Chicago (IL): ADHA; 2016 [cited 2018 Jun 30]. Available from: <https://www.adha.org/resources-docs/2016-Revised-Standards-for-Clinical-Dental-Hygiene-Practice.pdf>

Table 2. Canadian and American DHDx definitions

Country	Dental hygiene diagnosis definition
Canada (Canadian Dental Hygienists Association)	"A dental hygiene diagnosis involves the use of critical thinking skills to reach conclusions about clients' dental hygiene needs based on all available assessment data." ¹⁰
United States (American Dental Hygienists' Association)	"The identification of an individual's health behaviors, attitudes, and oral health care needs for which a dental hygienist is educationally qualified and licensed to provide. The dental hygiene diagnosis requires evidence-based critical analysis and interpretation of assessments in order to reach conclusions about the patient's dental hygiene treatment needs. The dental hygiene diagnosis provides the basis for the dental hygiene care plan." ¹¹

2) periodontal disease, 3) oral lesions, and 4) sensory disorders. All team members rated the role of the dental hygienist on the pediatric feeding team as “very important/most relevant.”¹⁶

Even though dental hygienists are ethically responsible for and qualified to recognize oral diseases and use the DHDx to formulate an appropriate individualized dental hygiene care plan,^{9,11} no research has been conducted to understand the process of the DHDx as performed by dental hygienists in practice. The purpose of this qualitative study was to explore the DHDx in order to gain an in-depth understanding of how dental hygienists currently licensed and practising in the US experience this phenomenon. The following research questions guided the conduct of this study: 1) How do dental hygienists learn to value the DHDx? 2) How do dental hygienists perform the DHDx in clinical practice? 3) Why do dental hygienists perform the DHDx in clinical practice? 4) How do dental hygienists create a dental hygiene care plan based on the DHDx?

METHODS

Study design and participant recruitment

A qualitative descriptive approach was adopted to facilitate the in-depth exploration of dental hygienists' experiences with DHDx in clinical practice. This research design is appropriate to explore phenomena where little theoretical or practical knowledge exists.¹⁷ Based on the limited knowledge of the implementation of DHDx during clinical care, this qualitative approach was used to gain an understanding of this aspect of the dental hygiene process of care and provides a foundation on which other investigations are conducted. The study design underwent full IRB review from the University's Human Subjects Committee and received approval (IRB-FY2017-252).

Purposive sampling is commonly implemented as the sampling plan for a qualitative descriptive study.¹⁷ The recruitment of individuals who have experiences with the phenomenon (DHDx) and are able to inform data collection are important considerations of purposive sampling.¹⁸ Participants were initially recruited through personal networking by the researchers who emailed an IRB-approved announcement to colleagues in California, Oregon, and Colorado. These states were selected because the dental hygiene scope of practice includes direct access to dental hygiene care. Additionally, in Oregon and Colorado, DHDx is specifically identified in the practice act as a procedure for dental hygienists.¹⁹ Furthermore, the snowball sampling method¹⁸ was implemented to gain referrals of other dental hygiene colleagues who could be recruited for the study.

Inclusion and exclusion criteria

Inclusion criteria were dental hygienists who were actively practising at least 16 hours a week and had a minimum of 1 year of experience. Exclusion criteria eliminated dental hygienists who were currently or previously employed

as educators in dental hygiene programs or worked less than 16 hours per week. When potential participants were identified, a screening questionnaire was completed to establish who met the inclusion criteria and determine procedures they completed during client care.

Participant selection

The 10 dental hygienists selected were those who collected assessment data, evaluated risk factors for oral disease, and determined dental hygiene treatment based on the assessment data and client risk factors. Additionally, demographic questions were asked on the questionnaire to establish maximum variation in the sample.

Maximum variation was implemented to gain diversity within the sample¹⁸ based on demographic (gender, age, years in practice) and type of practice (general private practice, direct access practice, corporate practice) variables. Using maximum variation in a qualitative descriptive inquiry provides researchers with the opportunity to explore similar and unique experiences across varied contexts.¹⁷ During the interview process, saturation determined the final sample size. Saturation involves increasing the sample size until no new information surfaces during the interviews.¹⁸

Data collection and data analysis

The 4 research questions directed the development of the interview guide as depicted in Table 3. The guide included major questions and subordinate questions to elicit additional detail in responses. The content validity of the questions was established by using the Standards for Clinical Dental Hygiene Practice of the ADHA and previous DHDx research.^{9,15} Using the guide ensured that all topics were covered in a valid and reliable manner during each interview.¹⁸ Two members of the research team conducted a pilot interview to determine whether the major and subordinate questions would collect data to answer the research questions as a validation process. The interview guide was sent to participants at least 1 week prior to the interview to help them formulate responses.

Written informed consent was obtained prior to interviews being conducted by the principal investigator through an audiorecorded phone interview. Interviews were conducted with semi-structured methodology allowing for additional follow-up questions to collect more in-depth data or new data. The conversation was audiorecorded using the Olympus WS-300M 256 MB Digital Voice Recorder and Music Player. All audiorecordings were transcribed verbatim by a professional transcriptionist. Participant pseudonyms were used during the interview and on the interview transcript to protect confidentiality and ensure anonymity. The principal investigator listened to the audiorecorded interviews to verify the accuracy of the transcriptions.

Data regarding the DHDx generated from the interviews were analysed simultaneously with data collection; both

Table 3. Interview guide

Interview guide
<p>General questions regarding dental hygiene practice experience:</p> <ol style="list-style-type: none"> 1. In what type of practice are you currently employed? 2. What other types of practices have you had experience?
<p>How do dental hygienists perform the DHDx in clinical practice?</p> <ol style="list-style-type: none"> 3. How would you define a DHDx? 4. Tell me about your typical day at work with your patient? 5. What assessment data do you collect on your patients? 6. Does the dentist in your practice do a clinical exam at every dental hygiene appointment? If not, how often? 7. In your practice, are you expected to report suspicious oral lesions, caries lesions, and/or periodontal disease to the dentist? If yes, how do you report or discuss your findings with the dentist? 8. How do you perform a DHDx? Can you give an example?
<p>Why do dental hygienists perform the DHDx in clinical practice?</p> <ol style="list-style-type: none"> 9. How were you taught DHDx in the dental hygiene program where you attended? 10. What conditions were you taught to diagnosis? 11. How do you feel performing the DHDx benefits a patient?
<p>How do dental hygienists create a dental hygiene care plan based on the DHDx?</p> <ol style="list-style-type: none"> 12. In your practice, do you create the dental hygiene care plan for the treatment you would perform for the patient? <ol style="list-style-type: none"> a. What types of procedures, education, or referrals might be included? 13. How is the dental hygiene care plan discussed with the patient? <ol style="list-style-type: none"> a. Can you give an example of this discussion? 14. Is the DHDx discussed with the patient? <ol style="list-style-type: none"> a. Can you give an example of how the DHDx is discussed? 15. Do you document the DHDx in the patient record? <p>If yes, how do you document the DHDx in the patient record?</p> <p>If no, what are your reasons for not documenting the DHDx?</p> 16. Do you feel the DHDx improves patient outcomes? <p>If yes, can you explain how the DHDx improves patient outcomes?</p> <p>If no, why do you feel the DHDx does not improve patient outcomes?</p>
<p>How do dental hygienists learn to value the DHDx?</p> <ol style="list-style-type: none"> 17. How do you feel you learned to value a DHDx? 18. When you graduated, did you value DHDx as a part of care? 19. As you have been practicing, how do you value your ability to perform a DHDx? 20. What barriers or hindrances do you encounter with the DHDx?
<p>Additional comments:</p> <ol style="list-style-type: none"> 21. Do you have any other thoughts or comments about your experience with the DHDx? 22. Is there anything else you would like to tell me about DHDx?

processes reciprocally influenced each other.¹⁷ The data analysis method of choice for qualitative descriptive studies is qualitative content analysis.¹⁷ The result of this analysis is a descriptive summary of the data, which is less interpretive than data analysis other qualitative approaches use.¹⁷

Transcripts were read numerous times by the investigators to become familiar with the data and to develop a contextual understanding of factors related to perceptions of DHDx. Open coding deconstructed the data into manageable one-word or short phrases describing the participants' experiences relevant to answering the research questions.¹⁸ During the next phase—axial coding—

open codes were combined to form larger segments of data indicated as categories. Each research team member coded the same interview, compared and discussed findings until consensus was reached. Common categories were then analysed and organized to summarize the data, following Merriam and Tisdell's¹⁸ recommendation that categories should be responsive to the purpose of the research, exhaustive, mutually exclusive, sensitizing, and conceptually congruent.

Establishing rigour

Two research team members conducted an independent peer examination of the data analysis to ensure validity. Another procedure used for validity was respondent validation.¹⁸ Member checks by participants evaluated the preliminary findings and provided feedback on the accuracy of the researchers' interpretation of the data. All 10 participants reported they agreed with the analysis.

RESULTS

Study participants

Demographic data for the 10 participants were analysed using descriptive statistics and are presented in Table 4. Six dental hygienists from California, 2 from Oregon, and 2 from Colorado participated in the study. The majority of participants were between the ages of 34 and 44 years, female, and had over 13 years of experience. Eight participants worked in private practice under the supervision of a dentist; 2 worked in independent practices without the supervision of a dentist. These independent practitioners provided care in long-term care facilities, at a senior citizen centre, and with a mobile dental clinic.

Four categories emerged from the study: expertise and confidence; client communication; dental hygiene care plan; and dentists' trust.

Expertise and confidence

Participants revealed that, while foundational learning of the DHDx began in dental hygiene education, expertise and confidence in performing the DHDx was gained through clinical practice. Most participants reported learning to perform the DHDx in their dental hygiene education program. Hannah described being taught in a clinical setting, with a client present, and under the guidance of the dental hygiene faculty. She learned to diagnose periodontal case types and elaborated on her oral pathology education, stating:

We were always encouraged to look out for unusual findings in the mouth. If we did see anything, we were to describe it, to actually measure it, and write it down.

Mike stated, "we're really good at diagnosing periodontal disease," and detailed also being taught to diagnose bruxism, wear patterns, abfractions, dental caries

Table 4. Participant demographic data

State	n (%)
California	6 (60%)
Oregon	2 (20%)
Colorado	2 (20%)
Age range (years)	
28 to 33	3 (30%)
34 to 44	4 (40%)
45 to 53	3 (30%)
Gender	
Male	2 (20%)
Female	8 (80%)
Years in practice	
1 to 6	2 (20%)
7 to 13	2 (20%)
Over 13	6 (60%)
Degree	
Associate	3 (30%)
Bachelor	6 (60%)
Master	0 (0%)
Doctorate	1 (10%)
Type of practice	
General private practice	6 (60%)
Independent/Direct access practice	2 (20%)
Corporate practice	1 (10%)
Certified advanced practitioner working in private practice	1 (10%)

risk, and dental caries on radiographs. Mia explained how she was educated to assess for dental caries and determine the dental caries classification. Jane confirmed learning to diagnose not only dental caries, but also radiolucencies around tooth apices. Nikki discussed that her postgraduate advanced practitioner training developed her use of the DHDx because she would be working in independent practice without a dentist present.

I really probably learned [DHDx] through the training I received at my postgraduate AP [advanced practitioner] class. They really stressed that on us, more so than my bachelor degree dental hygiene class twenty-four years ago. A lot has changed and because we're seeing these patients independently, you get better at evaluating things and being confident in your evaluation and referrals.

Other ways participants learned DHDx were through reading articles in professional journals and attending continuing education courses.

In contrast, Michele and Leah specifically acknowledged they did not learn to determine the DHDx during their dental hygiene education. Michele was educated to recognize different levels of periodontal disease and discuss the findings with the supervising dentist who would provide the diagnosis and referrals. Furthermore, Michele expressed, "I like the fact that I don't have the legal responsibility of diagnosis because that is left to the doctor's hands." Leah stated, "We weren't specifically taught a DHDx and how to write that up, with that title." She explained how she was taught to do an oral assessment, oral cancer screening, and to recognize abnormal oral conditions to be diagnosed by the dentist. Even without specific terminology for the DHDx, Leah was expected to identify dental caries, both clinically and radiographically, in addition to decalcification and root caries.

Developing confidence in and appreciating the value of conducting a DHDx occurred through clinical experiences in practice. All participants confirmed that their increased confidence in diagnosing improved communication skills regarding the DHDx and strengthened the value they place on DHDx. Jane specifically credited the dentist by whom she is employed for increasing her knowledge of diagnosing and motivating her to perform the DHDx.

I had a lot of good foundational knowledge and then was able to apply it [DHDx] to all the many patients in clinical practice. It just expands upon what you've already learned. I've also learned a lot from the dentist I work for. I feel like he's taught me a lot. I do have a lot more confidence in saying yes, this is what I think this is and explaining that to the patient. And I think that would come with time.

Multiple participants confirmed that the more years they were in practice and performing the DHDx, the more confident they became in their diagnosis. As Elizabeth explained:

When I was first out of school, if I got hesitation [about recommendations] from a patient, it would make me feel uncomfortable and make me second guess whether my diagnosis was correct or not. And now that I've been practicing so long, I know what my diagnosis is and it's MY job to help the patient understand why I'm making that diagnosis. I'm not going to be talked out of what I'm recommending for a patient.

Additional supporting quotations illustrating how DHDx expertise and confidence develop through clinical experiences are presented in Table 5.

Table 5. Supporting quotations for category 1

Expertise and confidence
I think with anything, it [DHDx] gets better with time. The more you do it, the better you become with it and the more varied the mouths are that you've been exposed to, you learn something new all the time. So I think I value it more because my—the education in practice—has always been more valuable than the education at school. (Michele)
[DHDx has] definitely gotten better over time. I wouldn't say that in the first year, second year, I was that confident. But I feel very confident about it now. Without having a dentist present I could still make that diagnosis. (Mia)
Definitely, I feel like I'm more competent now than seventeen years ago and more confident in making the diagnosis and not second-guessing myself. (Mary)
I am much more confident in my diagnoses now. I know what I am saying is truthful and I can back it with information and my own experience. (Hannah)

Patient communication

The DHDx helps to make clients aware of their health condition and provides the dental hygienist with an opportunity to explain the DHDx to the client. Albert, Hannah, and Mary each described how they present the DHDx to their clients.

An example of how I take a DHDx. I had a patient in her 60s. She had several missing teeth, crowns, and very large fillings. She had failing restored margins, pockets, clinical attachment loss, radiographic evidence of bone loss, heavy plaque, and debris on the gingival surface of those teeth. She stated disappointment with failing treatment that she attributed to herbs by her previous dentist. And she said (quote), "Dr. Oz said I don't need fluoride." She was on several medications for hypertension and diabetes. Her DHDx was generalized mild to moderate chronic periodontitis, high caries risk, restorative needs requiring a dentist's attention, anxiety, high risk of perceived or actual failure of treatment, high risk of oral systemic complications, pockets of deficits related to effects of treatment, fluoride and personal health habits, affective deficits related to interaction with health professionals and sources of information, and psychomotor deficits related to home care habits. (Albert)

To the patient I described earlier, I explained that because she had problems with her dental treatment in the past, I would like to have her release prior records to us before I begin providing treatment. To the event, to prevent

the same pitfalls from happening again. I also asked her to have Dr. Oz send his diagnostic and treatment notes so I could understand why he did not think she needed fluoride. I explained the effects of fluoride on dental health, the characteristics of her periodontitis and treatments. I also explained the treatment I recommended for her would help the longevity of her restoration and interact positively with her systemic health. (Albert)

I need to feel I'm doing the best possible thing for my patient. There needs to be honesty between the hygienist and the patient which will develop trust. The DHDx is a true representation to the best of my knowledge of the patient's condition which is the baseline which I work from to perform the best possible care, and I value that. Because periodontal disease can have no symptoms, many people don't realize they have it. Explaining to the patient the diagnosis is educational and they should know if there is a problem so it can be addressed as soon as possible. (Hannah)

I would sit the patient up and we usually take photographs and radiographs and show the patient in their own mouth what's going on. Explain to them how their systemic condition relates to their oral health. Explain to them what we're finding as far as pocketing and bleeding and calculus and let them know what their options are for treatment. (Mary)

In some cases, participants divulged that clients are not always informed of their oral health status. Michele, Mike, Elizabeth, and Mia reported occasions when clients had been shocked to learn their DHDx because they had never previously been told of their disease state.

I've had patients that are shocked. They have been going to their office and seen routinely for care, and all of a sudden, they come in, they see me for the first time, and when I tell them what the diagnosis is and the treatment plan, they are shocked. They'll ask questions why or how did this happen? Or what do I do to prevent it? (Mia)

Participants reported the significance of educating the client while informing them of the DHDx. When clients are made aware of their disease status through the DHDx, they are more likely to accept dental hygiene treatment. Mike explained, "By telling the patient and educating them,

you'll get a lot better results. They're a lot more aware and so they'll take more action."

Leah discussed how dental hygienists back up the DHDx with "a lot of information for the patient to make sure the patient understands." She further detailed her direct access practice at a senior citizen centre, stating that some clients she treated would not seek oral care at a dental office. The only care some clients were willing to have involved dental hygiene procedures completed at the senior citizen centre. Leah stressed that referrals were made to dental offices, but clients did not always follow through with them. In one case, she informed a client of an abscess. By helping the client understand the diagnosis, she was able to convince the client to seek treatment. Furthermore, Leah called a clinic to schedule an appointment, thus fulfilling the role of a case manager of oral health care to ensure the spread of infection did not affect systemic health. Additional supporting quotations for this category appear in Table 6.

Dental hygiene care plans

A dental hygiene care plan consists of formulating conclusions about dental hygiene treatment based on the results of the assessment data and the DHDx. Participants described how they relate the dental hygiene care plan to the DHDx.

I begin explaining the assessment data, the implication of that data, and the diagnoses that emanate from that data. Then I explain the diagnoses and how the recommended treatment will address the diagnoses. (Albert)

After the initial therapy, we'll be seeing the patient for a six-week evaluation appointment. That allows us to see what healing has occurred. It is a long-term commitment on their part because it requires them to come in every three to four months for at least the first year. If we see any inflammation, bleeding, pocketing remaining after one year, then we will keep them on a three- to four-month periodontal maintenance program. I explain the difference between periodontal maintenance and a prophylaxis. We typically go over recommendations for flossing. If they don't like regular floss, we recommend soft picks or water flosser. We typically recommend using an electric toothbrush and tongue brushing. (Elizabeth)

Participants described many aspects of the dental hygiene treatment planning process, including the importance of the DHDx. The care plans included detailed information on what treatment, nutritional counseling, education, and referrals were recommended. Additionally, participants determined the number of appointments, length of each

Table 6. Supporting quotations for category 2

Client communication
<p>Oftentimes, their response is that they had never been explained exactly what was going on in their mouth before. (Michele)</p> <p>If anyone's informed and knows what going on, the majority of people in this world will take actions to get better. When you go to your doctor, he tells you that you have high blood pressure. He explains the plan and meds, and how often to follow-up with him. It's the same thing with dental hygiene. (Mike)</p> <p>I think that they have more trust and I see more respect for the dental profession because it not only improves their oral health, but the systemic link. Patients feel like we're looking out for all of them just not their mouths. So, I think it's a good thing. It builds trust. (Mia)</p> <p>I think it would help them have a greater understanding of, "I do have periodontal disease." Maybe they didn't know that before. Or, "Oh, I didn't know I had a cavity there. It didn't hurt." Or, "Oh, yeah, I never noticed that lesion in my mouth." By me pointing those things out to them, it gives them information that's beneficial to them. So it is addressed and treated properly and doesn't go unnoticed. (Jane)</p> <p>You don't want them to lose their teeth. If they have an aggressive form of periodontal disease, we need to help the patient understand this is serious. You're going to lose your teeth. I feel like that would be very beneficial to them. This is what's going on in my mouth, this is a serious thing, and I need to address it. If it was a cavity, we don't want it progressing from a small cavity to potentially a root canal. With a pathology, that could become oral cancer. There can be long-lasting effects. I think it's extremely beneficial that we, as hygienists, point this out to our patients. Now in these conversations. (Jane)</p> <p>I just think it puts everybody on the same page and allows for better communication. Because there's so many different people involved a lot of times with a client's care, it kind of gets us all on the same page. (Nikki)</p>

appointment, and what treatment would be included at each appointment. These dental hygienists proposed necessary referrals, discussed the cost of the treatment, and at times assigned insurance codes. Recommended re-evaluation and recare intervals were generally determined by the dental hygienist. This information was given to the dentist to get final approval for proposed treatment if needed, to the front office staff for financial considerations, and to the client to obtain informed consent.

Albert discussed how presenting an individualized dental hygiene treatment plan, based on the DHDx, to a client gave the client the necessary knowledge to accept or decline treatment. In regard to finances, clients gained "confidence that their money was going toward something worthwhile." Michele emphasized that an important aspect of care planning was to explain to the client not only what treatment was recommended, but also why it was necessary. The goal of the care plan is to provide the best possible care and referrals to improve the client's oral and overall health.

Further, participants discussed the referral of clients to medical and dental professionals in multiple disciplines as

a necessary component of the care plan. Mike described interprofessional practice by referring clients to physicians to evaluate the status of diabetes, high blood pressure or medications. Jane referred to a dermatologist when a suspicious lesion was observed on a client's face or lips. Elizabeth explained how the recognition of possible acid reflux, visible by lingual erosion, required further evaluation by a physician. She described to clients the importance of further evaluation by stating "this is a major concern because it puts you at a high risk for esophageal cancer and oral cancer, as well as eroding away the enamel." Summing up her thoughts, Elizabeth stated, "The body is all interconnected and interlinked."

Mia discussed the importance of referrals for emotional health and for alcohol dependency problems. She also explained the need for an interprofessional referral to a physician for a client who had excessive bleeding problems or for those who were not responding to appropriate dental hygiene treatment. She made clear to those clients that a medical examination was recommended to ascertain if a systemic problem existed. Nikki, in independent practice, stressed to the clients and to family members of cognitively impaired clients the importance of understanding the relationship between oral health and general health when recommending frequent dental hygiene visits. This recognition of the oral-systemic link confirmed the significance of including health factors when making care plan recommendations.

In addition to systemic conditions, many participants reported intraprofessional referrals to dental professionals, such as dentists, periodontists, orthodontists, endodontists, and maxillofacial surgeons. These dental hygienists recognized the need for a dentist or dental specialist referral. Intraprofessional practice was described by Elizabeth as "a partnership" between the dentist and the dental hygienists working to help one another and facilitate collaboration. Nikki, who works in independent practice, referred to a dentist or mobile dentist for conditions requiring a dental diagnosis and dental treatment. Supporting quotations pertaining to the referrals that participants make as part of the dental hygiene care plan appear in Table 7.

Dentists' trust

From the participants' experience, dentists trust dental hygienists to diagnose. Participants related that the dentist does not perform an oral examination of the client at every dental hygiene appointment. In some cases, a dental examination is only performed once per year or if there is a chief complaint. Therefore, the dentist relies on the dental hygienist's ability to diagnose oral conditions and inform them of relevant findings. Nikki, in independent practice, explained how the dentists rely on accurate dental hygiene diagnosing.

Table 7. Supporting quotations for care plan referrals

Dental hygiene care plan referrals

For referrals, most often the dentists or dental specialists, frequently physicians or other medical specialists. Occasionally, nurses, chiropractors, massage therapists. I've even recommended people to see exercise instructors. (Albert)

I refer them to their medical doctor. I've had patients who I've suspect have diabetes and so that's usually the referral to set up an appointment and I bug them at every appointment until they do it...I have given some referrals to some organizations like mental health, alcoholic programs. (Mia)

We typically refer to periodontists, orthodontists, endodontists, oral surgeons. Those are kind of our top four. We also work with a sleep study place to diagnose sleep apnea. We don't do any type of nutrition or smoking cessation of adults at all. If that's an issue, we usually refer them to their general doctor or general physician. (Elizabeth)

We refer out primarily to the endodontist, the periodontist, the orthodontist, and the oral surgeon. I've seen a couple abnormalities on someone's face or on their lips and I've suggested they see a dermatologist. (Jane)

I think it's [DHDx] pretty important because it allows you to be the bridge between the patient and the family and also the dentist of referral, if there are any dental issues. And it allows me to communicate to facilities that I visit via a written form creating an oral health record so that they can place that in their chart. It's good. It kind of creates a trail that they are getting taken care of and the need is being met with their oral care. And it allows me to better educate caretakers or the CNAs in areas that need improvement with daily care. (Nikki)

I saw signs of acid reflux, like a really red like soft palate and I saw a lot of inside lingual erosion on the teeth. I would ask the patient if you aware of any acid reflux or did you go through a period where you were throwing up a lot. This is a major concern because it puts you at a high risk for esophageal cancer and oral cancer as well as erosion of the enamel on your teeth. You need to get this under control. The medication required would be provided through your general practitioner. (Elizabeth)

If a patient has diabetes, I'll ask their HbA1c. You'd be surprised how many patients don't even know or don't even know the last time they did the test. I'll tell them they need to get it checked. The one on the high blood pressure medications, I'll ask the patient when's the last time you've seen your cardiologist or your physician regarding your blood pressure meds? If they said over a year, I'll tell them you should get that checked. (Mike)

I feel that they [mobile dentists] count on us to diagnose correctly because they are making a trip based on the diagnosis that I see. And they base their treatment plan for that mobile visit based on what I see. They're coming out [to treat the patient] with the knowledge and the anticipation that those are the lesions that they would be treating. (Nikki)

Leah described how communicating the DHDx to the dentist and then having the dentist reinforce the DHDx to the client “solidifies in the patient’s mind what is important.” This communication between the dental hygienist and the dentist ensured that the client received the necessary care.

Lastly, participants noted they have observed important findings to assist the dentist in performing a comprehensive diagnosis, and for the most part, the dentist has agreed with the DHDx. Specific quotations supporting these concepts are provided by Mia, Michele, and Jane.

There have been times where I brought a new patient, he’s done his exam, he’s diagnosing, and then they [patients] hop in my chair and then I find things that maybe he didn’t find. He’s thanked me on several occasions when these things have happened. The hygienist is a second pair of eyes for him. (Mia)

He [the dentist] makes my input seem valuable to the patient and that has given me a lot of confidence and makes me want to make sure my diagnosis is good and that I’m looking for those things and just not leaving it in his hands; 99 times out of a 100 my dentist does agree with what I’ve suggested for the patient. (Michele)

The dentist says, “Good job, Jane, that’s a good catch and good eye.” More times than not, he agrees with my diagnosis. That is a cavity. That is a problem. I trust you and 99% of the time he agrees with my diagnosis and my treating plans. (Jane)

DISCUSSION

This qualitative descriptive study explored DHDx in clinical practice and is a unique addition to the scientific body of knowledge. The findings from this investigation might expand the breadth of professional associations’ definitions of DHDx. Similarities between this study and current association definitions of DHDx exist in the areas of assessment findings determining the DHDx and the use of the DHDx to plan dental hygiene interventions.

According to the professional standards of practice established for the dental hygiene discipline, DHDx is an essential step between collecting assessment data and planning for dental hygiene care.^{8,9} Participants in this study verified that DHDx is a necessary component of the dental hygiene process of care. They used their data collection findings to create a DHDx, which then supported the development of an individualized, comprehensive care

plan. Further, Santana et al. explained the importance of health care providers sharing information so “patients make informed decisions in relation to their diagnosis and treatment plans.”¹³ These authors stressed the importance of “building a partnership with patients” throughout this decision-making process.¹³ Participants in our qualitative descriptive study recognized the difference in how clients responded when their DHDx and treatment plans were shared with them. Clients were more engaged in the decision making about their treatment options when they understood their diagnosis.

Although participants acknowledged the importance of the DHDx, they were confused by the instruction received during their education. They noted that dental hygiene program educators taught students how to diagnose in multiple areas. However, educators also informed students that they could not legally diagnose based on state regulations. Gurenlian et al.¹⁵ conducted a survey to determine how dental hygiene educators taught DHDx in entry-level educational programs. Results revealed that 98% of responding dental hygiene educators taught the dental hygiene process of care and DHDx, including DHDx diagnostic terms.¹⁵ There might still be opportunities to educate students in using the DHDx in clinical practice to uphold their professional standard of care.

Most participants reported needing years of experience in practice to achieve full confidence in performing the DHDx. Once experience was gained in clinical practice, the true value of DHDx was appreciated. This gap in time before fully incorporating the DHDx step in practice could be detrimental to client care especially if the dentist is relying on the dental hygienist to diagnose and plan care for dental hygiene interventions. This finding is supported by the research of Williams et al.²⁰ on dental and dental hygiene students’ knowledge of diagnosing, treating, and referring for periodontal disease. Their results demonstrated that only 40% of dental students and 36% of dental hygiene students “reported confidence in diagnosing, treating, and appropriately referring” periodontal clients.²⁰ The authors concluded that dental and dental hygiene programs might not be preparing students to transfer knowledge learned into clinical practice appropriately.²⁰

A unique finding of this research was the trust that developed between clients and dental hygienists, and between dental hygienists and dentists based on the DHDx. Clients reported feeling more informed about their oral health when dental hygienists notified them of the DHDx, and they trusted the treatment plan that was recommended based on that diagnosis. These clients appreciated the time and money that was being invested in their oral health care. In addition, dentists trusted dental hygienists to diagnose oral conditions based on clinical assessments, so they could make informed decisions about further care needed. In some cases, the DHDx enhanced the care of underserved populations including residents of long-term care facilities.

From the participants' perspectives and experiences, DHDx included the identification of multiple oral diseases including dental caries and periodontal diseases. Dentists relied on and trusted the dental hygienists' diagnoses. Many states within the US have expanded regulations to include direct access practice.¹⁹ Because the DHDx is critical for comprehensive dental hygiene care, it should be recognized within all state practice regulations as a necessary responsibility of the dental hygienist.

Participants reported having the responsibility in practice to create the dental hygiene care plan, which included multiple intra- and interprofessional referrals. This holistic team approach to care is at the forefront of health care. These results align with the discussion by Walji et al.¹² which included the importance of a long-term relationship between the person and the provider and the significance of a holistic approach to care. An example of interprofessional practice was reported by An and Ranson²¹ in a literature review conducted on obstructive sleep apnea (OSA), a potentially fatal condition. The researchers concluded that dental hygienists are in a primary role to perform screenings for OSA and recognize the need for referrals.²¹ In medical practice, Graber et al.²² discussed the importance of diagnosis being a "team-based activity" that involves collaboration between all health care providers involved in a particular case as well as the client. The goal of this holistic team approach was to improve the diagnostic process. This approach "takes advantage of each team member's particular expertise and involvement" and, increasingly, the teams were led by health care professionals other than physicians.²²

Dental hygienists must become advocates to expand the scope of practice to include DHDx. Practitioners should educate state legislators about professional care standards related to DHDx and its importance to clinical practice. Compromising these DHDx standards could affect client care and treatment outcomes. Therefore, state regulations must align with the professional standards regarding DHDx to ensure that quality care is provided. Clients need to be able to consent to treatment based on having been informed of their diagnosis. This expectation is routine for other health care providers. Assisting stakeholders in understanding that diagnosis is as relevant to dental hygiene practice as it is to dental practice, nursing practice, medical practice, and other health care practices might provide the insight needed to support language changes to uphold dental hygiene standards in rules and regulations governing the practice of dental hygiene.

A noticeable missing aspect of diagnosis among the participant responses was the consideration of social determinants of health. In addition, when reviewing the CDHA and ADHA definitions of DHDx, neither mentions social determinants of health.^{10,11} The World Health Organization (WHO) defines social determinants of health as:

*The conditions in which people are born, grow, live, work and age. These circumstances are shaped by the distribution of money, power and resources at global, national and local levels. The social determinants of health are mostly responsible for health inequities—the unfair and avoidable differences in health status seen within and between countries.*²³

Health care providers, in this case dental hygienists, should be aware of the inequalities and access-to-care challenges that their clients face. They should include these determinants in the DHDx and address them in the dental hygiene care plans. Gurenlian and Swigart⁷ included "social hindrance to care" as a DHDx on a process of care operatory chart model. This step in the right direction for dental hygiene care may not have reached the clinical practice of dental hygienists. The current versions of the associations' definitions need to be revisited to include provisions related to informing the client for increased understanding and improving unmet needs and social determinants of health.

Limitations of the study pertain to only interviewing dental hygienists from 3 states from the western region of the US. Dental hygiene practice might be different in these states compared to other states. Reflexivity or researcher bias is a core characteristic of qualitative research and may also be a limitation of this type of descriptive study.¹⁸ Additionally, the qualitative descriptive study is less interpretive than other types of qualitative designs.¹⁷ Although 10 interviews might seem to be a limitation as a small sample size, this number was sufficient because saturation was reached for this exploratory study.¹⁸

Dental hygienists have the responsibility in practice to determine dental hygiene care. Further research could include a comparison study of DHDx among Canadian dental hygienists and US dental hygienists to identify similarities and differences in clinical practice specifically as it relates to DHDx. In addition, a study is needed to investigate direct access dental hygienists and how DHDx informs their intra- and interprofessional referrals. Further, a Delphi study could be conducted to construct a new definition of DHDx based on current parameters of health care, theoretical models of care, social determinants of health, and interprofessional collaborative practice.

CONCLUSION

A qualitative descriptive study was conducted to investigate dental hygienists' experiences with DHDx. Dental hygienists in 3 US states—California, Colorado, and Oregon—were interviewed. Four categories regarding DHDx emerged: expertise and confidence, client communication, dental hygiene care plans, and dentists' trust. The DHDx

informs the client, increases understanding, and engages the client in the decision-making process. A DHDx is educational, improves communication, and supports the building of trusting relationships.

CONFLICTS OF INTEREST

The authors have declared no conflicts of interest.

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Oral health knowledge and practice among orthodontic clients in China and New Zealand

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ABSTRACT

Background: The oral hygiene habits of clients wearing fixed orthodontic appliances is poorly understood. Assessment of oral hygiene behavioural patterns is essential for understanding clients' oral health care needs. The aim of this study was to investigate orthodontic clients' oral hygiene behaviours, brushing techniques, and oral hygiene awareness. **Methods:** A total of 200 orthodontic clients wearing fixed orthodontic appliances were consecutively recruited from the Sichuan Provincial Hospital, Chengdu, China, and the Faculty of Dentistry, University of Otago, Dunedin, New Zealand. A 47-item questionnaire was used to survey study participants. **Results:** The survey had a 92% response rate, with 67.5% of respondents being female and 32.5% male. Most were non-smokers (94.2%) and the majority (80.0%) brushed their teeth twice daily. Most (80.4%) brushed their teeth for 1 to 2 minutes, and 68.7% positioned their toothbrush both horizontally and vertically, with horizontal being the preferred direction of motion. One-third (33.5%) did not use any auxiliary oral hygiene aids; most snacked between meals; only 31.4% received professional tooth cleaning during orthodontic treatment; and 56.8% experienced an increased level of halitosis after appliance placement. Most respondents (79.4%) thought their oral hygiene was good, but 51.0% reported bleeding gums during tooth brushing, 31.4% found they rarely bled, and only 17.6% reported no bleeding. Most respondents agreed that good oral health was very important for orthodontic treatment and that their own efforts were the most important factors. **Conclusions:** Client awareness of the importance of oral hygiene during orthodontic treatment requires improvement. Clinician reinforcement of oral hygiene should become a priority for orthodontic clients.

RÉSUMÉ

Contexte : Les habitudes d'hygiène buccodentaire des clients qui portent des appareils orthodontiques fixes sont mal comprises. L'évaluation des modèles de comportement en matière d'hygiène dentaire est essentielle pour comprendre les besoins en soins de santé buccodentaire des clients. L'objectif de cette étude était d'étudier les comportements d'hygiène buccodentaire des clients orthodontiques, leurs techniques de brossage, et leurs connaissances en matière d'hygiène buccodentaire. **Méthodologie :** Un total de 200 clients orthodontiques portant des appareils orthodontiques fixes ont été recrutés consécutivement à l'Hôpital Sichuan Provincial, à Chengdu en Chine et à la Faculté de dentisterie de l'Université d'Otago, à Dunedin en Nouvelle-Zélande. Un questionnaire de 47 éléments a été utilisé pour sonder les participants à l'étude. **Résultats :** Le sondage avait un taux de réponse de 92 %; 67,5 % des répondants étaient des femmes et 32,5 % étaient des hommes. La plupart parmi eux étaient des non-fumeurs (94,2 %) et la majorité (80,0 %) se brossait les dents 2 fois par jour. Pour la plupart (80,4 %), le brossage durait entre 1 et 2 minutes, et 68,7 % plaçaient leur brosse à dents horizontalement et verticalement; la position horizontale étant la direction de mouvement préférée. Un tiers (33,5 %) des répondants n'utilisaient pas d'aides-auxiliaires d'hygiène buccodentaire, la plupart mangeaient une collation entre les repas, seulement 31,4 % ont obtenu un nettoyage dentaire professionnel au cours de leur traitement orthodontique, et 56,8 % ont connu une augmentation du niveau d'halitose après la pose d'un appareil. La plupart des répondants (79,4 %) pensaient avoir une bonne hygiène buccodentaire, mais 51,0 % parmi eux ont déclaré avoir des saignements de gencives pendant le brossage des dents, 31,4 % ont trouvé qu'ils saignaient rarement, et seulement 17,6 % ont déclaré ne pas saigner. La plupart des répondants ont convenu qu'une bonne santé buccodentaire était très importante pour le traitement orthodontique et que leurs propres efforts étaient les facteurs les plus importants. **Conclusions :** La sensibilisation des clients à l'importance de l'hygiène buccodentaire pendant le traitement orthodontique exige une amélioration. Le renforcement de l'hygiène buccodentaire par les cliniciens devrait devenir une priorité pour les clients orthodontiques.

Keywords: braces; fixed appliances; oral hygiene; orthodontics

CDHA Research Agenda category: risk assessment and management

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PRACTICAL IMPLICATIONS OF THIS RESEARCH

- Oral hygiene is important for dental health during orthodontic treatment.
- Orthodontic clients in this study brushed their teeth twice daily but were not fully aware of their oral hygiene status.
- Clinicians should improve their clients' awareness of their oral hygiene and offer oral hygiene instruction during orthodontic treatment.

INTRODUCTION

It is important for clients to maintain good oral hygiene during orthodontic treatment because poor oral hygiene can cause side effects, such as enamel demineralization, gingival inflammation, and halitosis, negatively affecting their quality of life.¹ The placement of orthodontic appliances not only promotes biofilm accumulation but also increases the level of cariogenic bacteria within the dental biofilm, resulting in an increased risk of biofilm-related side effects (e.g., enamel demineralization).² Even though the majority of clients report daily oral hygiene, the prevalence of biofilm-related oral diseases still remains high among orthodontic clients.^{1,3}

It has been shown that oral hygiene behaviour and compliance play an important role in the prevention of biofilm formation.^{4,5} For example, the modified Bass technique is often recommended by oral health professionals and in numerous textbooks. However, there is wide variation in the toothbrushing techniques used by the population, with most people brushing their teeth using simple horizontal and circular strokes.⁶⁻¹⁰ In a video observation study of toothbrushing and flossing behaviour in young adults, a significant neglect of brushing oral surfaces and insufficient use of floss was reported.⁶ A Swedish study demonstrated that clients' attitudes towards and behaviours relating to fluoride toothpaste use and toothbrushing habits were significantly inadequate even after 2 years of toothpaste intervention. The majority of study subjects indicated "fresh breath" as their prime motivation for performing oral hygiene. Dental professionals could perhaps appeal to this motivating factor during health promotion efforts.¹¹ However, these studies were performed on subjects without orthodontic appliances. To date, no specific information could be found for orthodontic clients.

The oral hygiene behaviour of clients wearing fixed orthodontic appliances is not well documented and thus poorly understood. An assessment of behavioural patterns in oral hygiene practices among orthodontic clients is essential for understanding their oral health care needs.¹² Therefore, the aim of this study was to investigate the oral hygiene behaviours, brushing techniques, and oral hygiene awareness of clients wearing fixed orthodontic appliances.

MATERIALS AND METHODS

This study was designed as a 2-centre cross-sectional survey and approved by the Sichuan Provincial People's Hospital Ethics Committee and the University of Otago Human Ethics Committee (17/101). Verbal consent was obtained from each study participant over 16 years of age or their parent for those under 16 years. A total of 200 orthodontic clients were consecutively recruited from the Sichuan Provincial People's Hospital ($n = 120$) and University of Otago ($n = 80$). The determination of sample size was based on previous cross-sectional studies^{13,14} by

setting type I error at 0.05 and type II error at 0.20 (80% power). To account for possible dropouts during the study, we aimed to recruit 200 participants. The inclusion criteria were clients wearing full, fixed orthodontic appliances for at least 1 month in upper and lower dental arches, and willingness to participate in the study. The exclusion criteria were individuals wearing lingual fixed appliances, those with extensive dental restorations, active periodontal disease, craniofacial syndromes, hypodontia, oligodontia or cleft lip/palate syndromes.

A hard copy of a 47-item questionnaire was distributed in person to each client or parent to survey the client's oral hygiene behaviours, brushing techniques, and oral hygiene awareness (i.e., the client's attitude towards and knowledge of oral hygiene). The initial version of this questionnaire was designed in consultation with senior orthodontic and public health academics and researchers at the Faculty of Dentistry, University of Otago.^{15,16} After an initial pilot interview, the data were analysed and necessary modifications were made to generate the final version of survey questions (Appendix).

Statistical analysis

Descriptive statistics were analysed using the Statistical Package for the Social Sciences (version 23.0; SPSS Inc, Chicago IL). Continuous variables were expressed as the mean \pm standard deviation (SD) if normally distributed, or as the median and quartiles if they had a skewed distribution. Categorical variables were described as counts and percentages and compared using the Chi-square test.

RESULTS

A total of 184 participants completed the questionnaire, yielding a response rate of 92%. The mean age of clients included in the study was 16.2 ± 4.3 years (67.5% female and 32.5% male). Most participants were studying in secondary schools (63.5%) and were non-smokers (94.2%).

Oral hygiene behaviour

The majority of study participants (85.1%) used a manual toothbrush; 14.9% used an electric toothbrush ($p = 0.016$) (Figure 1). More than half of the participants (60.2%) preferred a toothbrush with soft bristles, 21.0% preferred a toothbrush with hard bristles, and 18.8% preferred a toothbrush with medium bristles ($p = 0.023$). About half of the participants (49.7%) changed their toothbrushes every 3 months, 21.2% changed their toothbrushes monthly, and 29.1% changed their toothbrushes every 6 months. Most participants (88.6%) used fluoridated toothpaste, 2.8% used non-fluoridated toothpaste, and the rest of the participants (8.6%) were not sure ($p = 0.011$). The majority of the participants (80.0%) brushed their teeth twice daily, while 9.0% brushed more than twice daily ($p = 0.037$). Most of the participants (80.4%) brushed their teeth for 1 to 2 minutes. Only 19.2% of the participants performed tongue cleaning while brushing their teeth.

Only a small number of study participants used interdental brushes (15.3%), dental floss (10.2%), and mouth rinse (35.0%) during their daily oral hygiene ($p = 0.016$). About one-third of participants (33.5%) did not use any auxiliary cleaning tool (i.e., interdental brush or floss) apart from a toothbrush. Less than one-third of participants (31.4%) received professional tooth cleaning during their orthodontic treatment. A majority of participants snacked between meals, with 31.5% snacking more than twice daily, 40.2% twice daily, and 28.3% once daily ($p = 0.045$) (Figure 1).

Brushing techniques

Insofar as brushing techniques were concerned, 33.3% of the participants chose a random area to start toothbrushing, 68.7% positioned their toothbrush both horizontally and vertically, 29.3% and 2.0% used them horizontally or vertically, respectively ($p = 0.029$) (Figure 2). Most participants (60.8%) brushed their teeth with a combination of repetitive small and large strokes, 27.5% and 11.7% used only small repetitive strokes or large strokes, respectively ($p = 0.043$). Horizontal motion was the most preferred movement ($p = 0.002$) on all teeth surfaces except for the inner surface of the front teeth, where 16.8% preferred a vertical motion and 12.6% preferred a circling motion (Figure 2). More than half (54.9%) of the study participants preferred to rinse and spit after toothbrushing, while the rest (45.1%) preferred to spit only ($p = 0.252$). Lower posterior teeth were considered the most difficult to clean (58.9%), followed by upper posterior teeth (37.3%) ($p = 0.041$).

Oral hygiene awareness

Most of the participants (79.4%) described their oral hygiene as good; only 2.0% described their oral hygiene as poor ($p = 0.024$) (Figure 3). Fifty-six percent (56.0%) of participants considered their knowledge of oral health to be fair; only 19.7% reported that their knowledge of

oral health was quite poor. Close to three-quarters (72.5%) of the participants agreed that good oral health was very important for orthodontic treatment. About half (51.0%) of the participants reported their gum sometimes bled during toothbrushing, 31.4% found they rarely bled, and only 17.6% reported never bleeding. A majority of participants (84.3%) believed the most important factor for their oral health was their own efforts, and 11.8% considered both their own efforts and professional dental services to be important ($p = 0.011$).

About half of the participants (51.2%) claimed that their oral hygiene improved after orthodontic treatment, while 31.4% reported that their oral hygiene was the same, and 17.4% reported that their oral hygiene was worse after orthodontic treatment ($p = 0.043$). About half of the participants (56.8%) reported an increased level of halitosis after the placement of orthodontic appliances ($p = 0.033$) (Figure 3).

DISCUSSION

Some studies have reported that the placement of fixed appliances impedes toothbrushing and promotes biofilm formation in orthodontic clients.^{2,3} Baseline information of clients' oral hygiene behaviours is useful for the oral hygiene management and prevention of caries during orthodontic treatment. This study found that most participants used manual toothbrushes and brushed their teeth at least twice daily with fluoridated toothpastes. The majority of participants did not use auxiliary cleaning tools (i.e., interdental toothbrushes and floss) during orthodontic treatment although these auxiliary tools were provided to clients for free at their first orthodontic bonding appointment. Preferred brushing techniques included horizontal and vertical motions; a horizontal motion; and a combination of small and large strokes. Most participants reported their oral hygiene as good with a fair amount oral health knowledge. The most important factor that affected

Figure 1. Oral hygiene behaviours

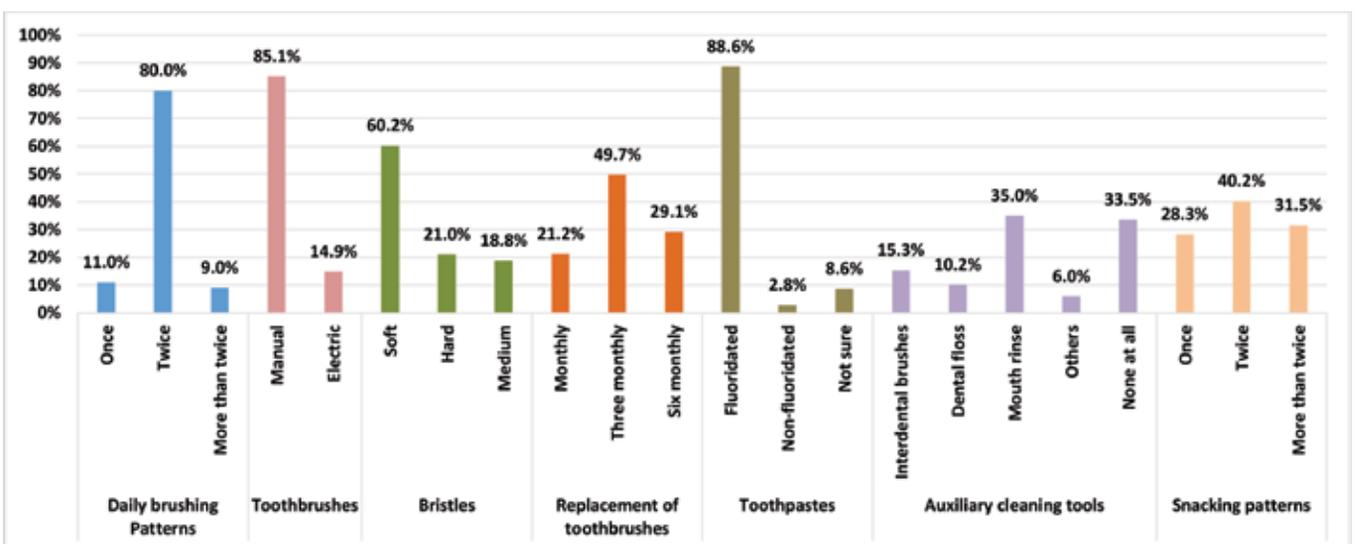
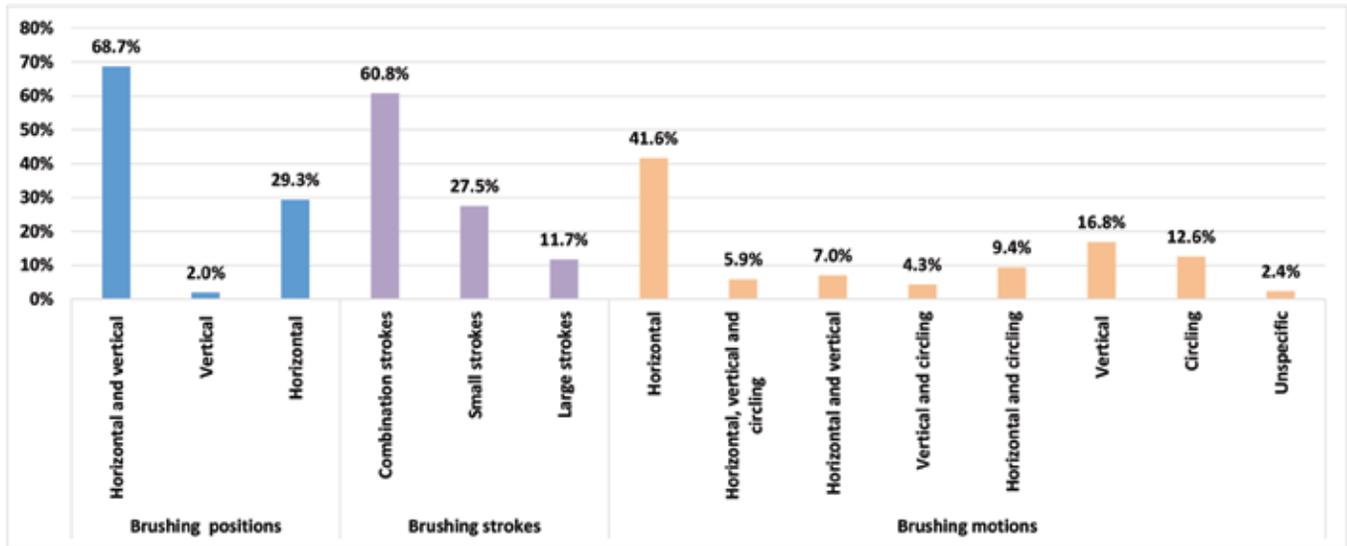


Figure 2. Toothbrushing techniques



their oral health might be their own efforts. Although half of the study participants noticed an improvement in their oral health after orthodontic treatment, no improvement in their halitosis was reported.

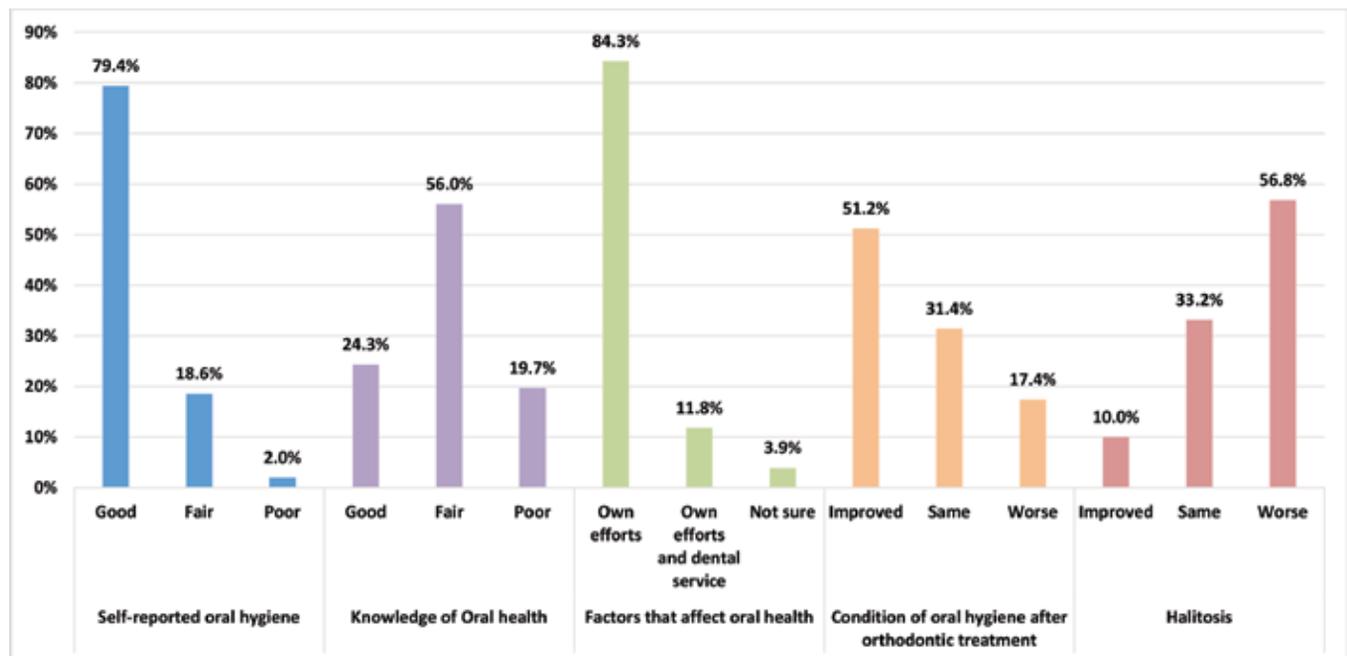
Interestingly, while only 2.0% of the study participants thought their oral hygiene was poor, the majority reported gingival bleeding during tooth brushing. This finding confirms a lack of awareness of their oral hygiene status, which was in fact poor, based on their reported bleeding of their gums.

Most of the participants in the study reported using soft-bristled manual toothbrushes with fluoridated toothpaste. Although hard-bristled toothbrushes have been

shown to remove more dental plaque, they have also been reported to cause more gingival abrasion than soft-bristled toothbrushes.^{17,18} The amount of plaque removal, however, is mainly dependent on the toothbrushing technique and time spent on brushing rather than bristle hardness. Most participants brushed twice daily, with a self-reported duration between 60 and 180 seconds, which is similar to findings from other studies.^{8,19-21}

Although the use of auxiliary aids such as floss and interdental brushes were reported by only 25% of participants, it was interesting to note that a higher percentage reported using interdental brushes (15.3%) than floss (10.2%). This finding is congruent with results

Figure 3. Oral hygiene awareness



obtained by Da'Ameh et al.²², in whose study 14.4% reported using interdental toothbrushes. However, it was lower than in other studies, which reported between 23.3% and 68.6% of subjects using interdental brushes.^{20,23}

Findings from the present study revealed a higher number of individuals (35%) reporting a preference for use of mouthrinses as another form of plaque control during orthodontic treatment. Several other studies have reported lower percentages of mouthrinse use, ranging from 25.9% to 32.6%.^{20,22,23} In addition, the present study found that a majority of participants snack at least once a day between meals. One disturbing finding was the lack of professional cleanings during orthodontic treatment, which is similar to findings of previous studies.^{23,24} As suggested by Lee et al.²³, lack of awareness, motivation, and a failure to understand the need for dental hygiene therapy could be reasons for poor oral hygiene during orthodontic treatment.

A recent study by Mei et al.¹³ investigating the factors affecting the accumulation of oral biofilm in orthodontic clients reported that study subjects were able to clean the occlusal surfaces (in relation to the bracket) of the teeth better than the gingival, mesial, and distal areas. Unfortunately, the most critical sites for biofilm accumulation are the areas cervical to the brackets and underneath the orthodontic archwires (i.e., areas mesial and distal to the brackets).¹³ Therefore, clients wearing orthodontic appliances should be instructed to clean these areas in particular. Other aids such as plaque-disclosing agents and other visual methods should be employed to motivate and educate clients.¹⁴ Several studies have also reported success with behaviour change techniques such as motivational interviewing to assist orthodontic clients in achieving better plaque control. Recommended techniques should be based on the client's age and individual case.

Although the modified Bass technique has been the most commonly recommended toothbrushing technique by dental professionals and dental associations,^{9,10} neither the Bass toothbrushing technique nor the Modified Bass toothbrushing techniques were observed in a study of uninstructed adults.²⁵ Circular brushing motion was reported as the most preferred habitual toothbrushing motion.²⁵ It has been reported that study subjects brushed different areas of the mouth with different types of strokes, predominantly with horizontal and circular strokes on the buccal and labial surfaces, horizontal strokes on posterior teeth, and vertical strokes on anterior teeth in non-orthodontics clients.⁶ In the present study, participants reported mostly using horizontal motions to clean their teeth and appliances; this finding may be due to the practical convenience and the limited space between the braces and gingival margin or to a lack of knowledge of other techniques. Although spitting without rinsing after toothbrushing with fluoridated toothpaste has

been shown in studies to preserve fluoride relatively longer in the oral cavity,²⁶ more than half of the participants in this study did not indicate doing so. The majority of participants in previous studies^{13,14} claimed that the oral hygiene instruction given before and during orthodontic treatment was not specific and practical enough, indicating the need to reinforce oral hygiene instruction, especially visually aided approaches, in clients wearing orthodontic appliances. This finding is in agreement with our study findings.

In the present study, participants' awareness of their oral hygiene status was not encouraging as the majority were satisfied with their own oral hygiene, even though more than half of the participants had unsatisfactory oral hygiene according to the literature.^{3,13} Our research finding is similar to a previous study from Sweden, in which 90% of subjects were found to have poor oral health knowledge. Despite the subjects' attitude towards their oral hygiene status and their oral hygiene knowledge, they believed their oral hygiene was satisfactory.²⁷

Limitations

There are some limitations to this study. Although the study was carried out in 2 clinical centres, the sample size was small. Future studies could consider broadening the recruitment range to account for potential influences of demographic and socioeconomic factors on participants' oral hygiene behaviour. In addition, the frequency of visiting dental hygienists and dentists may also cause potential bias in reinforcing oral hygiene instruction. Since the course of orthodontic treatment is relatively long, it would be interesting to repeat and compare the questionnaire at the beginning and end of orthodontic treatment to identify whether oral hygiene behaviours change over time. Future studies could also consider both quantitative and qualitative methodologies for data collection and analysis to identify possible results not covered by a survey questionnaire.

CONCLUSION

Most study participants brushed their teeth twice daily with a soft manual toothbrush and fluoridated toothpaste but were not fully aware of their oral hygiene status. Clinicians should improve their clients' awareness of their oral hygiene during orthodontic treatment. Reinforcement of oral hygiene instruction is recommended in all cases of orthodontic treatment.

CONFLICTS OF INTEREST

The authors have declared no conflicts of interest.

APPENDIX: SURVEY QUESTIONNAIRE

Survey Introduction

We invite you to take part in this survey which covers a wide range of topics relating to the oral hygiene during your orthodontic treatment.

If you are older than 16, you can take the questionnaire on your own; if you are younger than 16, the questionnaire is advised to be completed under your parents'/caregivers' supervision.

All responses are confidential. Data entry and analysis will be done using anonymised data.

Demographics

1. How old are you? _____
 2. Are you a male or female?
 - Male
 - Female
 3. Which one of the followings best describes your ethnicity?
 - NZ Māori
 - NZ European/Pakeha
 - Pacific Islander
 - Asian
 - Other (please specify)
 4. What is the highest degree or level of school you have completed?
 - Primary school (Year 1-6)
 - Intermediate school (Year 7-8)
 - Secondary school (Year 9-13)
 - Tertiary qualifications (diploma, bachelor, PhD, etc.)
 - Other (please specify)
 5. Do you smoke?
 - Yes
 - Yes, e-cigarette
 - No, but I'm an ex-smoker
 - No, I never smoked before
- Oral hygiene practices: General aspects**
6. Do you brush your teeth using a manual toothbrush or an electric toothbrush?
 - Manual toothbrush
 - Electric toothbrush
 - Other (please specify)
 7. What type of toothbrush do you use?
 - Hard
 - Medium
 - Soft
 - Ultrasoft/slim soft
 - I don't know
 8. Does your toothpaste contain fluoride?
 - Yes
 - No
 - I don't know
 9. How regularly do you change your toothbrush?
 - Every month
 - Every three months
 - Every six months
 - Every year
 - Other (please specify)
 10. How often do you brush your teeth?
 - Less than once a day
 - Once a day
 - Twice a day
 - More than twice a day
 - Don't know
 11. When do you brush your teeth? (Tick all that applied)
 - In the morning
 - After breakfast
 - After lunch
 - After dinner
 - At night time before bed
 12. How long does it usually take to brush your teeth?
 - Less than 1 minute
 - 1 to 3 minutes
 - 3 to 5 minutes
 - More than 5 minutes
 - I don't know
 13. Do you clean/brush your tongue?
 - Always
 - Sometimes
 - Rarely
 - Never
 14. Do you usually use interdental brushes (fingernail sized small brushes) to clean behind braces?
 - Yes, always
 - Yes, but only when needed
 - No, never heard of them before
 - No, know what they are but don't have them
 - No, have them but rarely used them
 15. Do you floss?
 - Yes, everyday
 - Yes, but only when needed
 - No, used to floss but now don't know how to floss around braces
 - No, never know how to floss
 - No, I know how to floss but I don't do it
 16. Do you usually use any other cleaning aids to maintain your oral hygiene? (Please tick all that applied)
 - Nothing else
 - Mouth rinse
 - Chewing gum
 - Toothpick
 - Waterpik
 - Fluoride gel/paste/drop/foam/varnish/tablet
 - Tooth mousse (CPP-ACP)
 - Other (please specify)
 17. How often do you use the cleaning aids?
 - Rarely or never
 - Occasionally
 - Once a day
 - After every meal
 18. How often do you eat snack between meals?
 - About 3 times per day
 - About twice a day
 - About once a day
 - Occasionally, not everyday
 - Rarely or never

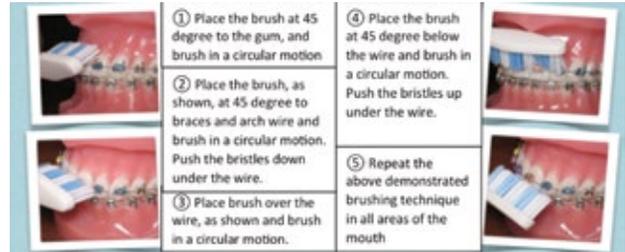
19. Have you received a professional cleaning since you started wearing braces? (A professional cleaning is usually performed by a dental hygienist or a dentist)
- Yes
 - No, never since had braces on
 - No, never had professional cleaning before

Tooth brushing techniques

20. Which teeth do you begin to brush?
- Upper right teeth
 - Upper left teeth
 - Lower right teeth
 - Lower left teeth
 - Randomly
21. Are you using your toothbrush
- Horizontally (as shown as photo 1)
 - Vertically (as shown as photo 2)
 - Both
22. Which one of the following brushing techniques do you use while brushing?
- Small repetitive strokes
 - Large strokes
 - Combination of the two
 - Other (please specify)
23. When you brush the OUTER side of BACK teeth (cheek and lip side), which of the following movement(s) do you use? (Please tick all that applied)
- Horizontal (left and right)
 - Vertical (up and down)
 - Circling (like drawing circles)
 - Unspecific movements (please describe)
24. When you brush the INNER side of BACK teeth (tongue side), which of the following movement(s) do you use? (Please tick all that applied)
- Horizontal (left and right)
 - Vertical (up and down)
 - Circling (like drawing circles)
 - Unspecific movements (please describe)
25. When you brush the BITING SURFACE of BACK teeth, which of the following movement(s) do you use? (Please tick all that applied)
- Horizontal (left and right)
 - Vertical (up and down)
 - Circling (like drawing circles)
 - Unspecific movements (please describe)
26. When you brush the OUTER side of FRONT teeth (lips side), which of the following movement(s) do you use? (Please tick all that applied)
- Horizontal (left and right)
 - Vertical (up and down)
 - Circling (like drawing circles)
 - Unspecific movements (please describe)
27. When you brush the INNER side of FRONT teeth (tongue side), which of the following movement(s) do you use? (Please tick all that applied)
- Horizontal (left and right)
 - Vertical (up and down)
 - Circling (like drawing circles)
 - Unspecific movements (please describe)

28. After tooth brushing do you usually
- Just swallow
 - Rinse and swallow
 - Rinse and spit
 - Just spit
 - Don't know
 - Other (please specify)

29. Which of the following instructions are you applying with?



Oral hygiene practices: Before and after your orthodontic treatment

30. Were you using electric toothbrush before the orthodontic treatment?
- Yes
 - No
31. Have you received oral hygiene advices before having your braces?
- Yes and it was helpful
 - Yes but I don't remember
 - No
32. After receiving the advices, did you change your tooth brushing techniques?
- Yes
 - No
33. Since you had braces, which area(s) is/are the most difficult to clean? (Tick all that applied)
- Upper front teeth
 - Upper back teeth
 - Lower front teeth
 - Lower back teeth
34. If you compare your oral hygiene before and after having your braces, do you think your oral hygiene?
- Has improved
 - Is more difficult to maintain
 - Is the same
35. Comparing to before and after having braces, do you spend more time to clean/brush your teeth?
- Yes
 - No
 - Same
 - I don't remember
36. Have you had bad breath?
- Before having braces
 - After having braces
 - Both before and after
 - None

Oral hygiene awareness

37. How would you describe your oral hygiene?
- Excellent
 - Very good
 - Good
 - Fair
 - Poor
 - Don't know
38. Is your orthodontic practitioner (postgraduate student and/or clinical supervisor) happy with your oral hygiene?
- Yes
 - No
 - I don't know
39. Your knowledge regarding tooth decay and gum disease is:
- Good
 - Fairly good
 - Fair
 - Quite poor
 - Poor
40. How important is it for you to clean your teeth?
- Very important
 - Fairly important
 - Less important
 - Not at all
41. How important is it for you to have healthy oral conditions?
- Very important
 - Fairly important
 - Less important
 - Not at all
42. Do you know the reasons why it is important to maintain a high level of oral hygiene during your orthodontic treatment?
- Yes
 - No
43. Are you aware that oral health is related to systemic (general) health?
- Yes
 - No
44. Does your gum bleed when you brush your teeth?
- Always
 - Sometimes
 - Rarely
 - Never
45. What is the most important factor for your future oral health?
- My own efforts
 - The dental health service
 - Other (please specify)
46. Did your parents/caregiver remind you to brush your teeth?
- Yes
 - No
- Additional comments**
47. Please add any further comments you may have:

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Perceptions of access to oral care at a community dental hygiene clinic for women involved with the criminal justice system

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ABSTRACT

Background: Women involved with the criminal justice system are often marginalized or vulnerable and may face oral health inequities. Through a community-engaged program at a Canadian university, dental hygiene students provided preventive care at an organization supporting this population. This study explored the impact of these oral care services from client and organization staff perspectives. **Methods:** One focus group with 6 clients, 2-person interviews with 4 clients, individual interviews with 3 clients, and one focus group with 4 organization staff members were conducted. Discussions were audio recorded, transcribed verbatim, and analysed thematically. The concept of access, proposed by Penchansky and Thomas (1981) and Saurman (2015), was used as the conceptual framework to organize the themes. **Results:** Nine themes were identified from the focus group and interview discussions: limited options, convenience, realistic expectations, respect and attention, no judgement, physical environment, communication, clients' unique needs, and appropriate messaging. **Discussion:** The clinic's close proximity and services, for which women did not need to pay out-of-pocket, facilitated access to preventive care. The person-centred and trauma-informed care further facilitated access. However, access to comprehensive care through referrals was limited by cost and likely issues of stigmatization from other dental care providers. Clinic aesthetics, advertising, and communication between the students and women receiving care also hindered access. **Conclusion:** Preventive oral care services provided at this clinic for marginalized and vulnerable women who have been involved with the criminal justice system were valued by clients and staff. Findings will help inform future community-based dental hygiene clinics for this population.

RÉSUMÉ

Contexte : Les femmes qui font face au système de justice pénale sont souvent marginalisées ou vulnérables et peuvent être confrontées à des inégalités en matière de santé buccodentaire. Dans le cadre d'un programme engagé sur le plan communautaire, mis en place dans une université canadienne, des étudiants en hygiène dentaire ont prodigué des soins préventifs dans une organisation qui soutient cette population. La présente étude a exploré les répercussions de ces services de soins buccodentaires du point de vue des clients et du personnel de l'organisation. **Méthodologie :** Un groupe de discussion comprenant 6 clients, des entrevues à 2 personnes avec 4 clients, des entrevues individuelles avec 3 clients et un groupe de discussion avec 4 membres du personnel de l'organisation ont été menées. Les discussions ont fait l'objet d'un enregistrement sonore, puis ont été transcrites textuellement et analysées par thèmes. Le concept d'accès, proposé par Penchansky et Thomas (1981) et Saurman (2015), a été utilisé à titre de cadre conceptuel pour organiser les thèmes. **Résultats :** Le groupe de discussion et les entrevues ont permis de définir 9 thèmes : choix limités, commodité, attentes réalistes, respect et attention, absence de jugement, environnement physique, communication, besoins uniques des clients, et messages appropriés. **Discussion :** La proximité et les services de la clinique, pour lesquels les femmes n'avaient pas à payer de leur poche, ont facilité l'accès aux soins préventifs. Les soins axés sur la personne et les soins adaptés au traumatisme ont davantage facilité l'accès. Cependant, l'accès à des soins complets par l'intermédiaire de renvois a été limité par le coût et les enjeux de stigmatisation probables de la part d'autres fournisseurs de soins dentaires. L'esthétique de la clinique, la publicité et la communication entre les étudiants et les femmes recevant les soins ont également entravé l'accès. **Conclusion :** Les clients et le personnel ont attribué une valeur aux soins buccodentaires préventifs fournis à cette clinique réservée aux femmes marginalisées et vulnérables qui ont été impliquées dans le système de justice pénale. Les résultats permettront d'orienter les cliniques communautaires futures d'hygiène dentaire destinées à cette population.

Keywords: community dentistry; community-institutional relations; criminal justice system; dental clinics; dental health services; health services accessibility; oral health; oral hygiene; vulnerable populations; women

CDHA Research Agenda category: access to care and unmet needs

PRACTICAL IMPLICATIONS OF THIS RESEARCH

- Dental hygiene students who participate in community-based learning engage with a wide range of populations and learn about the socioeconomic factors that affect access to oral care.
- Understanding how to provide appropriate oral care to women involved with the criminal justice system may improve dental hygiene services and access for this marginalized and vulnerable population.

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INTRODUCTION

Women who are involved with the criminal justice system (CJS) are a subset of women in our society who are often marginalized or vulnerable. These women have been touched in some way by the CJS: they may have experienced incarceration themselves, may be at-risk for incarceration due to poverty, homelessness or substance use, or they may have a parent, child, other family member or partner who has been incarcerated. Women who are marginalized or vulnerable because of homelessness,^{1,2} substance use³ or incarceration^{4,5} have often had disadvantaged and traumatic backgrounds and experience inequities in oral health and access to oral care. Individuals experiencing homelessness in Toronto, Canada, have poor oral health and limited access to dental care.² Individuals in England who use drugs also have greater difficulty accessing dental services and a significantly higher level of oral health problems compared to those who are gender and age-matched who do not use drugs.³

Oral health status and access to oral care for women incarcerated in Canada is not well documented. However, a 2017 study highlighted that access to dental care is important to help keep women out of prison.⁶ Lack of access to dental care in the community was associated with self-reported reengagement in criminal activity for women released from provincial incarceration in British Columbia.⁶ Women incarcerated in London, England, are more likely to have poor oral hygiene, an increased incidence of caries, higher sugar intake, and to smoke and use drugs compared to those who are not incarcerated.⁵

Women in transition from incarceration to living in the community face unique barriers to oral health care in Canada. In 2017, 14% of adults admitted to provincial and territorial correctional institutions and 8% admitted to federal institutions in Canada were female,⁷ with an overrepresentation of Indigenous women.⁸ Women in correctional institutions in Canada often serve short sentences⁹ and face many transitional challenges after incarceration, including obtaining employment, securing housing, and accessing health care.^{10,11} Women leaving prison have expressed the desire to improve or maintain their oral health during the transition period,¹²⁻¹⁴ yet the financial burden of dental services in Canada^{15,16} and the stigma of incarceration,¹⁷ lack of housing or poor oral health¹⁸ can hinder access to health care. In a study exploring access to dental care for previously incarcerated individuals in New Brunswick, 33% of formerly incarcerated individuals said their access to dental care had improved compared to access in prison, 23% said it had decreased, and 44% said it remained the same after release from prison.¹⁴ The privately administered and delivered model of oral health services in Canada may be insufficient to meet the needs of women who are marginalized or vulnerable, and an alternative method to provide accessible oral care is needed.

Given the privately delivered model of oral health services in Canada and the complex issues around access to oral care, community-engaged learning within dental hygiene programs may offer the opportunity to address oral health inequities through advocacy, health promotion, and the provision of preventive care and oral health education. It also allows those involved to learn directly from each other.

One of these community-engaged learning initiatives was established in 2013 by the University of British Columbia's dental hygiene degree program and the Elizabeth Fry Society of Greater Vancouver (EFry), located in New Westminster, Canada. EFry is a non-profit organization that was originally established to support women preparing to leave prison, but now also supports women and their families who are marginalized or vulnerable due to a variety of experiences with the CJS including incarceration, homelessness, substance use, and having a family member or partner who has been incarcerated. EFry offers programs and services that emphasize gender-specific support and aims to address issues of poverty, homelessness, addiction, and mental health problems specific to women. In this community-engaged learning program, fourth-year dental hygiene students provide preventive oral care with no out-of-pocket costs, oral health education, health promotion, and referrals for dental care for women and their children who are clients of EFry. The clinic is located within a women's drop-in centre, which offers a safe space for women who are marginalized or vulnerable and/or who have experienced trauma from men—a frequent occurrence among justice-involved women¹⁹—to seek shelter, wash clothes, eat, socialize, and collect donated clothing.

EFry is currently planning for a new dental clinic to provide comprehensive oral health services to its clients. Identifying how clients and staff at EFry perceive the current dental hygiene clinic will help to inform the development of this new clinical space. This study aimed to explore clients' and EFry staff's perceptions of how the clinic has influenced access to oral health care, and addressed the following question: "How has the current community-based dental hygiene clinic influenced access to oral care for women impacted by the criminal justice system?"

METHODS

Ethical approval was received from UBC's Behavioural Research Ethics Board (H14-01925). Focus groups, 2-person interviews, and individual interviews were conducted with clients and EFry staff to explore perceptions of the clinic and how it has influenced access to oral care. Previous client satisfaction surveys were also reviewed.

Review of client satisfaction surveys

Data from 62 satisfaction surveys, which clients were encouraged to complete after receiving preventive services, were analysed quantitatively and qualitatively to identify access-related aspects of the clinic that clients perceived

as satisfactory and less satisfactory. Such aspects helped to inform the interview guide.

Focus groups and interviews

Qualitative methods were used to explore how the clinic influenced access to oral care from the perspective of clients and EFry staff. The concept of access to health care, proposed by Penchansky and Thomas²⁰ and Saurman²¹, was used as the conceptual framework for this study and the reporting of its findings. In this framework, access to health care is a concept with 6 interrelated dimensions: affordability, accessibility, availability, acceptability, accommodation, and awareness.^{20,21} Affordability describes the relationship between service costs and clients' ability to pay.²⁰ Accessibility describes the relationship between the location of the service and clients and focuses on transportation, distance, and cost to reach the service.²⁰ Availability describes whether the amount and type of service meet clients' needs.²⁰ Acceptability refers to clients' attitudes towards the service or provider and the provider's attitude towards clients.²⁰ Accommodation refers to the interaction between how a service is organized to accept clients, including appointment scheduling and operating hours, and clients' perceptions of these factors.²⁰ Finally, awareness refers to the clients' awareness that the service exists and their ability to access the service.²¹

The study used purposive sampling to recruit EFry staff members to participate in a focus group. Two EFry staff members helped identify 8 staff members in different roles and programs who have close contact and engagement with clients who access services at the dental hygiene clinic or who might have unique perspectives on how the clinic has influenced access to oral care for this subset of clients. Among the 8 individuals identified, 4 staff participated. These staff members worked in the building in which the dental hygiene clinic was located, in various roles and programs, including a women's drop-in centre, a transition house, housing services, and organization administration. Three of them directly engaged with clients in their daily work. Convenience sampling was used to recruit clients to participate in focus groups; clients were recruited through posted flyers around the EFry building. Client participants had to be 18 years of age or older, English-speaking, and a past or present client of the dental hygiene clinic. Clients of the clinic and clients who participated in our study were not asked specifically about their experiences with the CJS, including incarceration, to create a low-barrier clinic and to avoid potentially stigmatizing the women. Six clients participated in a first focus group (conducted by author LRD). Because of difficulties in recruiting participants for additional focus groups, author KMH conducted 2-person interviews with 4 clients, one of whom had also participated in the first focus group, which was later discovered. Continuing difficulties in recruiting clients to meet in-person for a focus group prompted author KMH to conduct individual phone interviews with 3 other client participants.

A semi-structured interview guide was developed for the focus group with EFry staff and for the focus group and interviews with clients based on the concept of access^{20,21} and the review of satisfaction surveys. This guide allowed participants to discuss aspects of the clinic important to them while also emphasizing access-related issues. Examples of interview questions are, "What are some reasons why you decided to come to the dental hygiene clinic here, as opposed to going to a different clinic?" and "What do you think about the appointment system here at the clinic?" Clients received a \$25 grocery store gift card for their time. Staff did not receive an honorarium as they were being compensated through their employment while participating in the study. Qualitative data collection and analysis were conducted concurrently so data analysis from previous focus groups and interviews could inform the remaining focus groups and interviews. Data from the focus groups, interviews, and client satisfaction surveys were also compared to ensure credibility of the findings by identifying common factors related to access.

Qualitative data analysis

Focus groups and interviews were audio recorded and transcribed verbatim, and transcripts were managed in NVivo 12™ (QSR International). Data from the focus groups and interviews were analysed thematically, as described by Braun and Clarke.²² Transcripts were each reviewed once and compared to the audio recording to ensure accuracy and familiarity with the data.²² The study used an inductive approach to thematic analysis to analyse the focus group and interview data; data were analysed on their own, and codes and themes were identified apart from the conceptual framework used.²² Data that related to the research question were coded line-by-line; extracts of data from the transcripts, rather than individual data items, were coded to ensure that context of the discussions was retained.²² Codes were then organized into themes, which were identified based on their prevalence across focus groups and interviews; a theme was defined as salient if it was voiced by more than one participant.²² Thematic analysis was iterative by which codes were revisited to ensure their consistent application within and across transcripts. Themes were then arranged within the 6 dimensions of the concept of access mentioned earlier.^{20,21} Collection of focus group and interview data was conducted concurrently with thematic analysis until no new or "surprising" codes and themes were identified.²³

To ensure trustworthiness of the analysis, 2 authors (KMH and LRD) made preliminary codes for the first focus group separately and met to discuss the coding until reaching consensus. KMH then carried out the remainder of the thematic analysis, meeting with the other authors frequently. To ensure validity of the initial thematic analyses, 7 client participants were contacted by phone and given an opportunity to provide feedback about their input and the analysis as a member checking exercise.²⁴

Four client participants chose to listen to a short summary analysis over the phone; 2 chose to review the entire transcript sent by email as requested; and 1 participant chose to review both and was given a hard copy of the transcript in person. All 7 participants were satisfied with the initial analyses and 5 provided additional information and clarification to their initial statements. One participant who reviewed the entire transcript also changed the wording and grammar of a phrase she had initially said in the focus group to better reflect what she wanted to convey.

RESULTS

Review of client satisfaction surveys

Survey respondents were satisfied with their care and grateful for the service. Some aspects of the dental hygiene clinic were perceived as less satisfactory, including whether the oral care providers had the necessary supplies to provide care, clients' comfort level in receiving care, the perceived impact on clients' oral health knowledge, whether the care providers explained the time needed for treatment, and whether clients received a referral for additional care (Table 1). Respondents made suggestions to improve the clinic atmosphere, including music for distraction purposes, more comfortable dental chairs, and brighter lighting (Table 2). To improve care, suggestions included providing explanations about the nature of and time needed for care, having specialized oral self-care supplies for clients, and providing written oral self-care resources (Table 2).

Access to oral health care

Based on the focus groups and interviews with clients and organization staff, 9 themes were identified in relation to access to oral health care. For the purposes of reporting and in the interview transcripts, all participants were assigned a pseudonym.

1. Limited options—Affordability

Not needing to pay out-of-pocket for the services provided was a major reason for attendance at the clinic. As Melanie

and many other participants told us, “[You’re] the only ones that do free cleaning...everywhere [else] you either need coverage, insurance coverage or work coverage.” Clara also described how limited options for affordable oral health care can exacerbate oral health problems, and how the clinic’s affordability allowed her to access care and become aware of such problems:

If [the clinic] wasn’t for free, honestly, I wouldn’t have [come] and I wouldn’t know what was going on so I would have neglected [my mouth], it would have got worse, I would have been in pain, I wouldn’t have been able to eat properly. So to be aware of what’s going on was awesome.

Participants whose coverage would have been limited to diagnostic or emergency treatment, or maximized if they had to use it for restorative care, were able to receive preventive services without using their current dental coverage, as Carrie described:

I receive government disability benefits so there’s only a limited amount of funds for a two-year period of time, and I find that the government benefits are not adequate... I wanted to try it to see what this clinic was like, and not to exhaust my government benefits too quickly.

Some participants related affordability to the convenient location of the clinic, which mitigated transportation costs had it been located elsewhere. As Sabrina told us, “It’s free! So I like to come to here. Otherwise I have to take a bus, two-zone fare, to pay the fare, then pay the cleaning fee.”

2. Convenience—Accessibility

The clinic was accessible because it is conveniently located in the same building where clients attend for other services, as well as being close to public transit and participants’ place of residence or employment: “It’s convenient. It’s

Table 1. Participant responses to each satisfaction factor

Satisfaction factor	Agree/Partly agree (%)	Neutral (%)	Partly disagree/ Disagree (%)
Student was able to provide a referral for additional care (n = 54)	72.2	22.2	5.6
Clear explanations about time to complete care (n = 62)	80.6	8.1	11.3
This clinic improved oral health knowledge (n = 56)	89.3	7.1	3.6
Felt comfortable receiving care at this clinic (n = 56)	94.6	1.8	3.6
Student had the equipment and supplies to complete my care (n = 55)	98.2	0	1.8
Clear explanations about details of care (n = 62)	100.0	0	0
Information is kept private and confidential (n = 56)	100.0	0	0
Respectful treatment (n = 62)	100.0	0	0

Table 2. Examples of survey respondents' suggestions to improve the clinic and care

Satisfaction factor	Comments
Clinic location	A location closer to Vancouver
Clinic environment	I'm comfortable with student and instructor, however, the light and supplies is [sic] not enough
	Needs better ceiling lighting
	Better arm rest supports
	Music is a healthy distraction
Student–client communication	Why are we checked for cancer? The feeling of face or throat (student professional) can feel uncomfortable. Also if every tooth gum must be poked-checked. My student was respectful, professional my question was about the reason for the procedure itself as we all have different life experiences.
	Time estimate would be useful
	It would be nice to have a phone # to contact you throughout the week
Having specialized oral self-care supplies	Have some equipment needed by patient—did not have the reach brush for back teeth
Providing written oral self-care resources	A sheet from the student dentist about how to take care of my teeth maintaining oral health

free and I'm always here at the drop-in, why not [attend the clinic]" (Rachel). For other participants, the location of the clinic was seen as inconvenient because of the cost of travel, as voiced by Melanie:

I didn't bring my children because normally everything that they need is covered by assistance. So I can go somewhere closer to where we live for them... To take the SkyTrain it costs me ten dollars for a bus pass each day that I went, which took two days to fully clean my whole mouth. And, if I had to cart two children...that would be more difficult. Plus extra [money] for [transit] passes.

3. Realistic expectations—Availability

Preventive services including oral health assessments, periodontal therapy, fluoride varnish, oral health education, sealants, temporary restorations, and referrals were available to meet clients' needs, but not other dental services, as Rachel commented:

I wish there's the same service you're getting for the hygiene thing if we could have like, free dentist...even if it's gonna take a long time, if it's gonna be...in a school setting, it's okay as long as [my mouth problems] can be taken care of.

Participants discussed that the cost of referred care precluded them from having their dental needs met, and that they would only access the referred care when in pain. While participants were seeking services beyond what the dental hygiene clinic provided, including orthodontic services, extractions, restorations, and crowns, they had realistic expectations, as voiced by Lauren:

There's only so much free stuff that they can do for you, right? I mean if you wanna get like surgery, or fillings, or root canals you can't because, that's not what you guys do, right?

4. Respect and attention—Acceptability

Participants valued their interactions with the dental hygiene students and clinic instructor and perceived them to be respectful and attentive. Participants felt respected in terms of how they were greeted: "Last time I was there [she] remembered me...she's like 'Oh yeah, I know you from before', and yeah, I really like her" (Lauren). Participants valued being called by their names, while attention during appointments was also valued, as Jamie explained: "They didn't leave me sitting in the chair to go and do anything else. The attention was constant." Melanie further described how attentive the students were, frequently checking in to ensure her comfort: "[The student] constantly asked me if I was okay, how I was doing, like she really did try and be gentle. She wasn't just like zoning in and working away at it like it was a sculpture...She knew there was a person behind those teeth." Respectfulness was further demonstrated through the provision of clear explanations of the time needed to complete care and the oral procedures to be performed. Carrie described why she values such explanations:

I care about my body. I want to know what goes on, everything... Every part of my body, my mouth is very important, my teeth are important, an important part of my physique. In my opinion, in general, if a person is performing this type of invasive procedure in someone else's body, explanations should be given, except for urgent or emergency situations.

5. No judgment—Acceptability

Participants also valued that they were not judged or looked down upon because of who they are. Allie, for example, did not feel judged due to her gender: “When they know I’m transgender they don’t [make me] feel [like] I’m [a] different person to any person here... They wanna make sure I’m okay.” Melanie was relieved she was not judged by the condition of her dentition or income level:

They didn’t look grossed out when they saw how unclean my teeth were...you always worry about how they’re gonna react, when they look in your mouth and see the neglect... They didn’t treat me as if I was any lower than they were. ...I didn’t feel judged.

However, Melanie later described an experience at the clinic in which she felt subtly judged because she felt she was perceived as not being able to afford further dental care:

[The student] said we could talk about [a referral] after and then we just didn’t. ...I think I even felt discouraged before even knowing anything...she said it would cost still like at least a hundred dollars a month, probably on some payment plan. So I don’t know, she just figured I couldn’t afford that or, I’m not really sure why.

While clients viewed the dental hygiene students as non-judgmental, staff also described how the clinic’s location at EFry created a low-barrier and less judgmental environment compared to typical dental clinics, as Daniela discussed:

...I’ve heard from some of my clients that had to go access a dentist and call, and even just to make that phone call there’s that barrier there, there’s that judgement that they hear on the other end of the phone. So, to actually come here and know that...it’s a safe environment, you know, it’s part of the EFry program.

Serena, another EFry staff member, similarly noted how clients may have difficulties attending referrals at other dental clinics due to acceptability considerations:

...I think the fact [the clinic is] in our building...makes a big difference... Part of the issue with when you guys make referrals, and then clients don’t go to the referrals, it’s that they don’t want to or that they can’t take that extra step to get themselves in that other location.

6. The physical environment—Acceptability

The environment of the clinic within the women’s drop-

in centre was perceived differently by clients. Most participants accepted the environment: “[The clinic feels] at home...this is my second home... I used to be here every single day” (Rachel), while others did not:

I was expecting...sort of a good set up, and I saw what they had to work with. I did feel a little bit more uncomfortable. Just because I was thinking “is this actually sanitary enough?” ...Like their tools look shiny and they got a tray, but the floor looks...well used... But you get past that and you realize what they’re doing for the greater cause. (Melanie).

Participants described the clinic as dimly lit and small in size but accepted that, as Lauren said, because “you have to make do with what you have.” Participants perceived the small size to be mostly problematic for the dental hygiene students as they needed to navigate a small space, and some perceived such navigation problems as affecting the length of the appointments.

7. Communication—Accommodation

The clinic is organized to accept clients over the phone or in person, and clients perceived the availability of walk-in appointments as accommodating. Both clients and staff discussed difficulties in communicating over the phone, as noted by Serena: “There’s sometimes...a disconnect in clients trying to connect with the students and get appointments made or things sorted out, or information clearly conveyed between the two sides.” Clara discussed how the availability of walk-in appointments was accommodating for her in spite of such communication difficulties:

I think we had a little bit of difficulty with [making an appointment]. My support worker was trying to call...she left a message, and no reply back. So I kind of just showed up. And I guess there was an available spot where someone didn’t show up. So I was lucky to get in.

The clinic’s limited operating hours made it difficult for dental hygiene students to contact clients in a timely manner, and staff discussed how this could be perceived as unaccommodating given the clients’ often transient lifestyles. Serena explained, “The client might not even remember making that phone call...or be around anymore!” Clients also reported difficulties in communicating over the phone but did not perceive these difficulties as problematic, although one participant was frustrated because they ended up communicating through voicemails.

Staff also discussed how their clients may have difficulty expressing their needs when contacting referral appointments, as Rachele, an EFry staff member, highlighted, “If [the referral] was for a specific cause in the

mouth, they might not know the words to use to say that.” Serena further discussed how to accommodate clients through the referral process:

What I think could make a difference...is that we don't do it for them but that we support them in doing it... We might write some notes about what they would say on the phone if they're nervous about that—"I don't know how to talk to this person," "What do you say?"

8. Clients' unique needs—Accommodation

Participants appreciated that the dental hygiene students accommodated their unique needs. Melanie described how the students considered her children during appointments: “They watched [my children] for me outside of the working room... I don't think any other dentistry place would have been able to do that.” Sabrina also described how the clinical instructor (the dental hygiene student faculty mentor) accommodated her care needs because she performed maintenance care during the summer when the students were unavailable.

9. Appropriate messaging—Awareness

Participants became aware of the clinic through volunteering at EFry, hearing about it from support workers, from word-of-mouth at a women's shelter nearby, and from posted flyers. However, overall awareness of the clinic seemed to be poor. Participants noted that other EFry clients were unaware of the clinic, and some others might have assumed that preventive services could not meet their oral health needs. Staff discussed how some clients with low English literacy might not understand information on clinic flyers, as explained by Serena: “We put up all these posters everywhere but a lot of our clients aren't reading those posters. Or they just see, you know, certain words like ‘UBC’ or ‘students’ and so they don't take in that information.” Clients and staff discussed methods to better inform other clients, including having dental hygiene students facilitate face-to-face information sessions for clients and staff. Serena also noted the power of peer influence: “If [clients] can talk to other clients who have gone [to the clinic] you can see a shift in their attitude.”

DISCUSSION

This study explored how a community-based dental hygiene clinic influenced access to oral health care for women involved with the CJS in New Westminster, Canada. The clinic's affordability and convenience and the respectful, attentive, and non-judgmental quality of the care provided facilitated access, while alternate communication approaches and clinic promotion strategies should be considered to further facilitate access.

Affordability, accessibility, and availability

Clients discussed how the cost of oral care and transportation, as well as the availability and affordability of comprehensive services affected their ability to access oral care. Clients discussed the limited availability of oral health services in the community that do not require out-of-pocket fees, suggesting that this clinic presented a unique opportunity for women to receive preventive care, which would otherwise be unaffordable. The cost of oral health care is a major barrier for Canadians, as 17.3% of those in the general population avoid visiting the dentist due to cost.²⁵ Clients who received public dental benefits said their benefits are limited and do not financially support all of their oral care needs. They also discussed how their fixed income precludes their ability to afford transportation to and from oral care services. This finding is unsurprising since the majority of those involved with the Canadian CJS live at or below the poverty line,²⁶ and transportation and treatment costs are the main reasons people avoid the dentist.¹⁶ The cost of care and transportation are also barriers to oral care specifically for people who experience homelessness,¹ an important consideration since women involved with the CJS may experience homelessness. While transportation was identified as a general access barrier, clients were willing to cover transportation costs to this clinic, suggesting that other factors besides affordability influenced access. In regard to access to comprehensive care, while students provided referrals to trusted, low-barrier, reduced-cost clinics located in the clients' own neighbourhoods, women expressed that even these services would be difficult to accommodate financially.

Although not discussed by participants in this study, availability of services may also affect access to care, particularly for individuals receiving social assistance whose perceptions of oral health may lead them to opt for dental services that improve their appearance.²⁷ Other women may have thus not attended the current clinic due to the unavailability of onsite dental services that women perceived as having the potential to improve their appearance. Overall, the realistic expectations that women held about the services offered suggest that women were happy to receive any type of oral care, as long as there were no out-of-pocket costs.

Acceptability

Clients valued the personable care they received at this clinic, particularly being respectfully greeted by name and receiving close attention. For those who are marginalized, approachable and friendly dental care providers can help facilitate access to oral care.²⁸ Women involved with the CJS often experience fragmented health care and transient relationships with health care providers,²⁹ so being greeted by name could have relayed to women that they are truly valued as clients of this clinic. Women also appreciated

that they received continued preventive oral care while the community-engaged learning program was out-of-session, which may have conveyed a genuine concern for their well-being. Women expressed that being closely attended to during appointments relayed thorough care. For women involved with the CJS, particularly women who are transitioning from incarceration to the community, the slower care at this clinic could have allowed women to feel like they were being taken care of by the oral care providers. Women leaving incarceration are often overloaded with competing demands, including managing health, mental health, and past trauma, securing education, employment, and safe and affordable housing, and reuniting with and caring for children.³⁰ These competing demands likely limit the time and energy that women have for self-care.

Clients also valued the respectful context in which care was provided, noting specifically the explanations given about the oral care procedures. Respect is a crucial aspect of person-centred care (PCC), as it relays to individuals that they are competent to make decisions about their care and have the right to do so³¹; individuals can feel neglected and powerless if dental care providers do not adequately communicate the details of their care.³² One survey respondent further indicated the importance of students providing explanations about oral care procedures since women at this clinic may have experienced past trauma (Table 2). Considering that women involved with the CJS have often experienced abuse or other trauma,^{19,33} it is imperative for oral care providers to practise trauma-informed care (TIC).³⁴ For example, oral care providers must be aware that a touch to the body may trigger trauma memories for some.³⁴ For women who have experienced abuse, touching their mouth, head or neck and performing treatment without warning may provoke fear.³⁵ Informing individuals of the procedures being performed is an important aspect of communication within a TIC approach.³⁴ It can help those who have experienced trauma feel a sense of control over their body.³⁶ Being informed of the length of appointments is also an important part of communication in an oral health care setting.³⁷ Women perceived the explanations they were given regarding the time needed to complete care as acceptable, although some survey respondents were less satisfied. This discrepancy could be due to participant sampling, as women who had negative experiences at the clinic may have been less willing to participate in the interviews.

The students' non-judgmental approach to the women's oral status, income level, gender or other factors facilitated access to care. This finding is not surprising considering that those from marginalized populations, including those who are lesbian, gay, bisexual, and transgender³⁸ and women who have experienced homelessness or incarceration,³⁹ often face barriers including stigmatization and discrimination when accessing health care. They value service providers who are non-judgmental and sensitive to their needs.

Poor client–student communication resulted in one client feeling judged for having low income, indicating that those providing care for this population must be sensitive to both the overt and subtle ways in which judgments may be relayed. PCC, particularly open communication and including women in the decision-making aspects of their care, may help mitigate such perceived feelings of judgment.³² EFry staff also discussed that perceived stigma from other providers may have impeded access to referred dental care. Individuals who are marginalized or vulnerable may avoid accessing health care due to stigma; those who experience homelessness may be fearful of attending the dentist and feel disrespected and stigmatized because of their lack of housing and poor oral health,¹⁸ and individuals who have experienced incarceration may forego disclosing their incarceration history for fear of being stereotyped or treated differently by health care providers.¹⁷ The EFry clinic mitigated the need for women to disclose such experiences. However, it is possible that fear of stigmatization due to marginalizing factors, including income status, housing situation or incarceration history, precluded access to comprehensive oral care.

Accommodation

Accommodating this population's unique care needs facilitated access. Clients valued that their children were accommodated during appointments, an important consideration since women involved with the CJS often have children; over 70% of women who are federally sentenced in Canada have children younger than 18 years of age.⁴⁰ EFry staff discussed that women might have difficulties navigating the referral process, specifically communicating with other dental care providers, and noted the value of having students guide women through this process. Further ways in which this population may be accommodated include providing written oral self-care education and written instructions about how to contact referrals.

Miscommunication between students and clients impeded access. Women struggled to contact students about appointments and information throughout the week while the students were not at the clinic. It is possible that women inquiring about the clinic experienced similar difficulties, thus precluding them from initiating contact. The availability of walk-in appointments seemed to mitigate these communication challenges, as the clinic was flexible in terms of accommodating women's schedules. Attendance at a community-based dental clinic in England for individuals experiencing homelessness was similarly influenced by the clinic's ability to accommodate these clients, whose lives can often be chaotic, by not penalizing them for missing appointments and by accepting walk-in appointments.²⁸ To encourage more timely communication in light of the clinic's limited operating hours, EFry

staff could be involved in scheduling appointments for clients while students are not at the clinic. Improved communication between students and clients could also help facilitate wrap-around care.

Some physical aspects of the clinic environment may also have impeded access, as women preferred clinic environments that were larger, appeared cleaner, and were aesthetically appealing in terms of brighter lighting and more comfortable dental chairs. Women's preference for a larger space could relate to past experiences of trauma, as those who have experienced trauma may be triggered by enclosed spaces.³⁶ Other women may not have attended appointments at this clinic because of similar concerns or because they did not feel comfortable seeking care at a more casual health care site. Findings suggest that women from this population may be more comfortable accessing care at a clinic that is community-based and approachable in terms of location and provider characteristics but also reminiscent of a typical health care clinic in certain physical aspects such as clinic size, lighting, and aesthetics.

Awareness

Finally, clinic promotional efforts seemed to hinder access. Other clients were not aware of the scope of services offered, and clinic information flyers could be unclear for women who are unfamiliar with the EFry building, ineffective for those who have low English literacy or intimidating for women who are uncomfortable with a university-affiliated clinic. Women might have been uncomfortable seeking care from an academic institution due to negative perceptions about research institutions or they may have been wary of receiving care from students rather than registered dental hygienists. Compared to clinic flyers that lack appropriate messaging, face-to-face information sessions with clients and staff may be more effective to relay information. Clinic promotion strategies should also be modified to shift the emphasis from the clinic's affiliation with the university to its affiliation with EFry.

Limitations

The generalizability of our findings is limited since women attending this clinic are not asked to disclose information about their experiences with the CJS, including incarceration history, and this study also did not ask participants to disclose these experiences. Thus, the study participants' specific involvement with the CJS remains unknown. Findings from the review of satisfaction surveys may also be skewed since clients may have completed more than one satisfaction survey as they are anonymous. Moreover, some women who completed a satisfaction survey were less satisfied with the provision of referrals, perhaps due to the required out-of-pocket costs of care or because there was no option on the survey to indicate that the client received no referral. Our collation of data from focus groups and phone interviews may have also limited our data obtained, as phone interviews may elicit more sensitive information compared to in-person interviews.⁴¹

The small convenience sample also limits the generalizability of our findings. We expected greater participation because of the honorarium and food provided to participants, and previous ease with participant recruitment. The unstable living conditions of this clientele could have affected their ability to follow through with participation, which was evident when some clients who initially confirmed their participation were unable to attend a focus group at the last moment. Some clients might have also been fearful of losing access to the clinic or to other EFry services if they disclosed negative information about the clinic, and so they decided to not participate. Those who did participate might have chosen to present a more positive view of the dental hygiene services offered. Moreover, no Indigenous women participated in our study, which was not surprising given our previous experiences working with this population and their reluctance to participate in traditional approaches to research. Future research on access to oral health care for this population would benefit from including Indigenous perspectives.

Given the difficulties that we experienced in conducting focus groups, individual interviews may be more appropriate for similar populations. Extra patience should be exercised when recruiting research participants from this population. Participant attendance should be confirmed if possible and researchers should anticipate no-shows by recruiting more participants than necessary and allowing adequate time for recruitment if using focus groups as the method of qualitative data collection. It would also be beneficial to ask women at the time of recruitment whether they would prefer to participate in a focus group or an individual interview, either in person or by phone. Accommodating their preferences may help women feel more comfortable participating in research and encourage their follow-through with participation.

CONCLUSIONS

Women who are involved with the CJS are an underserved population in terms of oral health care. They face multiple barriers when trying to comfortably access services. Our findings highlight the need for dental hygienists to be aware of this population's personal history and previous encounters with the health and dental care system, as well as the competing priorities in their lives. This study found that access to care for this population can be improved by creating a community-based, safe, low-barrier, and convenient location for the delivery of affordable services. Services offered in a respectful, attentive, and non-judgmental manner are valued. Ensuring timely and effective communication, wrap-around care, and appropriate clinic promotion materials will further facilitate access for this population. Introducing dental hygiene students to this population through community-engaged learning may help to improve access to comprehensive dental care for this population in the future.

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CONFLICTS OF INTEREST

The authors have declared no conflicts of interest.

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An umbrella review of systematic reviews of the evidence of a causal relationship between periodontal microbes and respiratory diseases: Position paper from the Canadian Dental Hygienists Association

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ABSTRACT

Previous position papers have confirmed to varying degrees associations between periodontal microbes and respiratory tract infections such as nosocomial or hospital-acquired pneumonia (HAP), ventilator-associated pneumonia (VAP), and chronic obstructive pulmonary diseases (COPD). Causal relationships have not been confirmed and have been the source of much confusion for the medical and oral health professions. **Aim:** to investigate whether sufficient evidence exists for a causal relationship between periodontal microbes and respiratory diseases, with a focus on HAP and VAP. **Methods:** The PICO question was "For patients in hospitals, nursing homes or long-term care facilities who are at high risk for respiratory infections, will an oral care intervention such as toothbrushing, administration of antimicrobial agents, and/or professional care, as compared to no oral care intervention (or usual oral care) reduce the risk for respiratory infections?" Only systematic reviews (SRs) with or without a meta-analysis (MA) of randomized controlled trials published in the English language between 2007 and 2019 were included. Databases searched included PubMed, MEDLINE, EbscoHost, CINAHL, Scopus, Cochrane Registry of Systematic reviews, and Clinical Trials Registry. Quality assessments were conducted by both authors using the PRISMA checklist. The Bradford Hill criteria were used to determine evidence for causality. **Results:** Of 47 respiratory studies retrieved, after elimination of duplicates and studies not meeting inclusion criteria, 10 SRs were selected, 9 of which included MAs. Although there was evidence that administration of chlorhexidine gluconate (CHX) reduced the risk for VAP, none existed for HAP. Limitations included inconsistencies among studies in population groups, CHX concentration, frequency of administration, number of applications, and insufficient evidence for use of povidone iodine or toothbrushing in ventilated patients. While some studies reported other patient-centred outcomes (i.e., ICU mortality, length of ICU stay or duration of mechanical ventilation), findings were positive only for cardiac surgery ventilated patients, who did not meet the inclusion criteria. **Conclusions:** Bradford Hill criteria analysis failed to support a causal relationship between periodontal microbes/oral health care and respiratory diseases such as pneumonia.

RÉSUMÉ

Les exposés de position précédents ont confirmé à des degrés différents les associations entre les microbes parodontaux et les infections des voies respiratoires telles que la pneumonie nosocomiale ou de contamination hospitalière (PCH), la pneumonie sous ventilation assistée (PVA) et les maladies pulmonaires obstructives chroniques (MPOC). Les relations de cause à effet n'ont pas été confirmées et ont été la source de beaucoup de confusion pour les professions médicales et de santé buccodentaire. **Objectif :** déterminer s'il existe suffisamment de preuves qu'une relation de cause à effet existe entre les microbes parodontaux et les maladies respiratoires, en mettant l'accent sur la PCH et la PVA. **Méthodologie :** La question de PICO était : « Chez les patients hospitalisés, en maisons de soins infirmiers ou en établissement de soins de longue durée qui sont à risque élevé de subir des infections respiratoires, le fait d'obtenir une intervention de soins buccodentaires telle que le brossage dentaire, l'administration d'agents antimicrobiens ou de soins professionnels, par rapport à ne pas obtenir une intervention de soins buccodentaires (ou des soins buccodentaires habituels) réduira-t-il le risque d'infections respiratoires? » Seules les revues systématiques (RS) avec ou sans méta-analyse (MA) d'essais contrôlés randomisés, publiées en anglais entre 2007 et 2019, ont été comprises. Les bases de données consultées comprenaient PubMed, MEDLINE, EbscoHost, CINAHL, Scopus, le Registre de revues systématiques Cochrane, et le Registre des essais cliniques. Les évaluations de la qualité ont été menées par les 2 auteurs à l'aide de la liste de vérification PRISMA. Les critères de Bradford Hill ont été utilisés pour déterminer les preuves de causalité. **Résultats :** Sur les 47 études respiratoires relevées, après élimination des doublons et des études ne répondant pas aux critères d'inclusion, 10 RS ont été sélectionnées, dont 9 comprenaient des MA. Bien que des preuves existaient que l'administration de gluconate de chlorhexidine (CHG) avait réduit le risque de PVA, il n'en existait aucune pour les PCH. Les limites comprenaient des incohérences parmi les études auprès des groupes de population, la concentration de CHG, la fréquence d'administration, le nombre d'applications, et l'insuffisance de preuves pour l'utilisation de povidone-iodine ou de brossage dentaire chez les patients ventilés. Bien que certaines études aient fait état d'autres résultats centrés sur le patient (p. ex., mortalité en USI, durée du séjour en USI ou durée de la ventilation mécanique), les résultats n'étaient positifs que pour les patients de chirurgie cardiaque ventilés qui ne répondaient pas aux critères d'inclusion. **Conclusions :** L'analyse des critères de Bradford Hill a échoué à soutenir un lien de cause à effet entre les microbes parodontaux ou les soins de santé buccodentaire et les maladies respiratoires telles que la pneumonie.

Keywords: antiseptics, periodontal disease; COPD, oral care; meta-analysis; oral health; periodontal treatment; periodontitis; pneumonia; respiratory diseases; systematic reviews; VAP; VAP prevention

CDHA Research Agenda categories: risk assessment and management; capacity building of the profession

CANADIAN DENTAL HYGIENISTS ASSOCIATION POSITION STATEMENT

The Canadian Dental Hygienists Association acknowledges that, although associations between periodontal and respiratory diseases such as pneumonia (VAP and NV-HAP) have been well established, there is insufficient evidence that periodontal microbes cause these diseases.

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INTRODUCTION

This position paper is the third in a series reviewing the state of the evidence of a causal relationship between periodontal disease and a systemic condition, in this case respiratory diseases. Because each of these papers forms the evidence for Canadian Dental Hygienists Association (CDHA) position statements, the information about causality in each paper's introduction section is essentially the same. It is important to clarify this concept for those who may not be familiar with or have the background to distinguish the difference between associations and causality, or for those who may not have read the earlier papers published in previous issues of this journal.

Relationships between periodontal disease/inflammation and a number of systemic diseases have been proposed since the late 1800s when physicians speculated that bacteria from the mouth caused everything from brain abscesses to arthritis.^{1,2} With the onset of “periodontal medicine” in the early 1990s, studies investigating the relationships between numerous oral and systemic conditions have increased, with inflammation now recognized as a common factor. Despite the amount of research published over the last 30 years, questions remain about the exact nature of these relationships. While relationships may be in the form of associations or correlations, they should not be assumed as causal.

Unfortunately, the differences between associations and causality are not well understood, and the terms are often used interchangeably. A relationship merely describes how 2 variables *might* somehow be related or connected to each other. For instance, lung cancer rates are higher for people without a postsecondary education (who tend to smoke more), but that does not mean that someone can reduce his or her cancer risk just by getting a college or university education.³ An “association” refers to “a relationship between an exposure (or a characteristic) and a disease that is statistically dependent; that is, the presence of one alters the probability of observing the presence of the other. An association is a necessary condition of a causal relationship, but not all associations are causal. If there is no association, the variables are said to be independent.”⁴

In order for a relationship to be coined as “causal,” actual “cause and effect” must be determined through a very rigorous set of epidemiological criteria. One must be able to state with certainty that a specific exposure has been shown to cause a specific outcome.⁴ Randomized clinical trials (RCTs) provide the strongest evidence for demonstrating cause and effect, rather than the outcome happening by chance. These experimental studies are the most methodologically challenging and ones in which the researcher controls or manipulates the variables (i.e., the intervention, its timing and dose) under investigation, such as in testing the effectiveness of a treatment, as compared to another treatment or a placebo.⁵

Often, when clinicians read a research article that is reporting a correlation or an association between an oral disease and a particular outcome of interest, they automatically, and incorrectly, jump to the conclusion that the relationship is causal. Prime examples of such misinterpretations are frequently found with proposed oral–systemic linkages, such as the assumption that periodontitis is one cause of heart disease or of adverse pregnancy outcomes, or that stress causes periodontitis. It is important for clinicians to understand that correlations and associations do not imply or equal causality. In fact, incorrect assumptions of causality are a major public health concern. From a public health perspective, any evidence should not be considered causal unless it has gone through very rigorous scrutiny using standard public health guidelines such as the Bradford Hill criteria for causality⁶ (Table 1).

CDHA published position papers on oral–systemic linkages in 2004^{7,8}, followed by updates in 2006⁹ and 2007¹⁰ with similar outcomes, reporting associations between periodontal disease and several systemic diseases. In particular, these papers identified strong evidence for an association between pneumonia and health-compromised seniors living in nursing homes and chronic care facilities.⁸

A recent systematic mapping of registers of clinical research trials conducted on periodontal medicine revealed 57 conditions that are currently hypothesized to be linked with periodontal diseases.¹¹ While it is beyond the scope of this current series of position papers to explore all of these proposed linkages, the status of 10 of these hypotheses will be evaluated in 5 position papers written by the same authors. The first 2 papers in this series analysed the state of the evidence of a causal relationship between periodontal disease and cardiovascular diseases¹² and between periodontal disease and adverse pregnancy outcomes¹³. This third paper focuses on the evidence related to whether a causal relationship exists between periodontal microbes and respiratory diseases, with an emphasis on pneumonia, both ventilator-associated pneumonia (VAP) and hospital-acquired pneumonia (HAP)—more recently termed non-ventilator hospital-acquired pneumonia (NV-HAP). Chronic obstructive pulmonary diseases (COPD) were excluded from this paper as the evidence of an association reported in the literature was weak and search results did not reveal any systematic reviews (SRs) or meta-analyses (MAs) on the topic.

Should you choose to read any of the individual SRs or the research articles discussed within them, you will come across the terms relative risk (RR), absolute risk ratio (ARR), numbers needed to treat (NNT), heterogeneity, and the symbol I^2 . The following are some basic definitions of each term.

Table 1. The Bradford Hill criteria for causality⁶

Criteria	Meaning
Strength of association	A strong association is more likely to have a causal component than is a modest association. Strength of the association is determined by the types of existing studies. The highest level studies from the evidence pyramid would represent the strongest associations (i.e., RCTs and systematic reviews with meta-analyses) Results from these studies must demonstrate an odds ratio or relative risk of at least 2.0 or above in order to be meaningful. Anything between 1 and 2 is weak while >2 is moderate and >4 is considered strong.
Consistency	A relationship is repeatedly observed in all available studies.
Specificity	A factor influences specifically a particular outcome or population. The more specific an association between a factor and an effect, the greater the probability that it is causal.
Temporality	The cause must precede the outcome it is assumed to affect (e.g., smoking before the appearance of lung cancer). Outcome measured over time (longitudinal study).
Biological gradient (dose-response)	The outcome increases monotonically with increasing dose of exposure or according to a function predicted by a substantive theory (e.g., the more cigarettes one smokes, the greater the chance of the cancer occurring).
Plausibility	The observed association can be plausibly explained by substantive matter (i.e., biologically possible).
Coherence	A causal conclusion should not fundamentally contradict present substantive knowledge. (Studies must not contradict each other.)
Experiment	Causation is more likely if evidence is based on randomized experiments or a systematic review of randomized experiments. However, these RCTs may not be ethically possible and thus prospective rather than experimental studies, such as cohort studies, may be the highest level of evidence available.
Analogy	For analogous exposures & outcomes an effect has already been shown (e.g., effects first demonstrated on animals or an effect previously occurring on humans such as the effects of thalidomide on a fetus during pregnancy).

Source: Lavigne SE. From Evidence to Causality: How Do We Determine Causality? [Online course]. 2018. Available from: www.dentalcare.com/en-us/professional-education/ce-courses/ce530

Relative risk (RR): the ratio of the probability of an event occurring (e.g., developing a disease, preventing a negative outcome) in an exposed group to the probability of the event occurring in a comparison, non-exposed group (B/A). A RR >1 indicates a positive benefit and a RR <1 indicates a negative risk.

Absolute risk ratio (ARR): the arithmetic difference between two rates, i.e., an event occurring in an exposed group minus the event occurring in a comparison, non-exposed group (A - B).

Numbers needed to treat (NNT): the number of clients (or teeth, surfaces, periodontal pockets, pneumonia) that need to be treated with the experimental treatment or intervention in order to have one additional client (or tooth, surface, periodontal pocket, pneumonia) benefit, or to prevent one adverse outcome. NNT is calculated as 1/ARR.

Heterogeneity: any variability or differences among studies brought together in a systematic review, such as in the intervention regimens or protocols (e.g., different concentrations of CHX); different delivery mechanisms (e.g., rinse, gel or foam); different frequency of application (e.g., once/day, twice/day or 3x/daily), and its study outcomes. SRs need ways to assess the variability in order to make

decisions about pooling data or making comparisons.¹⁴

I²: the percentage of variation across studies that is due to heterogeneity rather than chance. This statistic is used to quantify inconsistency among studies in a meta-analysis. It often is found on forest plots displaying the results of a meta-analysis. A rough guide for interpretation is as follows:¹⁴

- 0% to 40%: might not be important
- 30% to 60%: may represent moderate heterogeneity
- 50% to 90%: may represent substantial heterogeneity
- 75% to 100%: considerable heterogeneity

The purpose of this series of updated position papers is to review the research undertaken since the publication of the last CDHA position papers in 2006 and early 2007 on these proposed relationships. Unlike the methodology used for the previous position papers and updates, this series of investigations is targeted more specifically at identifying whether the evidence has evolved from one of association to one of actual causality. In order to establish a causal relationship, interventional studies are required, thus only

the highest levels of evidence have been sought for these updates. This position paper is the third in the series and investigates whether a causal relationship exists between periodontal microbes and respiratory diseases.

METHODOLOGY

The overarching PICO question explored in this series of position papers was customized for this paper on respiratory diseases, specifically pneumonia: “For patients in hospitals, nursing homes or long-term care facilities who are at high risk for respiratory infections (**Population**), will an oral care intervention such as toothbrushing, administration of antimicrobial agents, and/or professional care (**Intervention**), as compared to no oral care intervention (or usual oral care) (**Comparison group**), reduce the risk for respiratory infections?(**Outcome**)”

Eligibility criteria

Both authors independently searched the literature, limiting the search to SRs with or without MAs of intervention studies using the inclusion and exclusion criteria described in Table 2. SRs and MAs of observational studies were excluded.

Table 2. Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Published between 2007 and 2019	Published before 2007
English language	Languages other than English
SRs with or without MAs of RCTs	Abstracts, posters, conference proceedings, editorials or commentaries, duplicate studies, narrative reviews, RCTs, observational studies/ both cohort and case-control and systematic reviews of observational studies and/or case-control studies.
Studies involving humans	Animal studies (in vivo, ex-vivo) and in vitro studies

Search strategy

- Databases searched were PubMed, MEDLINE, EbscoHost, CINAHL, Scopus, Cochrane Registry of Systematic Reviews, and Clinical Trials Registry (clinicaltrials.gov). Additionally, bibliographies of retrieved articles were hand searched for further relevant SRs and MAs and added when appropriate.
- Keywords used for each search were as follows: respiratory diseases; pneumonia; COPD, oral care; antiseptics, periodontal disease; periodontitis; periodontal treatment; oral health; VAP; VAP prevention; AND systematic reviews; meta-analysis
- Search strategies (limited to publications after 2007 and in the English language) were carried out according to the conventions required by

each database. Within the same database, multiple strategies were used. For example, searches within PubMed were as follows:

- (periodontal disease OR periodontitis) AND (VAP) AND systematic reviews
- (periodontal disease OR periodontitis) AND (ventilator-associated pneumonia) AND systematic reviews
- (periodontal disease OR periodontitis) AND (VAP) and the filter “Article Type,” which provides check-off boxes including one for SRs and another for MAs

Study selection

Titles and abstracts of all articles retrieved using the specified inclusion criteria were screened independently by both authors. Their choices were then discussed to arrive at a consensus regarding their suitability for full-text reading. The selected articles were then independently reviewed, and consensus reached on their inclusion or exclusion.

Quality assessment

The methodological quality of the selected SRs and MAs was assessed blindly by both authors using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) checklist tool,¹⁵ available at www.prisma-statement.org. Where inconsistencies occurred, scores were compared and discussed to reach consensus.

Data extracted

Information extracted from each selected SR or MA was compiled and presented in table format: year published, number of RCTs included, country of origin, methods used for assessing risk of bias, heterogeneity, outcomes measured, and conclusions of the findings.

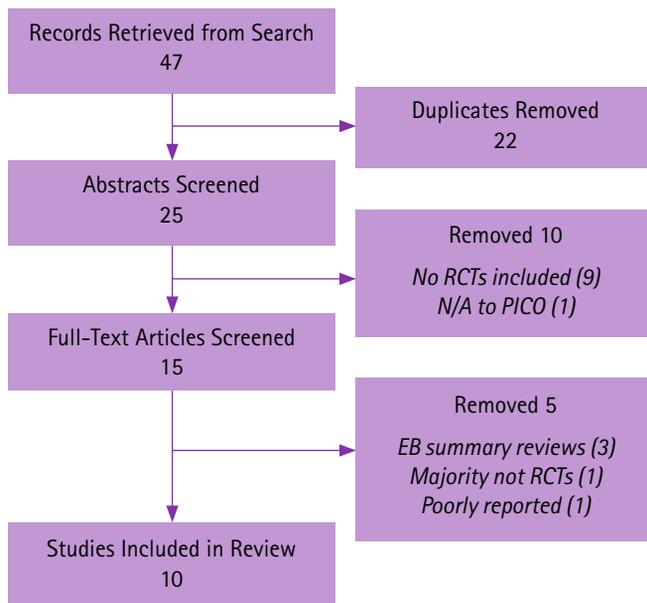
RESULTS

Forty-seven (47) SRs were retrieved from database searches and articles identified within these reviews. After eliminating duplicates, summaries of studies, and articles that did not meet the inclusion criteria, 10 studies¹⁶⁻²⁵ remained eligible for review, 9 of which included MAs.^{16-22,24,25} A flow diagram (Figure 1) illustrates the details of the selection process; Table 3 reports the reasons for elimination of full-text articles.

Results of the quality appraisal of the 10 included SRs and MAs are shown in Table 4. Based on the PRISMA checklist’s 27 items, scores ranged from 17 to 25. Agreement between the 2 independent evaluators was close to 100%, with a few scores being off by only 1 or 2 points. The quality of the systematic reviews was generally moderate to high, although 1 review did not report risk of bias¹⁹ and 1 review did not include a quality assessment tool.¹⁸

Of the 10 included SRs and MAs, 7 were specific to prevention of VAP while 3 studies addressed both NV-HAP and NV-Nursing Home Acquired Pneumonia (NV-NHAP).

Figure 1. Respiratory diseases search flow diagram



The majority of these SRs showed mixed results for a variety of reasons. Weaknesses identified by the systematic review authors included different study designs, methodology, settings, mixed populations and interventions, along with the quality of reporting, and lack of power calculations (Table 5). Of the VAP SRs, most of the included studies investigated the effects of chlorhexidine (CHX) and/or povidone iodine on reducing the incidence of VAP. Three reviews included the effects of both manual and power toothbrushing on reduction of VAP. In the 3 NV-HAP/NHAP SRs and MAS, a variety of interventions were included, such as professional oral care, toothbrushing by professionals, toothbrushing by staff, application of antimicrobial agents such as CHX, and povidone iodine brushing of the pharynx. Control groups in most studies were either usual care or placebo with the majority being usual care, which could comprise several interventions. Detailed results are presented in Tables 6 and 7.

DISCUSSION

It has been well established for over 2 decades that a relationship exists between periodontally associated microbes and respiratory infections such as pneumonia.^{7-10,33,35} The purpose of this umbrella review was to take this knowledge one step further to determine if new evidence exists to establish the nature of this relationship as causal. The relationship is based on the premise that oropharyngeal microorganisms are aspirated into the lower respiratory tract, colonize in the lungs, and develop pneumonia.²⁶ A search of the scientific literature revealed that the most common diseases for which there are high-level research studies (RCTs) are hospital-acquired pneumonia (HAP/NV-HAP), nursing home-acquired

pneumonia (NHAP/NV-NHAP), and ventilator-associated pneumonia (VAP). There is a lack of high-quality studies related to COPD and, thus, this relationship was not included in this umbrella review.

The occurrence of nosocomial pneumonia in health care facilities and nursing homes is a major public health concern. It is one of the major causes of mortality in nursing homes²⁷; the prevalence of VAP is 8% to 28%²⁸ in mechanically ventilated hospital patients. Systematic reviews of the individual RCTs focused on different oral hygiene procedures delivered by different people such as oral health professionals, hospital staff, nursing home and long-term care staff, and individual patients or residents. Among the different procedures and products employed were antiseptics at different strengths and frequencies, with CHX being the most common intervention. In fact, regular oral care with CHX gluconate in hospitals has become the gold standard of care for the prevention of VAP in many countries in both North America and Europe.¹⁹ Some studies investigated the effects of toothbrushing on the prevention of nosocomial pneumonia, while others examined various interventions and strategies, ranging from professional oral care to toothbrushing by professionals and caregivers along with the application of a variety of antimicrobial agents.

Several of the VAP studies had mixed populations: some ventilated patients had had cardiovascular surgery while others were critically ill patients in intensive care units (ICU). The inclusion of cardiac surgery patients is problematic as they do not fit the definition for VAP which is “pneumonia developing in people who have receive mechanical ventilation for at least 48 hours.”¹⁷ Cardiac surgery patients typically are intubated in the operating room and are extubated within one day. Thus, any pneumonia that they would be susceptible to would be nosocomial in nature, not ventilator associated.

Results from these mixed studies are confounded by the lack of focus on patient-centred outcomes, such as the effects of these various strategies on mortality, length of ventilation, and length of stay in ICUs. Despite this lack of focus on patient-centred outcomes, some SRs did report that the intervention administered had no effect on mortality, duration of mechanical ventilation or duration of ICU stay. Conversely, Klompas et al.¹⁹ reported an increase in mortality among non-cardiac surgery patients in a meta-analysis of 12 RCTs, 9 of which included non-cardiac surgery patients randomized to receive CHX. Interestingly, this was not the case when compared with the 3 cardiac surgery studies in the review, where no effect on mortality was found among those using CHX. The authors proposed 2 potential explanations for these findings, the first being the possibility that patients may have inadvertently aspirated small amounts of CHX causing acute lung injury. The other explanation suggested use of CHX may have masked the actual diagnosis of pneumonia, resulting in false negative VAP tests precluding early antibiotic intervention.¹⁹ This

Table 3. Screened respiratory articles included and deleted

Author & Year	Included	Deleted	Reason for deletion/Notes
1. Agado & Bowen 2012 ³³ SR pneumonia or COPD		XX	RCTs included along with other studies; outcome association vs. causal
2. Astvaldsdóttir et al. 2018 ³⁴ Knowledge		XX	Focus on knowledge vs. causal
3. Azarpazhooh & Leake 2006 ³⁵ SR of association between respiratory diseases and oral health		XX	Association investigated vs. not a causal relationship; too old
4. Cagnani et al. 2016 ³⁶ SR aspiration pneumonia		XX	No RCTs included in SR (case studies, cohort; lots of weaknesses)
5. Gomes-Filho et al. 2020 ³⁷ SR/MA		XX	No RCTs included in SR
6. Gu et al. 2012 ¹⁶ SR/MA toothbrushing	XX		
7. Hua et al. 2016 ¹⁷ Cochrane, SR/MA VAP; OH care	XX		
8. Veitz-Keenan & Ferraiolo 2017 ³⁸ Summary review of Hua		XX	Summary review of Hua (which is included)
9. Kaneoka et al. 2015 ¹⁸ SR/MA NV-HAP w/o mechanical ventilation	XX		
10. Klompas et al. 2014 ¹⁹ SR/MA VAP Reappraisal of routine use of CHX	XX		
11. Labeau et al. 2011 ²⁰ SR/MA VAP-CHX, P-Iodine	XX		
12. Li et al. 2015 ²¹ SR/MA Antiseptics prevention of VAP	XX		
13. Liu et al. 2018 ²² Cochrane, SR/MA Prevention nursing home-acquired pneumonia	XX		
14. Mitchell et al. 2019 ³⁹ SR NV-HAP		XX	Only 6 of 15 included studies are RCTs; no separate analysis of the 6
15. Scannapieco 2014 ⁴⁰ COPD summary review of Peter		XX	Summary review and no RCTs in the Peter study (case-control study)
16. Sjögren et al. 2008 ²³ SR/MA OH effect pneumonia & respiratory diseases	XX		
17. Sjögren et al. 2016 ⁴¹ SR/MA Older with pneumonia in hospitals or nursing homes		XX	Poorly reported; poor definition of groups and terms
18. Shi et al. 2013 ²⁴ SR/MA, VAP, CHX	XX		
19. Richards 2013 ⁴² EBD review of Shi		XX	Summary review of Shi (which is included)
20. Spreadborough et al. 2016 ⁴³ VAP		XX	No RCTs included in SR
21. van der Maarel-Wierink et al. 2011 ⁴⁴		XX	No RCTs included in SR
22. Villar et al. 2016 ²⁵ SR/MA, VAP (CHX)	XX		
23. Zeng et al. 2012 ⁴⁵ MA, COPD		XX	No RCTs included in SR
24. Zeng et al. 2016 ⁴⁶ Lung CA risk		XX	No RCTs included in SR Risk of lung CA association
25. Zhou et al. 2011 ⁴⁷ COPD, quality of life		XX	N/A to PICO and no RCTs in SR

Table 4. Quality appraisal and summary of the systematic reviews/meta-analyses (n = 10)

Author (Country)	PRISMA score (max 27)	Heterogeneity	Risk of bias	Quality assessment instrument	Number of RCTs & subjects; outcome measure	Included meta-analysis
Gu et al. 2012 ¹⁶ (China)	24	I ² = 61.1%	Unclear risk of bias	Jadad scale CHB ^a	4 RCTs, 828 subjects; toothbrushing, prevention of VAP	Yes
Hua et al. 2016 ¹⁷ (UK) Cochrane	25	I ² = varies with different comparisons	Low-quality evidence	CHB ^a	38 RCTs, 6016 subjects; oral health care & incidence of VAP	Yes
Kaneoka et al. 2015 ¹⁸ (US)	22.5	I ² = 0%	High risk of bias	CHB ^a	5 RCTs, 1009 subjects; oral care in preventing pneumonia in non-ventilated patients	Yes
Klompas et al. 2014 ¹⁹ (US)	23	I ² = 0% for cardiac surgeries I ² = 42% for non-cardiac surgery studies	11 of 16 studies were high quality	Assessed random sequence generation & allocation concealment only	16 RCTs, 3630 subjects; CHX & incidence of VAP; compared cardiovascular surgery patient outcomes with non-cardiovascular surgery patient outcomes	Yes
Labeau et al. 2011 ²⁰ (Belgium)	23	I ² = 29% for CHX; 67% for Povi-Iod	Not reported	Checklist from Dutch Cochrane	14 RCTs, 2481 subjects; oral antiseptics & prevention of VAP	Yes
Li et al. 2015 ²¹ (China)	23	I ² = 49.7% for CHX; 54.8% for Povi-Iod	Begg's test revealed no publication bias; Jadad score 4 (high quality)	Jadad scale	17 RCTs, 4249 subjects; oral antiseptics & prevention of VAP	Yes
Liu et al. 2018 ²² (China) Cochrane	24	Cochrane's Q and I ² = 67%	Low to very low quality evidence All studies identified as high risk of bias	CHB ^a	4 RCTs, 3905/3546 subjects; oral care & incidence of nursing home acquired pneumonia	Yes
Sjögren et al. 2008 ²³ (Sweden)	17	No MA due to heterogeneity of study designs	Jadad scores between 3 and 5 for 3 of the RCTs	Jadad scale	15, of which only 5 studied interventions; 10 were non-RCT	No
Shi et al. 2013 ²⁴ (China) Cochrane	24.5	Chi ² and I ²	High = 17, Low = 5, Unclear = 13	CHB ^a	35 RCTs, 5374 subjects; oral care & prevention of VAP in ICUs	Yes
Villar et al. 2016 ²⁵ (Brazil)	25	I ² = 45%	High = 8, Low = 1, Unclear = 4	CHB ^a	13 RCTs, 1640 subjects; incidence of VAP	Yes

^aCHB (Cochrane Handbook for Systematic Reviews of Interventions)

second explanation is plausible as a Canadian study by Muscedere et al.²⁹ demonstrated that culture-negative VAP diagnoses had higher mortality rates than culture-positive VAP. Although these mortality results from the Klompas et al.¹⁹ SR/MA were not statistically significant, the authors argued in favour of re-evaluating both the safety and efficacy of CHX for mechanically ventilated non-cardiac surgery patients.

Although several SRs and MAs produced significant results for reducing the incidence of VAP with CHX at 0.120%^{17,21,24}, 2 studies demonstrated only positive effects with 20% concentrations^{20,25} and/or with 4 times daily applications²⁵. Villar et al.²⁵ failed to produce significant results for the oral application of CHX in VAP incidence. However, a subgroup analysis showed CHX at 20% concentrations as well as CHX administered 4 times daily

to have a significant effect on reducing the incidence of VAP. Whereas the substantivity of CHX has been attributed to its presence in the oral cavity for >12 hours, its antimicrobial activity has been shown to last for only 7 hours after a mouthrinse.^{30,31} This could account for the better results for the 4 times daily application and/or the use of a higher concentration.

Li et al.²¹ had positive outcomes for CHX in reducing the incidence of VAP. However, the authors pointed out that more than half of the pooled study population in the MA were cardio-surgical patients, which they suggest could have influenced the results. In congruence with the Klompas et al.¹⁹ MA, subgroup analysis showed positive effects of the CHX to be most marked on the cardiac surgery patients ($p = 0.001$).²¹

Table 5. Summary of issues identified by authors of systematic reviews of RCTs

1. Inconsistency in defining or even including mention of periodontal disease status of study participants
2. Inconsistent definitions of VAP, HAP, and NHAP
3. Gold standard for diagnosing VAP not always used
4. Inconsistency in the type(s) of treatment(s) provided, i.e., timing, concentration of antimicrobial agents, frequency, clinician, use of antibiotics, mixing various interventions
5. Different settings and population groups
6. No mention of nursing or caregiver staff training re: providing oral care
7. Variation in outcomes measured and measurement technique used
8. No uniform methods for adjustment of confounders such as comorbidities and hospital treatment bundles for prevention of VAP
9. Comparison group in most studies was "usual care"—anything from toothbrushing to mouthrinsing—which could confound results. Only a few included studies used a placebo
10. Quality of studies (methodological shortcomings) and reporting
11. Publication bias: so few studies involved in some SRs that publication bias was not assessed
12. Lack of power calculations in studies
13. More consistent use of CONSORT in the RCTs would improve the quality of the studies

Interestingly, results were not significant for combining CHX with toothbrushing despite positive results for application of CHX alone.²⁴ These results were consistent with findings from the other 2 SRs/MAs^{16,17} involving toothbrushing for the prevention of VAP. These mixed results for the use of CHX are disappointing, particularly from a health policy perspective. Reducing the incidence of VAP using a measure such as CHX in addition to usual care, rather than treating it with systemic antibiotics, would be more cost effective and help to reduce the use of systemic antibiotics, which have become a major public health concern given the rise in antibiotic-resistant bacteria.³²

The lack of clear results for the prevention of VAP with the application of CHX could be explained by the fact that decontamination with chlorhexidine is only one of several interventions performed in ICUs by the nursing staff and may not be the sole preventive measure. There is a specific "ventilator bundle" that is used in all ICUs to promote better ventilator care and patient outcomes.²⁵ This bundle includes elevation of the head of the bed; daily sedation vacations and assessment of readiness to extubate; peptic ulcer disease prophylaxis; deep vein thrombosis prophylaxis; oral decontamination with CHX; coordinating spontaneous breathing trials with spontaneous awakening trials; early mobilization; conservative fluid management; and low tidal wave utilization.^{19,25} These confounders may significantly interfere with study results. It is also possible that the prevention of VAP may not be exclusively related to CHX.

What is of major interest and also very surprising is that numerous studies did not report the periodontal status of the study participants. In the Villar et al.²⁵ study, as an example, only 2 RCTs out of 13 included this information. This gap creates a huge problem when it comes to determining causality, particularly if it is unknown whether the patient even had periodontal inflammation, which would be the source of the microorganisms that have been hypothesized to initiate the pneumonia.

Using the Bradford Hill criteria for causation to determine whether a causal relationship exists between periodontal microbes and VAP/NV-HAP, it is clear that several criteria have not yet been satisfied. In examining the "strength of association," moderate evidence was presented by 4 of the 10 SRs and MAs for the use of CHX in lowering the risk for pneumonia, there was no evidence to support the use of povidone iodine, and there was weak to no evidence for the use of toothbrushing unless combined with professional oral care. The best evidence was for the use of CHX at a 2% concentration used 4 times daily. The criterion of "consistency" was not met since numerous inconsistencies in findings were reported. This situation also leads one to question whether studies with negative outcomes were turned away resulting in publication bias. Similarly, the criterion of "specificity," which requires similar outcomes in every instance, has not been demonstrated. The criterion of "temporality," where periodontal disease would be required to precede the respiratory disease, has not been established in these 10 SRs and MAs, definitely weakening the cause and effect hypothesis. In fact, few studies in these reviews even mentioned the periodontal or oral inflammatory status of the patient prior to administration of the intervention, which is problematic. Without this information, it is impossible to determine whether the oral cavity was the source of the microbes that initiated the pneumonia.

When considering the criterion of "dose-response," none of the studies included in these SRs compared results with various magnitudes of periodontitis, demonstrating that those with more severe periodontal inflammation would be at greater risk for pneumonia. The criterion of "biological plausibility," however, has been met, since numerous studies hypothesized that microorganisms from the oral cavity can serve as reservoirs for colonization and could be the source of infection travelling from the oral cavity to the lungs through aspiration. The criterion of "coherence" also has been previously met as numerous laboratory, animal, and human studies have established that a relationship does indeed exist between periodontal microbes and respiratory infections such as pneumonia. The criterion of "experiment" was not met in this review. Although numerous RCTs were conducted and evaluated in these 10 SRs and MAs, the results were mixed, and no study determined that periodontal microbes were the source of the infection. "Analogy," the weakest criterion, was not

Table 6. Primary outcomes of retained studies for ventilator-associated pneumonia (7 studies)

Interventions (CHX, Povidone Iodine, Toothbrushing)		
Chlorhexidine gluconate (CHX)		
Outcome 1 No relationship	Outcome 2 Possible relationship (mixed results)	Outcome 3 Positive relationship
Klompas et al. ¹⁹ No reductions in VAP with CHX	Labeau et al. ²⁰ Subgroup analysis favoured only the 2% CHX application; results for cardio surgery patients were stronger	Villar et al. ²⁵ Only at 2% or administered 4x daily
Villar et al. ²⁵ No overall reductions in VAP with CHX at 0.12%	For 0.12% CHX, risk reduction was not significant	Hua et al. ¹⁷ CHX gel or mouthrinse as part of OHC reduced risk of VAP by 18%
		Shi et al. ²⁴ Moderate evidence that CHX mouthrinse or gel as part of OHC reduced risk of VAP by 40%
		Li et al. ²¹ Overall oral care including CHX reduced risk of VAP but half the study group comprised cardiosurgical patients who do not qualify for VAP diagnosis, which may have influenced the results.
Povidone iodine		
Outcome 1 No relationship	Outcome 2 Possible relationship (mixed results)	Outcome 3 Positive relationship
Labeau et al. ²⁰ Effects not significant	Shi et al. ²⁴ Weak evidence that Povidone Iodine is better than saline	
Li et al. ²¹ Effects not significant	Hua et al. ¹⁷ Very weak evidence that Povidone Iodine is better than saline	
Toothbrushing		
Outcome 1 No relationship	Outcome 2 Possible relationship (mixed results)	Outcome 3 Positive relationship
Hua et al. ¹⁷ No effect of either manual or power toothbrushing on reductions in VAP		
Shi et al. ²⁴ No effect of either manual or power toothbrushing on reductions in VAP		
Gu et al. ¹⁶ Did not significantly reduce incidence of VAP, mortality or length of ICU stay or days on ventilator		

explored in this review. Thus, of the 9 criteria, only 2 (biological plausibility and coherence) can be said to have been fulfilled. Table 8 provides a summary of these results.

Based on this analysis, it is concluded that there is insufficient evidence at this time to support a causal relationship between periodontal microbes and nosocomial pneumonia.

In spite of these results, one must not assume that there is no relationship or association between periodontal microbes and respiratory infections, nor should these results negate the numerous studies showing strong associations. Results from this umbrella review demonstrate

that the existing relationships cannot be determined to be “causal” given the evidence available. Based on this analysis, since there is both biological plausibility as well as coherence, it will be very important to continue to conduct better interventional studies that address some of the shortcomings identified in Table 7.

None of the current studies included periodontal instrumentation, such as scaling and root planing, targeting the elimination and/or control of periodontal disease itself. These studies only targeted the removal of microbes with mouthrinses and/or toothbrushing which cannot eliminate periodontal disease alone without

Table 7. Primary outcomes of retained studies for nosocomial pneumonia (3 studies)

Interventions (Professional oral care versus usual care)		
Outcome 1 No relationship	Outcome 2 Possible relationship (mixed results)	Outcome 3 Positive relationship
<p>Liu et al.²² Used too many combinations of interventions. Unable to draw any conclusions from the 4 included studies as to which of the various interventions actually worked. Follow-up studies should be at least 24 months. Usual care should be replaced with placebo.</p> <p>Kaneoka et al.¹⁸ Same as above. Too many combinations of interventions that included professional care and brushing in nursing homes sometimes with Povidone Iodine. In hospitals, used brushing and chlorhexidine. Pooled results for 4 studies showed positive effects but unable to differentiate which worked the best.</p>		<p>Sjögren et al.²³ Best results from weekly professional care, brushing after each meal, and scrubbing pharynx with Povidone Iodine.</p>

mechanical treatment. Ideally, for a true effect, studies should be designed to eliminate periodontal inflammation at or prior to admission to the hospital or nursing home, and to ensure that oral hygiene for these individuals is maintained on a daily basis by staff and supported by intermittent professional maintenance appointments. However, these types of studies are difficult to design as it would be considered unethical to have a control group without any oral intervention compared with a test group that maximizes oral care to determine if they would be less likely to develop pneumonia than those with existing inflammation. No research ethics board would ever approve such a study, where the control group would receive no biofilm removal or daily plaque control, thus potentially making them more vulnerable to developing pneumonia. As a result, RCTs studying this subject tend to have a control group that receives what is coined as “standard or usual care,” which could end up being quite different for each participant thus confounding the results.

RCTs are necessary for satisfying the criterion of “experiment” to determine causality, but are extremely difficult to administer in hospitals and nursing homes due not only to the issue of ethics approval, as mentioned, but also to the level of illness of the individual patients or residents and to difficulties in obtaining consent, especially

from individuals who may not have the cognitive ability to give such consent. These issues do not, however, negate the importance of ensuring good oral hygiene for this very vulnerable population group. More emphasis in hospitals and nursing homes must be placed on providing adequate oral hygiene care for their patients and residents. Dental hygienists can play a very important role in these institutional settings, and policies need to be improved to include regular oral care for these vulnerable individuals.

CONCLUSION

Based on findings from the 10 SRs and MAs investigated in this review, one can state with confidence that the answer to the proposed PICO question, “For patients in hospitals, nursing homes or long-term care facilities who are at high risk for respiratory infections, will an oral care intervention such as toothbrushing, administration of antimicrobial agents, and/or professional care, as compared to no oral care intervention (or usual oral care) reduce the risk for respiratory infections?” is “unclear.” Current evidence is inconsistent and overall does not support oral care interventions such as toothbrushing or the administration of 0.12% CHX or povidone iodine to reduce the rate of HAP/NV-HAP or VAP. However, there is some evidence that administration of CHX at a 2% concentration or delivered 4 times daily does reduce the incidence of VAP. Additionally, the incidence of pneumonia was significantly reduced among cardiac surgery patients who received various concentrations of CHX application. Since these cardiac surgery studies were often included in the same SRs and MAs for VAP as were non-cardiac surgery patients, they were identified by the authors as confounders. They were also the source of positive outcomes for the other ICU group of patients. It is important to remember that pneumonia occurring in ventilated cardiac surgery patients does not fall under the definition of VAP and thus should not be combined with other mechanically ventilated patient studies.

Table 8. Bradford Hill criteria results

Bradford Hill criterion	Met	Not Met
Strength of association		X
Consistency		X
Specificity		X
Temporality		X
Dose-response		X
Biological plausibility	X	
Coherence	X	
Experiment		X
Analogy		N/A

Numerous issues in these published studies may have influenced the results. Future studies will need to focus on correcting the inconsistencies, particularly by 1) identifying the extent of periodontal disease in the study population; 2) using standard case definitions for periodontal disease, VAP, and NV-HAP; 3) providing a better explanation of the type and frequency of the intervention and control (i.e., usual care); 4) ensuring consistency of the target population; and 5) using the CONSORT guidelines to improve the quality of RCTs.

Two previous CDHA position papers on this topic have established associations between periodontal inflammation and respiratory diseases but neither of those papers investigated a causal link. This position paper explored whether periodontal microbes were causally related to respiratory diseases, in particular ventilator-associated pneumonia (VAP) and nosocomial pneumonia (NV-HAP). The results of this paper provide clear evidence that, although associations have been established, no causal link exists between periodontal microbes and respiratory diseases at this time.

Although a causal relationship has not been established by this umbrella review, there is still substantial evidence of an association between periodontally associated microbes and respiratory diseases, particularly VAP and

nosocomial pneumonia (NV-HAP). Pneumonia causes significant morbidity and mortality, particularly to individuals who are hospitalized or who reside in nursing homes and chronic care facilities. It also places a heavy burden on Canada's health care system, because of its high treatment costs. Consequently, dental hygienists could have a significant impact on reducing health care costs by helping to address the oral hygiene concerns of this very vulnerable population group.

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CONFLICTS OF INTEREST

The authors have declared no conflicts of interest.

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Barriers to environmentally sustainable initiatives in oral health care clinical settings

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ABSTRACT

Human health is linked to environmental health. Pollutants or disease-causing microbes released into the environment through human activity or natural disasters affect communities' air quality, water or food supply, and, ultimately, the livelihoods of residents. Oral health care (OHC) professionals, including dental hygienists (DHs), use vast amounts of resources in their daily clinical operations, which contribute to the global pollution burden and climate change. Canadian OHC professionals are largely missing from the environmental sustainability dialogue, despite their commitment to the holistic well-being of their clients and communities they support. **Objective:** This literature review explores the barriers to adopting environmentally sustainable (ES) initiatives in the clinical setting as perceived by OHC professionals, particularly DHs. **Results:** Eight studies reviewed highlight 4 key barriers—infrastructural, institutional, educational, and individual—to the adoption of ES initiatives by OHC professionals in the clinical setting. **Conclusion:** OHC professionals who adopt ES initiatives to curb the potential environmental impacts of their clinical practices support the population health of the communities they serve and, thus, the well-being of future generations. Further research may guide the development of education, protocol, policy, and infrastructure changes to facilitate the adoption of ES initiatives by OHC professionals even amidst ever-changing global conditions. Adopting ES initiatives not only benefits the environment, but it may also aid in improving client outcomes due to long-term practice savings that can be diverted to enhancing client care.

RÉSUMÉ

La santé humaine est liée à celle de l'environnement. Les polluants ou les microbes pathogènes libérés dans l'environnement par l'entremise de l'activité humaine ou des désastres naturels influencent la qualité de l'air, l'approvisionnement en eau ou en aliments, et ultimement, le moyen de subsistance des habitants d'une communauté. Les professionnels de soins de santé buccodentaire (SSB), y compris les hygiénistes dentaires (HD) utilisent d'importantes quantités de ressources dans leurs activités cliniques quotidiennes, ce qui contribue au fardeau de pollution et de changement climatique global. Les professionnels de SSB canadiens sont grandement absents du dialogue sur la durabilité environnementale, malgré leur engagement envers le bien-être holistique de leurs clients et des communautés qu'ils appuient. **Objectif :** Cette analyse documentaire explore les barrières à l'adoption d'initiatives environnementales durables (ED) du milieu clinique comme perçues par les professionnels de SSB, particulièrement les HD. **Résultats :** Huit des études examinées soulignent 4 barrières clés : infrastructurelles, institutionnelles, éducatives et individuelles, à l'adoption d'initiatives ED par les professionnels de SSB de milieux cliniques. **Conclusion :** Les professionnels de SSB qui adoptent des initiatives ED pour contrer les effets environnementaux potentiels de leur exercice clinique appuient la santé de la population des communautés qu'ils servent et ainsi le bien-être des générations futures. Des recherches plus approfondies peuvent orienter le développement de l'éducation, des protocoles, des politiques et des changements d'infrastructure pour faciliter l'adoption des initiatives ED par les professionnels de SSB, malgré la situation mondiale toujours changeante. L'adoption des initiatives ED est non seulement avantageuse pour l'environnement, mais elle aide aussi à l'amélioration des résultats des clients en raison des économies réalisées à long terme par les cabinets qui peuvent être dirigées vers les soins du client.

Keywords: best practices; biomedical waste; dental hygiene; dentistry; eco-friendly; environmentally sustainable; green; recycling; refuse disposal; waste management

INTRODUCTION

Without a healthy environment, economic and social stability cannot be achieved by societies.¹ Human health is linked to the environments in which communities are established.²⁻⁵ Pollutants, carcinogens, and disease-

causing microbes released into the environment through human activity or natural disasters affect communities' air quality, water and food supply, and livability.²⁻⁵ As concern for the well-being of the environment and

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The *Canadian Journal of Dental Hygiene's* Student Essay Award competition, proudly sponsored by PHILIPS Sonicare, encourages students in a diploma, baccalaureate or degree-completion program to develop a love for writing and research and to recognize the possibilities that such endeavours offer for personal and professional growth. The editorial board is delighted to publish the winning entry from its 2019–2020 competition, which ably addresses the Canadian Dental Hygienists Association's 2015–2020 dental hygiene research agenda category of "capacity building of the profession."

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the effects of climate change mounts, environmentally sustainable (ES) actions on national and international levels are urgently needed to mitigate the climate crisis.²⁻⁵ As a United Nations member, Canada has adopted and developed national and international ES commitments such as carbon taxes, zero-waste initiatives, and climate action policies to protect both the well-being of the environment and of future generations.^{2-4,6,7}

Environmental impacts of the oral health care field

Environmental sustainability is overlooked by health care professions, including oral health care (OHC) professionals such as dental hygienists (DHs).⁸⁻¹¹ The OHC field is a resource-intensive industry with heavy demands on supplies, energy, water, fuel, and more to sustain daily clinical activities.^{8-10,11-19} Resource consumption unavoidably contributes to environmental pollution and climate change through greenhouse gas emissions.^{8-10,11-19} In the United Kingdom, the OHC field contributed about 3% or 675 kilotonnes to the National Health Service's total carbon footprint between 2014 and 2015.⁵ Dental hygiene is a profession that champions ethical principles such as beneficence and non-maleficence, which can be extended to the environment humans inhabit, supporting population health promotion and disease prevention.^{11,20} Adopting ES initiatives and technologies in OHC clinical settings not only benefits the environment, but may also improve client outcomes by allowing for long-term economic savings in private or public practices that can divert labour, time, and physical resources towards improving client deliverables.^{8-10,17,18}

State of the literature

The mandate of Canadian OHC governing bodies is to protect the public who receive care from licensed OHC professionals. However, little attention is paid to the impact of this care on the environment. Apart from infection prevention and control protocols to avert microbial or amalgam cross-contamination, and separating sharps from landfills, there is a paucity of guidelines, education, incentives, and infrastructure to support OHC professionals who are interested in ES initiatives.^{8-10,12-19,21,22} Studies on ES practices among professionals in the OHC field are scarce and tend to focus almost exclusively on dentists and dental students. There is no known published research on this topic originating from Canada. This literature review investigates the barriers to adopting ES initiatives perceived by OHC professionals in the clinical setting.

METHODS

Academic databases and search engines used to retrieve quantitative, qualitative or mixed-method studies of environmental sustainability in the OHC clinical setting within Canada were PubMed, Web of Science/Clarivate, Google Scholar, CINAHL, and Ovid/MEDLINE. The search was restricted to peer-reviewed open access articles

published in English between January 2009 and November 2019. Keywords and MeSH terms consisted of a combination of best practices; biomedical waste; dentistry; dental, dental hygienist; eco-friendly; environmentally sustainable; green; health knowledge, attitudes, practice; medical waste; recycling; refuse disposal; sustainable; sustainable development; waste management. The references of articles retrieved, Canadian practice guidelines, and policy documents were also reviewed for relevant content.^{6,7,21,22} The 8 articles selected for final review included 4 quantitative cross-sectional surveys, 1 case study, 1 qualitative interview, and 2 mixed-methods studies (a descriptive survey and an action research approach).¹²⁻¹⁹

RESULTS

A breadth of perspectives was gleaned from OHC professionals on the barriers to adopting ES initiatives in clinical practice, particularly through open-ended interviews, surveys, and action research approaches. These studies offer a deeper insight into the identified barriers and their interplay with the participants' demographics through data saturation, triangulation, and member checking. The barriers identified can be categorized broadly as infrastructural, institutional, educational, and individual. No published studies conducted among Canadian OHC professionals were found during this search. The studies selected primarily surveyed dentists or dental students from India, Jordan, Saudi Arabia, Thailand, and the United States. Only 2 studies from England expanded their participant pools to include other OHC professionals such as DHs.

DISCUSSION

Infrastructural barriers

Costs are incurred when incorporating ES infrastructure into publicly and privately built environments. Study participants bemoaned the initial high cost of implementing ES technology as financial returns would not be seen for years, especially for private dental practices.^{11-13,17,19} Long-established clinics have to be retrofitted to incorporate ES infrastructure such as automatic sensor lights, faucets, and thermostats.⁹⁻¹⁰ Other building considerations noted were installing heat-loss minimizing windows, amalgam separators, and dry vacuum pumps.⁹⁻¹⁰ Although installing ES technology is a burden for sole proprietorship, the financial returns are still significant in the long term, which can then be allocated towards improving client deliverables.^{8-10,17,18}

Furthermore, municipal infrastructure in developing countries may not provide adequate waste management or accessible recycling facilities, particularly in areas experiencing rapid urbanization and with uncoordinated city planning.^{14,15,19} The studies also explored how the structure of the survey questions and the differences in resources, infrastructure or government incentives for the surveyed population could confound the results if

the research design was not adapted to the context of interest.^{12,13,17} ES initiatives already in practice, such as digital radiography or electronic charting, may account for the participants' low reporting of recycling paper products or analog radiography-related chemicals.^{12,13,17}

Suppliers and manufacturers dictate the environmental sustainability of supply procurement, delivery, and availability.^{15,19} Sourcing supplies locally decreases fuel costs of procurement, and reducing excess packaging prevents further waste.¹⁵ Differences in material preferences among clinicians influence industrial demand. OHC educational institutions are hesitant to use bulk materials, preferring single-dose materials to prevent cross-contamination.¹⁸ Some study participants preferred amalgam over alternatives despite its potential to contaminate the environment during sourcing or disposal.¹⁹ Should OHC professionals express greater interest in ES alternatives, industry standards may change.

Institutional barriers

Participants reported confusion over conflicting protocols between municipal waste management and professional infection control standards.^{15,16} Infection control protocols set out by professional colleges are primarily concerned with protecting the public from diseases or injuries incurred from infectious substances, biomedical, toxic or radiographic processing of wastes, and sharps injuries.^{21,22} As such, environmentally conscious OHC professionals were frustrated by rigid infection control protocols that undermined environmental sustainability in an effort to protect the public from perceived immediate dangers.^{13,15-18} For example, paper products deemed to be clinical waste by said protocols may actually belong to general recycling, yet OHC professionals must abide in the interest of preventing cross-contamination or for fear of external audits.^{15,16} Participants suggested that having an environmental sustainability authority would alleviate confusion among their teams.¹⁶ OHC professionals enabled to collaboratively choose ES initiatives given available resources were more likely to implement and maintain them.¹⁵ Simple recommendations, the ability to test recommendations, and the opportunity to observe immediate benefits from their application increased the acceptance of new initiatives.¹⁹

Further confusion stemmed from mixed messages about the importance of environmental sustainability due to the decentralized efforts of federal and state authorities, professional colleges, and other entities.¹⁸ Participants felt that professional ES protocols were more applicable to hospital settings, preventing the extrapolation of such practices to OHC settings.¹⁹ The lack of governmental tax incentives and exemptions for duties on purchases also deterred participants from considering ES initiatives.^{13,17} Collaboration between the OHC sector and governing bodies will help in the development of guidelines and protocols specific to OHC clinical settings and related industry activities.

Educational barriers

All studies highlighted the international gap in knowledge among participants about ES practices in OHC clinical settings.¹²⁻¹⁹ Many participants were unaware of appropriate waste segregation methods or of recycling facilities.^{12,14,19} Additionally, participants appeared unaware of the life course of materials after disposal, the purpose of segregation methods, and toxic gases emitted from incineration.^{12,15} However, one study found that dentists surveyed possessed adequate knowledge of ES initiatives, yet other barriers prevented their adoption.¹³

The absence of ES curricula in formal and continuing education was noted by OHC professionals as a major barrier in both training and practice.¹²⁻¹⁹ Dental students surveyed expressed interest in incorporating ES learning objectives into the curriculum.¹⁸ Education during undergraduate training and through professional development activities may encourage ES initiatives for future practice and clarify confusion.¹³

Individual perspectives

Participants cited time constraints as the most important barrier.^{13,15,16,18} Another barrier was the lack of knowledge of the consequences of unsustainable practices. Varying interpretations of infection control protocols and ES guidelines hindered cohesive interprofessional and intraprofessional group culture, especially among teams where values were fragmented.^{15,16}

Individually held beliefs and feelings about environmental sustainability ranged from enthusiasm to indifference to denial.^{15,16,18,19} Some studies reported participants had positive attitudes towards adopting ES initiatives, while others reported participants had poor attitudes.^{14,15,18,19} Attitudes reportedly differed depending on age; younger dental students were more likely to support renewable energy sources and to attribute climate change to human activity.^{15,18} Conversely, other studies reported that younger dentists were less concerned for the environment than their senior counterparts.¹⁹ Junior staff reported simply following current office practices to avoid disturbing the existing group culture.¹⁶ With the variety of perspectives that could exist in one clinical setting, the coordinated adoption of ES practices may prove to be challenging.

Dental hygiene and environmental sustainability

The dental hygiene profession subscribes to ethical principles, paradigms, and competencies that guide DHs to care for clients, communities, and populations by considering environmental risk factors that undermine health and quality of life.^{11,20,23,24} Ethical principles such as beneficence and non-maleficence, the social determinants of health, and Yura and Walsh's Human Needs Conceptual Model (1988, cited by Darby¹¹) relate human health directly to environmental issues.^{11,20,23,24} Considering clients holistically along with their environments enables DHs to

engage in activities championing social justice, health promotion, and disease prevention, thereby embodying do no harm, and doing good.^{11,20}

Although dentists dictate much of the operation and protocols within their clinical practices, DHs and dental assistants are heavily involved in practice management. DHs are key members of OHC clinical practice teams, capable of proposing and leading new initiatives. Evidence shows that climate inaction and pollution of the environment harm the health of current and future generations.¹⁻¹⁰ As the mandate of the dental hygiene profession revolves around preventive health care, it is in the interest of DHs to adopt and encourage the adoption by others of ES initiatives. Gathering the insight of DHs is pertinent to understanding the barriers to and facilitators of ES practices.¹²

Future directions

It is necessary that environmental sustainability efforts adapt to dynamic global conditions. The COVID-19 pandemic has demonstrated the impact that highly infectious diseases have should they spread.²⁵⁻²⁷ To mitigate transmission of COVID-19, high-level infection prevention and control protocols have increased demand for personal protective equipment, barriers, single-use disposables, single-dose materials, and stringent adherence to disinfection and sterilization methods.²⁷⁻³² Increased pollution is expected as the general public and non-health care industries make use of masks, gloves, and various disinfectant methods for everyday protection.³³ Because of physical distancing requirements and essential service-only orders around the globe, ES initiatives have been halted, including summits, enforcement, monitoring, and protests.³⁴⁻³⁶ Moving forward, an opportunity exists for OHC professionals to define their roles as stewards of both human and environmental health.

Further research will improve the understanding of the barriers to and facilitators of the adoption of ES initiatives in the OHC clinical setting. Research in the Canadian context, especially among DHs, will fill this gap in the literature. Gathering insights from all members of the OHC team, including DHs, will inform the development of education, incentives, protocols, and infrastructure to enable all OHC professionals to collaboratively choose ES practices applicable to their clinical settings.

CONCLUSION

The OHC field is a resource-intensive industry with heavy demands on supply, energy, water, and more.^{8-10,11-19} The success of implementing ES initiatives in the OHC clinical setting relies on a multidimensional, high-technology, and collaborative approach to mitigate greenhouse gas emissions and pollution. Current barriers to environmental sustainability in OHC clinical practice are infrastructural, institutional, educational, and individual. Further research and collaboration may guide the development of education,

protocol, policy, and infrastructure changes to facilitate the adoption of ES initiatives by OHC professionals amidst ever-changing global conditions. ES initiatives embody holistic and preventive approaches to which the dental hygiene profession subscribes. When DHs adopt ES initiatives to curb the potential environmental impacts of their work, they support population health promotion and disease prevention and thus the well-being of future generations.

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CONFLICTS OF INTEREST

None declared.

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The Importance of Instrument Handle Design in Dental Hygiene

In Relation to Work-Related Musculoskeletal Disorders

by **Klaudia Kulpa-Lindgren, MOT, OTR/L** and **Sabrina (Chia-Chun) Chang, MOT, OTR/L, CHT, CKTP, CEAS**

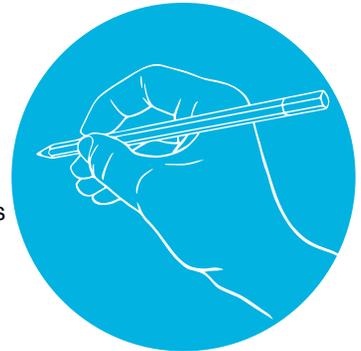
Dental hygienists are increasingly at risk for gradually developing work-related musculoskeletal disorders (WMSDs) of the upper extremities at the expense of productivity levels and billions of dollars in medical expenses.^{1,2} Frequent and highly repetitive motions applied to a group of muscles, joints, nerves, and tendons in the upper extremities, combined with a high pinch force applied for sustained periods of time, causes inflammation in the body and may lead to WMSDs.^{2,3,4,6,7} Disorders of the upper extremities that may occur are less likely to respond to treatment the longer times goes by and include the following:^{3,5,6,7}

- **De Quervain's tenosynovitis** - pain radiating over the base of the thumb.
- **Carpal tunnel syndrome** - paresthesias (numbness or tingling) of the thumb, index, middle, and half of the ring fingers. Decreased finger dexterity and increased symptoms at night.
- **Trigger Finger** - a painful snapping or clicking in the fingers while trying to make a fist and the inability to straighten back the fingers.
- **Osteoarthritis** - breakdown of cartilage resulting in painful and limited finger movements.
- **Thoracic outlet syndrome** - pain in the shoulders and neck, numbness, weakness, and coldness in the fingers.
- **Cubital tunnel syndrome** - numbness and tingling in the ring and little finger, especially when the elbow is bent. Weakness and aching pain in the arm and hand.

One ergonomic component that may contribute to reducing the onset of WMSDs of the upper extremity in dental hygienists is ergonomically designed instruments: specifically, scalers. While performing periodontal scaling, hygienists apply a high pinch force value due to the limited space of the oral cavity as well as to perform precise finger and hand motions.⁸

What is the significance of a high pinch force applied to instruments and WMSDs? In human development, our fingers and hand movements develop in a sequential order of grasp patterns over time. A precision grasp pattern consists of the thumb's ability to oppose towards the fingertips.⁹ When holding a scaler with a precision pinch, the thumb and index finger interphalangeal joints are flexed against each other with opposite forces. In order to utilize a precision pinch on a scaler, the joints of the hand must be pain free and have functional movement produced by muscles and sensation from nerves.^{3,10}

On the contrary, when force is placed on the same muscle group repetitively, this causes inflammation in the muscles and tendons as well as fatigue. The higher and longer the force applied, the faster muscle fatigue sets in. In addition, inflammation of the muscles and tendons may also increase pressure within the hand structures, which in turn compresses nerves causing peripheral nerve injuries such as carpal tunnel syndrome. Hence, by reducing the amount of pinch force a dental hygienist applies to a scaler and given recovery time between scaling, hand injuries are less likely to occur.³



HuFriedyGroup recognized the high prevalence rate of WMSDs among dental professionals and the high usage of hand scaling during a standard prophylactic appointment. This led HuFriedyGroup to collaborate with leaders in technology and development to conduct an extensive study regarding biomechanical stress placed on joints while scaling. The results of the study led to the development of a new design, the Harmony™ Scaler. This scaler has demonstrated to successfully reduce pinch force by up to 65% compared to other brands on the market, while also lowering the pressure on teeth by up to 37%.¹¹

Therefore, to potentially extend the longevity of a dental hygienist's career by reducing the onset of WMSDs of the upper extremity, one may proactively implement a component of ergonomics: properly designed hand instruments. By using the new Harmony Scaler designed by HuFriedyGroup, the pinch force that a dental hygienist applies while holding this scaler with a precision pinch grasp pattern will be reduced. As a result, the biomechanical stress on fingers and hands along with soft tissue compression will be reduced compared to other available scalers on the market. Hygienists may also experience decreased muscle fatigue, an overall increased work expectancy, and less injury visits to their local occupational therapist.

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