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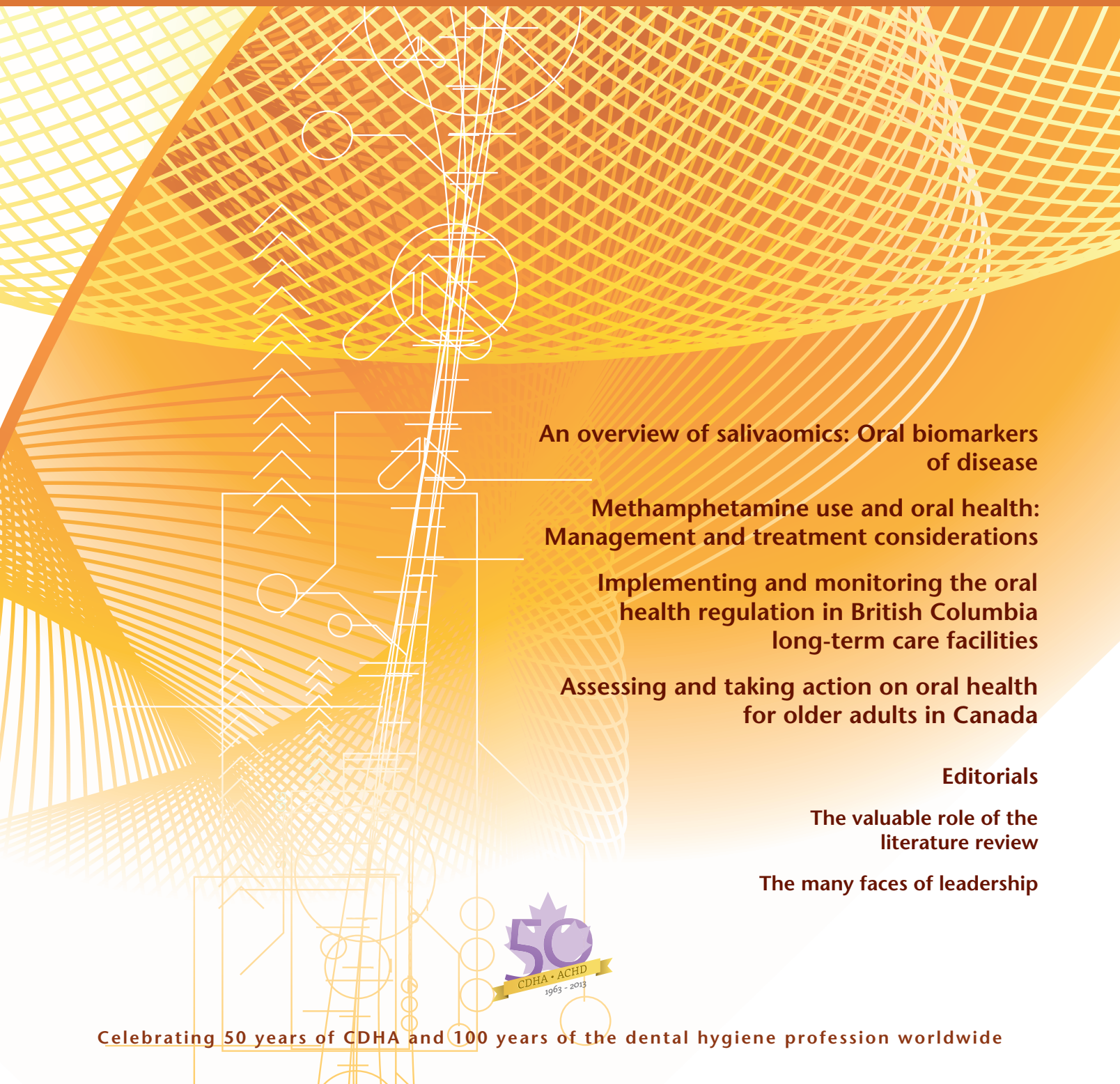

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The valuable role of the literature review

Katherine Zmetana, DipDH, DipDT, EdD

Scientific Editor, CJDH

It can be pretty much agreed that research is critical to evidence-based practice and that it is integral to the profession's image, credibility, and ability to grow. Many types of research—qualitative and quantitative—have made a contribution to dental hygiene in their own way. And many research questions have yet to be explored.

Before any research project can be undertaken, however, a review of the literature is necessary. This preliminary step is essential in understanding the broader context of the subject area, examining the research that has already been done, and identifying gaps that exist. The literature review directs the path of research—establishing focus and limitations, determining methodology, and clarifying purpose or applications.

Such characteristics describe the "traditional" literature review, long established as the foundational stage of all academic research, whether in the domain of philosophy, science, education or dental hygiene. To be considered valid or trustworthy, literature reviews, as with all research, must be conducted with rigour. That is, they must be undertaken in a thorough and well-defined process with clear parameters. Nevertheless, the interpretation, analysis, and summary of the collected information are somewhat subjective, dependent on the researcher's own perspective and purposes of investigation. Moreover, the process of investigation (for example, the choice of databases and number of articles selected) is also directed or at least supported by the lead investigator or supervising professor of the larger research project. Therefore there is no one standard or universally accepted methodology of the traditional literature review: it is highly dependent on topic, researcher, and supervising researcher.

Thus, to many in the academic or scientific world, the traditional literature review is not considered, in itself, stand-alone research. Indeed, literature reviews provide a summary of secondary sources; they are not a report of original, experimental work. They do not present anything new that hasn't been already researched. For this reason, there is often debate around the objective value of literature reviews, and whether they should be published as independent articles in scientific journals. It is important, then, to take into consideration the intended audience of the journal as well as the purposes of the literature review.

For some journals, what may be considered more "scientific" is the systematic review, which follows a specific methodology in selection, review, and interpretation of scientific studies. The standards guiding the methodology, such as those supported by the Cochrane Collaboration,[1] are internationally recognized. The purpose of a systematic review is to sum up the best available research on a specific question. This is done by synthesizing the results of several studies using statistical analysis.

"A systematic review attempts to identify, appraise and synthesize all the empirical evidence that meets pre-specified eligibility criteria to answer a given research question."[1] Researchers are rigorous and explicit in their methods of review; they follow a standard set of stages and requirements in user involvement to ensure that their study can be replicated. In effect, they analyze the effectiveness and reliability of the published (and sometimes unpublished) research on a specific research question.[2]

Because a systematic review is heavily weighted in favour of quantitative research and statistical analysis, its conclusions are considered unbiased and generalizable. Therefore it is often seen to have merit as an independent source of validated scientific evidence.

Another type of literature review that follows a protocol (with standardized methodology under development[3]) is the scoping review. This review is a "rapid gathering of literature in a given policy or clinical area where the aims are to accumulate as much evidence as possible and map the results. [Scoping reviews] provide an overview of the type, extent and quantity of research available on a given topic. . . . and do so by using systematic and transparent methods."[4] The scoping review is not narrowly focused on studies using identical research protocols; rather the intent is to scope out the existing research and look for recurring themes within the literature to determine the current state of research in that particular area of study.

While the systematic review focuses on a well-defined question and measures results, a scoping study tends to address broader topics where many different study designs might be applicable.[5] The traditional literature review, in contrast, provides a more qualitative interpretation of available information. It covers a more general range and often serves as a knowledge translation piece, which is ideal for such an area as education.[6] "In educational research,

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where the methods of inquiry are more varied than in medicine [or pure science], there is greater flexibility in making decisions about literature survey methodology."[3]

That brings us back to the question of determining which types of literature review, if any, should be considered for publication in a professional journal. In the case of the *CJDH*, we believe that all literature review methods offer a set of tools when used and applied appropriately. All forms of literature reviews—traditional, systematic, scoping—have valuable and unique roles.

A systematic review can confirm or disprove a specific intervention, such as the use of interproximal brushes or different applications of fluoride. A scoping review can relate the current state of research in a particular area and determine where more study may be needed, such as the use of lasers in dental hygiene. Traditional literature reviews provide readers with easy access to current, relevant, and meaningful research on a particular subject by summarizing articles in one complete report for a common base of understanding. An example of this would be an article on the known causes of oral cancer.

All forms of literature review provide an excellent starting point for discussion with colleagues and clients or researchers who are interested in original research. For that reason, they are all worthy of publication in our journal.

Literature reviews are invaluable learning tools that can be shared. They enable us to embrace and practise common goals of a professional community that may include:

- evaluating research in a particular area of interest
- encouraging research among members
- sharing knowledge with others
- re-examining the way we think about things
- making connections between ideas, theory, and experience
- developing skills in research, critical thinking, and writing
- gaining a worldview of professional practice

The *CJDH* aims to provide current, relevant information on topics of particular interest to clinical dental hygienists and educators as well as researchers. It is a venue to nurture, support, and promote dental hygiene research within the professional community and without. Literature reviews serve those purposes well.

This issue features two excellent literature reviews among other offerings. **Susan Badanjak** has written a comprehensive overview of the emerging field of salivaomics (p. 167). **Sabrina Lopresti**, **Deanna Ngo**, and **Jennifer Tocchio** have written a review on methamphetamine use and oral health (p. 176). The short communication by **Sharon Compton**, **Minn Yoon**, and **Joanne Clovis** reviews the insights and recommended actions resulting from an interprofessional symposium on age-related oral health care (p. 189). In addition, **Caroline Jiang** and **Michael MacEntee** explore the implementation of a government regulation on oral health care in long-term care facilities in British Columbia through interviews with administrators and health authority inspectors (p. 182). Finally, our new CDHA president, **Mary Bertone**, has written an editorial on the many aspects of leadership (p. 161).

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Errata

CJDH Volume 47, Number 3

In the August 2013 issue of the journal, authorship of three national conference scientific abstracts was not properly attributed. On page 140, the authors of "Examining the ability of the RAI–MDS 2.0 to predict dental need among long-term care residents" should have appeared as Nicole Hannigan, RDH, BSc; Sharon M. Compton, PhD, RDH; Minn Yoon, PhD. On page 142, the authors of "The use of adjunctive screening devices by Canadian dental hygienists" should have appeared as Denise Laronde, PhD, RDH; Kitty Corbett, PhD; Jelena Prelec, BDSc(DH), RDH, Miriam P Rosin, PhD. On page 145, the authors of "Clinical and molecular risk factors for second oral cancers" should have appeared as Jelena Prelec, BDSc(DH), RDH; DM Laronde, PhD, RDH; PM Williams, BSN, DMD; CF Poh, DDS, PhD; L Zhang, PhD; MP Rosin, PhD. These abstracts, with authorship now properly attributed, are available at www.cdha.ca/cjdh (Vol. 47, No. 3) for viewing and downloading.

In addition, an updated version of the scientific abstract by Hannigan, Compton, and Yoon appears in this issue on page 165.

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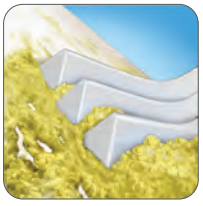

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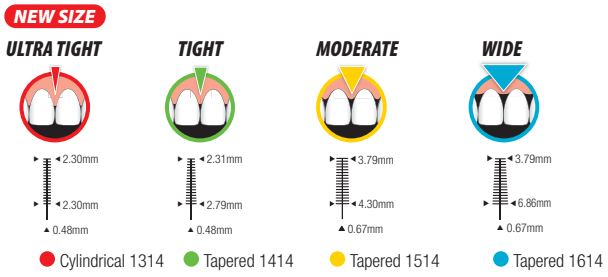

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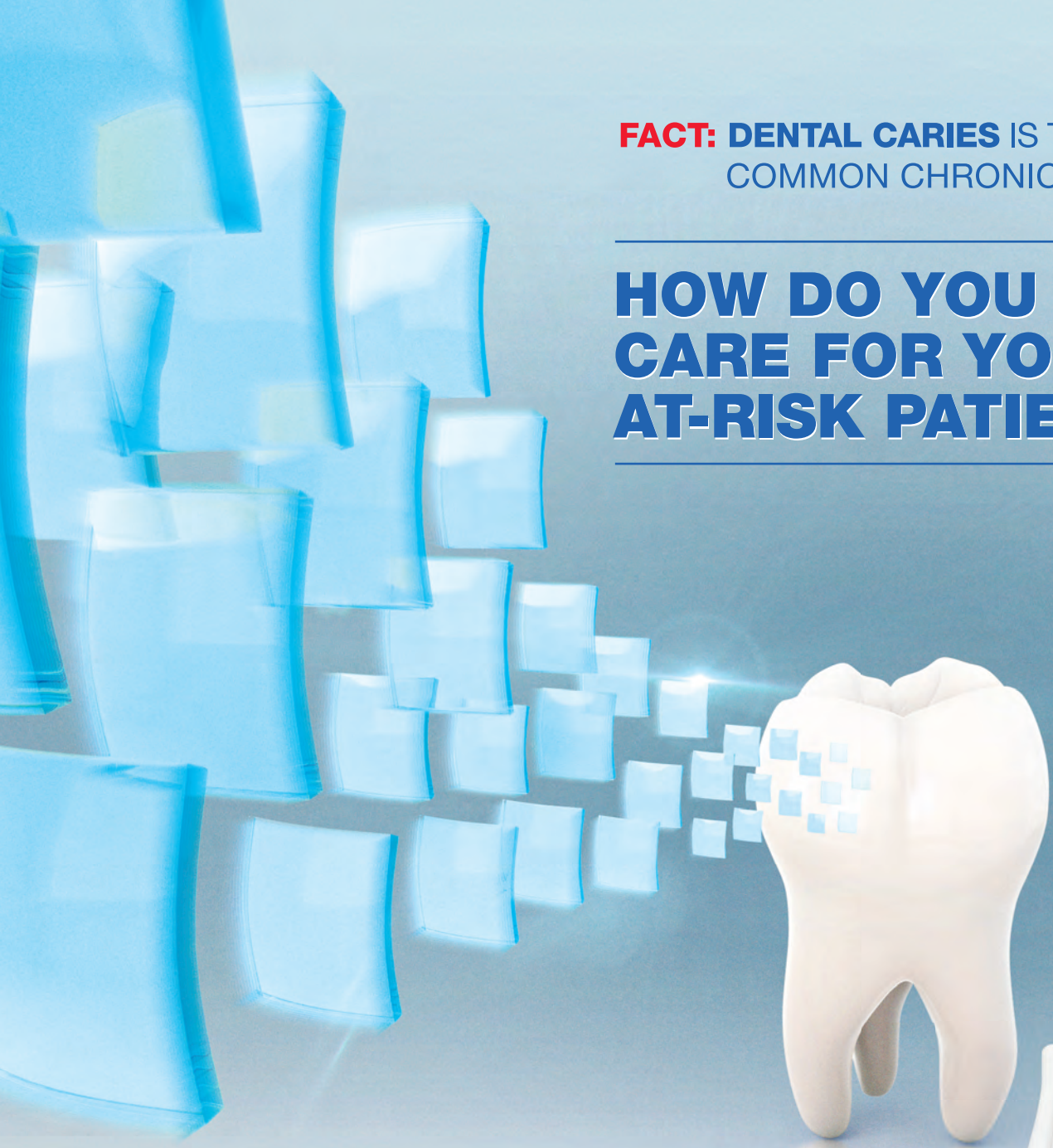

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The many faces of leadership

Mary Bertone, RDH, BSc(DH)

In my new position as president of the Canadian Dental Hygienists Association (CDHA), I find myself reflecting on what it means to be a leader. Leadership skills are not necessarily something that you are born with; they are developed over time. Dental hygiene has provided me with the ideal career for the development of my leadership potential. My solid education as well as the guidance and support of colleagues have helped me to deal with and grow from the work and life experiences that have ultimately shaped my path to leadership. I think this is true for most people.

Mary Bertone

CDHA President
Présidente de l'ACHD

I recently attended the University of Manitoba School of Dental Hygiene's 50th anniversary brunch to bring greetings on behalf of CDHA. As a proud alumna, my greetings were addressed to the educators who taught me, encouraged me, and sometimes even pushed me. Yet these leaders and mentors who helped me to chart my own direction are not unique; our profession boasts leadership on many levels and in many different capacities. Whether a dental hygienist's work is in clinical practice, public health, education or research, leadership opportunities abound and our colleagues are consistently up for the challenge.

Fundamentally, leadership in dental hygiene begins with education. Of course, dental educators lead through teaching and curriculum standards. However, educators are in a uniquely powerful leadership position as they are able to influence and inspire future dental hygienists and to arm them with the skills that they need to become future leaders themselves.[1] It is an incredible opportunity to instill leadership aspirations in these future professionals at a time when they are in pure learning mode. It is also a great responsibility, as it is incumbent on educators to engrain the profession's collective sense of social responsibility into the conscience of students.[1] In order to address the future challenges facing our profession (including access to care) and to prepare students to better serve the underserviced and at-risk populations, today's dental hygiene students need to be groomed to be leaders.[1,2]

In any profession, ethical leadership is paramount.[1] The CDHA Dental Hygienists' Code of Ethics is founded on five ethical principles: beneficence, autonomy, integrity, accountability, and confidentiality.[3] This code is the core of dental hygiene: do good for our clients, help our clients to make informed decisions, consistently conduct ourselves beyond reproach, be accountable for our actions,

Les nombreux visages du leadership

Dans mon nouveau poste de présidente de l'Association canadienne des hygiénistes dentaires (ACHD), je me vois réfléchir sur ce que signifie être leader. Les talents du leadership n'apparaissent pas nécessairement à la naissance; ils se développent avec le temps. L'hygiène dentaire m'a procuré une carrière idéale pour développer mes possibilités en ce sens. La formation solide que j'ai reçue ainsi que l'orientation et le soutien des collègues m'ont aidée à m'occuper et à grandir à la suite des expériences de travail et de vie qui ont finalement dressé mon cheminement vers le leadership. Je crois qu'il en est ainsi pour la plupart des gens.

Récemment, j'ai eu le plaisir de transmettre de vive voix les meilleurs vœux de l'ACHD à la Faculté d'hygiène dentaire de l'Université du Manitoba qui célébrait son 50e anniversaire. Ancienne étudiante, j'ai présenté mes vœux aux professeures qui m'avaient enseignée, encouragée et parfois même incitée. Néanmoins, ces cheffes et guides qui m'ont aidée à tracer mon orientation ne sont pas uniques; notre profession fait valoir son leadership à beaucoup de niveaux et sous de nombreuses capacités différentes. Qu'une hygiéniste dentaire travaille en pratique clinique, en santé publique, dans la formation ou la recherche, les occasions de leadership foisonnent et nos collègues sont constamment prêtes à relever le défi.

Fondamentalement, en hygiène dentaire, le leadership commence durant la formation. Évidemment, les enseignants dentaires mènent selon les normes d'enseignement et du curriculum. Toutefois, le personnel enseignant se trouve dans une position de leadership uniquement puissante, car il peut influencer et inspirer les futures hygiénistes dentaires et munir celles-ci des talents dont elles auront besoin pour devenir elles aussi des leaders.[1] Il y a là une occasion incroyable d'inculquer des aspirations au leadership chez ces futures professionnelles au moment où les étudiantes se trouvent en mode de pure apprentissage. C'est aussi une grande responsabilité, car il incombe aux enseignantes d'inculquer le sens collectif de la responsabilité sociale dans la conscience des étudiantes.[1] Afin d'envisager les éventuelles responsabilités que devra assumer la profession (y compris l'accès aux soins) et de préparer les étudiantes à mieux servir les populations insuffisamment servies et à risque, les étudiantes en hygiène dentaire ont besoin d'être préparées au leadership.[1,2]

Dans toute profession, le leadership éthique est primordial.[1] Le Code de déontologie des hygiénistes dentaires de l'ACHD se fonde sur cinq principes déontologiques : la bienveillance, l'autonomie, l'intégrité, la responsabilité et la confidentialité.[3] Ce code se trouve au cœur de l'hygiène dentaire : faites du bien

THIS IS A PEER-REVIEWED ARTICLE.
Correspondence to/Correspondance à: Mary Bertone, CDHA President /Présidente de l'ACHD; president@cdha.ca

and maintain client privacy.[3] When we walk the ethical walk by minding each of these five principles, we lead by our example to our clients, our colleagues, and the public.

Research is another means through which dental hygienists can show leadership. Dental hygienists involved in research are blazing a trail in search of new knowledge and best practices for the rest of us. Research allows us to improve what we do in a responsible and scientifically supported manner, and those undertaking the research are leading the way. Quality research requires quality thought. Opportunities for advanced education are paramount to the role that the profession will play in supporting and enhancing research performed by dental hygienists.[4-6]

The qualities of an effective oral health leader include "being approachable, inspiring, fair, firm, unbiased, a team worker, a good listener, having good knowledge of their business, and having a broad perspective on key issues."[7] The Canadian dental hygiene community is truly blessed to count among its ranks some true visionaries and pioneers who have leveraged these qualities to take our profession to where it is today. Some of our predecessors are now gone, and as sure as the sun will rise tomorrow, others will follow them. To ensure that our profession has strong leadership tomorrow, we need to work together to create a culture of leadership development today.

à nos clients, aidez-les à prendre des décisions éclairées, ayez constamment une conduite irréprochable, soyez responsable de vos actions et conservez la vie privée des clients.[3] Lorsque nous agissons en toute éthique en pensant à chacun des cinq principes, nous donnons l'exemple à nos clients, nos collègues et le public.

La recherche offre aux hygiénistes dentaires d'autres moyens de faire valoir leur leadership. Les hygiénistes dentaires impliquées dans la recherche nous tracent une voie pour la poursuite de nouvelles connaissances et l'amélioration de la pratique. La recherche permet d'améliorer ce que nous faisons de manière responsable et soutenue scientifiquement, puis les personnes qui entreprennent la recherche ouvrent la voie. La recherche de haute qualité repose sur une pensée de qualité. Les possibilités de formation avancée sont primordiales pour le rôle qu'assumera la profession en soutenant et en faisant progresser la recherche menée par les hygiénistes dentaires.[4–6]

Les qualités d'une leader efficace en santé buccodentaire comprennent « être avenante, inspirante, équitable, ferme, impartiale, équipière et bonne auditrice, avoir une bonne connaissance de leur entreprise et aborder les principaux problèmes dans une plus vaste perspective ».[7] La communauté canadienne d'hygiène dentaire est vraiment heureuse de compter dans ses rangs certaines vraies visionnaires et pionnières qui ont mis à profit ces qualités pour mener notre profession à ce qu'elle est aujourd'hui. Certaines de nos prédécesseures ont maintenant quitté et, aussi sûre que le soleil se lèvera à nouveau demain, d'autres les suivront. Pour nous assurer que notre profession aura un solide leadership demain, nous avons besoin de travailler ensemble afin de créer aujourd'hui une culture de développement du leadership.

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CDHA 2013 National Conference Revised Scientific Abstract

Examining the ability of the RAI–MDS 2.0 to predict dental need among long-term care residents

Nicole Hannigan, RDH, BSc; **Sharon M. Compton**, PhD, RDH; **Minn Yoon**, PhD
University of Alberta, Edmonton

ABSTRACT

Objective: This study investigated whether the Resident Assessment Instrument–Minimum Data Set (RAI–MDS) 2.0 is capable of predicting dental need in a sample of elderly long-term care (LTC) residents. The RAI–MDS is conducted by nursing staff and is designed to address LTC residents' needs and to facilitate the development of care plans. Therefore, it is important to know if the dental and oral health components of this assessment provide accurate and valuable information.

Methods: Chart reviews were conducted comparing RAI–MDS data with onsite dental assessments. Assessments collected from 2008–2012 on residents aged 65 years and older were used.

Results: A total of 332 assessments were used for comparison in the study. Early data analysis reveals discrepancies in assessments conducted by nursing staff and the dental professional. The prevalence of moderate to severe gingivitis recorded by the dental professional was 74% compared to less than 1% prevalence of inflamed gums recorded by the nursing staff on the RAI–MDS. The RAI–MDS data showed negligible documentation of orofacial pain, and significant differences were found in recording the residents' state of dentition. Although RAI–MDS data show that daily care is being performed, the oral health status of the population, determined by the comparative dental assessments, is still very poor. Individual dental RAI–MDS items that are expected to suggest treatment need, such as orofacial pain and caries, do not show any significant association with the dentist's identification of treatment need.

Conclusion: There is a need to elevate awareness of the oral health of older adults, especially those residing in LTC facilities who may be dependent on others for oral care provision and be susceptible to poorer oral health. The current use of the RAI–MDS does not appear to be useful in identifying individuals in need of dental treatment, indicating that a more effective assessment process is required. The results from the current study support the need to develop a sensitive oral health assessment tool, which can identify those individuals who require attention.

RÉSUMÉ

Objet : Cette étude a examiné si l'Instrument d'évaluation des résidents et l'Ensemble de ses données minimales (RAI–MDS) 2.0 permettent de prévoir les besoins dentaires d'un échantillon représentatif des résidents recevant de soins de longue durée (SLD) parmi les aînés. Le RAI–MDS est dirigé par le personnel infirmier et conçu pour examiner les besoins des patients en SLD et faciliter le développement des régimes de soins. Il est donc important de savoir si les composantes de santé bucco-dentaire de cette évaluation fournissent une information exacte et valable.

Méthodes : Examen des dossiers permettant de comparer le contenu du RAI–MDS et les évaluations des dents sur place, selon les données d'évaluation recueillies entre 2008 et 2012 chez des résidents âgés de 65 ans et plus.

Résultats : En tout, 332 évaluations ont servi à la comparaison dans cette étude. L'analyse des premières données a révélé des divergences d'évaluation entre le personnel infirmier et les professionnelles des soins buccodentaires. La prévalence des gingivites, de modérées à graves, notées par la professionnelle des soins buccodentaires était de 74 %, comparativement à moins de 1 % pour celle notée par le personnel infirmier selon le RAI–MDS. Les données du RAI–MDS ont présenté une documentation négligeable de la douleur bucco-faciale et l'on a trouvé des différences significatives concernant l'état de la dentition des résidents. Bien que les données du RAI–MDS indiquent la performance des soins quotidiens, l'état de santé buccodentaire de la population, établi par la comparaison des évaluations buccodentaires, est toujours très médiocre. Les articles dentaires individuels du RAI–MDS qui devraient suggérer un besoin de traitement, telles les douleurs bucco-faciales et les caries, ne montrent pas d'association significative avec l'identification du besoin de traitement par le dentiste.

Conclusion : Il est nécessaire de prendre davantage conscience de la santé buccodentaire des adultes plus âgés, spécialement ceux qui résident dans des établissements de SLD et, susceptibles de dépendre des autres pour leurs soins buccodentaires, sont plus enclins à avoir une piètre santé buccodentaire. Le recours actuel au RAI–MDS ne semble pas être utile pour identifier les personnes ayant besoin de traitements buccodentaires. Cela indique le besoin d'une procédure d'évaluation plus efficace. Les résultats de la présente étude soutiennent le besoin de développer un outil sensible d'évaluation de la santé buccodentaire, qui pourrait identifier les personnes qui requièrent de l'attention.

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An overview of salivaomics: Oral biomarkers of disease

Susan M Badanjak, RDH, ADH

ABSTRACT

Purpose: This literature review examines the discipline of salivaomics in the oral environment and beyond as a diagnostic tool for disease. Its purpose is to acquaint dental hygienists with the science of salivary diagnostics and examine how it is currently being used for both intra- and extra-oral pathologies. Salivaomics or salivary diagnostics, a subset of molecular diagnostics, has moved to the forefront of disease detection, as most of the biomarkers found in blood and urine can also be detected in saliva. **Methods:** A PubMed search of articles published in English, between 2009 and 2013, was conducted. These articles were cross-referenced, verified for the chronological restriction and duplication; those not meeting these criteria were eliminated. The majority of the articles retained were review articles, which was expected, as salivaomics is an emerging field. **Results:** A growing body of literature supports salivary biomarkers as credible, measurable, and quantifiable biological indicators. Approximately 73% of salivary proteins are not present in plasma, making saliva an excellent diagnostic medium. Saliva can be used to screen, detect, diagnose, stage, and monitor disease and treatment outcomes. The saliva testing process is safe, in terms of reduction of needlestick injuries, simple, rapid, noninvasive, painless, reliable, complementary, and cost-effective. **Conclusion:** The emerging field of salivaomics will continue to play an increasingly important role in the diagnosis of oral and systemic disease. Its real-time and point-of-care advantages and its potential to reduce diagnosis-to-treatment time will revolutionize health care delivery.

RÉSUMÉ

Objet : Cette revue de la littérature examine les méthodes d'examen salivaire (*Salivaomics*) comme moyens de diagnostic de maladie. Elle a pour objet de renseigner les hygiénistes dentaires sur la science des tests de diagnostic salivaire et d'examiner comment cette méthode est actuellement utilisée en pathologie buccale, intra et extra. Les diagnostics salivaires, sous-ensemble des diagnostics moléculaires, sont montés au premier rang de la détection des maladies en tant que marqueurs biologiques qui, comme ceux trouvés dans le sang et l'urine, peuvent aussi être détectés dans la salive. **Méthodes :** Exécution d'une recherche d'articles publiés en anglais dans PubMed, entre 2009 et 2013. Ces articles ont fait l'objet de renvois et de révisions concernant les révisions chronologiques et les duplications; ceux qui ne respectaient pas ces critères furent éliminés. La majorité des articles retenus comportait des exposés de synthèse. Ce résultat était attendu, car l'examen salivaire est un émergeant domaine d'études. **Résultats :** Une documentation littéraire de plus en plus importante soutient les marqueurs biologiques en tant qu'indicateurs crédibles, mesurables et quantifiables. Environ 73 % des protéines salivaires ne sont pas présentes dans le plasma, ce qui fait de la salive un excellent moyen de diagnostic. La salive peut servir à scruter, détecter, diagnostiquer, mesurer et surveiller la maladie et les résultats des traitements. Le processus des tests de salive est sécuritaire, en ce qui a trait à la réduction des blessures par piqûre d'aiguille, simple, rapide, non envahissant, indolore, fiable, complémentaire et rentable. **Conclusion :** L'émergence du domaine d'études jouera un rôle de plus en plus important dans le diagnostic des maladies buccales et systémiques. Ses avantages concernant le temps réel et le point des soins ainsi que la possibilité de réduire le délai entre le diagnostic et le traitement vont révolutionner la prestation des soins de santé.

Key words: saliva, salivary, biomarker(s), diagnosis, diagnostic(s), biological marker(s), mouth disease

INTRODUCTION

Historically used to diagnose caries and periodontal disease,[1–15] salivary diagnostics continue to evolve and advance, not only in dentistry, but especially in the field of medicine.[2–5,8–20] Over the last 10 years, knowledge gleaned from the detection of disease in saliva, a diagnostic tool known as salivaomics,[5,13,14,21] has the capacity to alter the process of care. This oral fluid has become so significant that U.S. President Barack Obama declared detecting disease in samples of saliva to be one of the 14 grand challenges for biomedical research in the 21st century.[22]

The ideal diagnostic tool should be highly sensitive and specific, possess medical functionality, support high-throughput screening, have portability, and be economical.[4,5] Today's technologies for discovery of salivary biomarkers are extremely close to meeting the mark, as they are simple to perform, noninvasive, and painless.[3–5,8–15,18–20,23] Typically diseases are diagnosed through reported symptoms, medical history, clinical examination, and chemical analysis of blood and urine samples. Oral samples are usually only collected when

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oral infection or malignancy is suspected. However, oral samples such as saliva, gingival crevicular fluid (GCF), oral swabs, biofilm, and volatile sulfur compounds (VSCs) can help to identify systemic disease symptoms or susceptibility. Indeed, based on preliminary research, saliva plays a critical role in the detection of disease.[1–15,17–20,23–29]

This review aims to familiarize dental hygienists with salivaomics. First, it describes saliva's protein constituents and functions, and provides brief descriptive comparative information on human salivary and serum proteomes. Second, the review summarizes the diagnostic role of salivary biomarkers in common oral, viral, systemic, and malignant diseases. Finally, the value of salivaomics in health care is discussed and foretells how integral oral biofluids will be in determining overall health. The days of dental chair-side monitoring of overall health, disease, and treatment outcomes are imminent.[4,10–12,14,15,19]

METHODS

A literature search of PubMed was limited to articles published in English between 2009 and 2013. An initial search, using the "All Fields" category with the words saliva, oral disease, salivary, diagnostics, and biomarkers, and using the Boolean operator term "AND," was performed, retrieving 58 articles. A second search with the same operator term in "All Fields" and the words saliva, oral diseases, salivary, diagnostic, and biomarker returned an additional 85 articles. The MeSH keywords saliva, diagnosis, biological marker, biomarkers, and mouth disease were identified from these initial searches and were subsequently searched with the "AND" operator term in the "All Fields" category, yielding another 256 articles. All 399 articles were reviewed for the prescribed cut-off date and duplicates. Those not meeting these requirements were rejected. Subsequent and separate searches in "All Fields" and "Title" categories using saliva, the same Boolean term, and the words biomarker, biomarkers, diagnostic, diagnostics, biological marker, and biological markers were completed. An identical search was effectuated using the word salivary in lieu of saliva. These articles were cross-referenced and verified for the chronological restriction and duplication; those not meeting these criteria were eliminated. The mined articles were systematically reviewed for inclusion, and those retained from the initial search were ascertained to provide valuable information on current and evolving use of salivaomics in dentistry and medicine. Articles from the search using MeSH terms were also deemed appropriate based on the needs of this review. The majority of the articles were review articles, which was to be expected, as salivaomics is an emerging field. Finally, 5 additional articles not meeting the inclusion criteria of the methodology were included in order to expand and clarify specific subject matter in this review.

REVIEW OF THE LITERATURE

Saliva

Mainly composed of water (95% to 98%) and organic and inorganic molecules (2% to 5%), saliva is a complex secretion; both its quantity and quality are consequential.[4–6,8–14,20,24,29] Ninety-three percent of the volume of saliva is secreted by 3 pairs of the major extrinsic salivary glands, namely the parotid, submandibular, and sublingual glands; many smaller intrinsic salivary glands found throughout the mouth, including the tip of the tongue, secrete the remaining 7%.[4,8,10,14,24] Daily secretion ranges from 500 to 700 mL; the average oral volume is 1.1mL.[4,8,14,24] Whole saliva comprises glandular secretions, gingival crevicular fluid (GCF), serum filtrate particles, shed human cells, microbial cells and debris.[4,5,8,14,24] Saliva plays an important role in the maintenance of oral mucosa integrity, the preservation of dentition, the control of oral infection, the digestive process, and speech.[4–6,8–14,20,24,29]

Epidermal growth factor (EGF) is present in human saliva, and EGF receptors have been found on human buccal mucosa,[4,8,24] which may explain why mucosal tissue has the capacity to regenerate faster than dermal tissue and to restore oral mucosa soundness.[4,8,24] Saliva's role in caries prevention is comprised of 4 actions: diluting and eliminating sugars and other substances from the mouth, buffering capacity, balancing the demineralization/remineralization process, and inhibiting the growth of microrganisms.[4–6,8–14,20,24,29] Saliva contains a multitude of defence chemicals, both locally and systemically produced, including immunoglobulins, lysozyme, mucins, and a gamut of antimicrobial peptides (AMPs).[4,8,13,24] Digestion begins in the mouth with salivary enzymes such as amylase, lipase, ribonucleases, and proteases, and the lubricating factors of saliva prepare food for swallowing.[4,8,13,24] Saliva also contributes to taste due to gustin.[4,8,24] Finally, saliva's lubricant, mucin, plays a functional role in phonation.[4,8,13,24,26] Table 1 lists 50 distinct salivary proteins that have been identified in the saliva of healthy humans.[5]

Proteomes—protein compositions—are found in both plasma and saliva.[14,21] Loo et al.[21] state that 2698 proteomes have been identified in plasma, 2290 in whole saliva, and 1205 in collective parotid, submandibular, and sublingual secretions.[21] Interestingly, only a little more than 25% of the plasma proteomes overlap with salivary proteomes. Through salivaomics, an additional 797 proteomes have been discovered.[21] Salivary biomarkers effectively outnumber plasma biomarkers, making this oral secretion valuable in disease detection.[21] A Venn diagram illustrates the overlapping proteomes (Figure 1).

Salivary biomarkers of common oral diseases

Head and neck oral squamous cell carcinoma

Occurring in the mouth and/or oropharynx and ranked as the 6th most common carcinoma worldwide, oral cancer has a poor survival rate, especially if diagnosed in advanced stages; early detection is essential for effective treatment.[8,10,13,14,20,29–31] Approximately 25% to 50% of patients will experience recurrence within 2 years of resection and have a 5% annual risk of developing a second primary carcinoma.[24] The most common form of oral cancer is oral squamous cell carcinoma (OSCC), which accounts for more than 90% of clinical cases and includes adenocarcinomas, lymphomas, sarcomas, human papilloma virus (HPV)-associated verrucous or

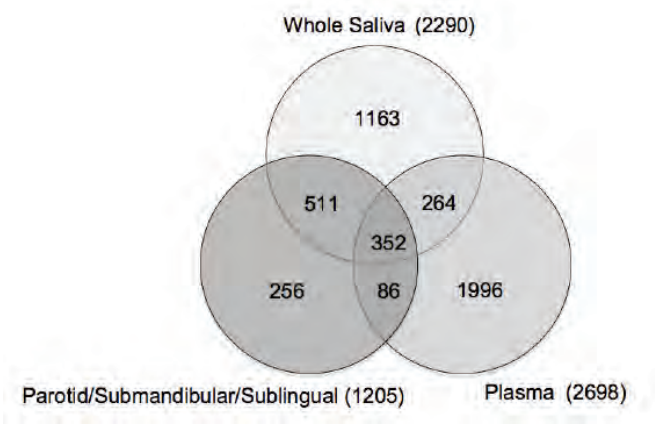
Table 1. Identified human salivary proteins

Human salivary proteins	
IgG	α-2-macroglobulin
Haptoglobin	Neutrophil elastase
Proline-Rich Proteins	Cathepsin G
MUC5B	α-Defensin 2
Amylase	TIMP-2
SIgA	Plasminogen
Cystatins	Cathepsin L
Albumin	Interleukin-1β
MUC7	MMP-9
Lactoferrin	Myoglobin
Histatins	MMP-3
Statherin	CA15-3
Transferrin	MMP-2
Lyzozyme	C-reactive protein
C3 Complement	Osteopontin
Carbonic anhydrase VI	Interleukin-2
C4 Complement	Interleukin-6
Thymosin	TNF-α
β-Defensin 3	Troponin 1
S100	Interleukin-8
GP340	Interleukin-1α
LL-37	HNP1-3
α-1-Antitrypsin	β-2-Microglobulin
Fibronectin	Factor B
TIMP-1	MMP-1

Source: Adapted from Amado FML, Ferreira RP, Vitorino R. One decade of salivary proteomics: current approaches and outstanding challenges. *Clin Biochem.* 2013;46(6):506–17.

mucoepidermoid carcinomas, malignant melanomas, and human immunodeficiency virus (HIV)-associated Kaposi's sarcomas.[11] Usually assessed visually and by palpation and confirmed histopathologically with biopsied tissue, these oral cancers and their staging biomarkers can now be detected in saliva through validated and subtractive methods.[4,10,11,13,19,24,32–34] Elashoff et al.[34] recently prevalidated 10 salivary biomarkers for OSCC: DUSP1, H3F3A, IL-1β (mRNA and protein), IL-8 (mRNA and protein), OAZ1, S100P, SAT, and M2BP. Overall, further refinements are required to improve early detection of OSCCs,[35] as well as for routine clinical assay diagnostics, risk assessment, therapeutic response,

Figure 1. Venn diagram of overlapping saliva and plasma proteomes



Source: Adapted from Loo JA, Yan W, Ramachandran P, Wong DT. Comparative human salivary and plasma proteomes. *J Dent Res.* 2010;89(10):1016–23. Reprinted by permission of SAGE Publications.

and economics.[11,13,14] Tongue squamous cell carcinoma (TSCC) remains the most fatal of oral cancers.[13] Recently discovered, promising early-stage diagnostic salivary biomarkers for TSCC include Interleukins (IL)-1α, -6, -8, vascular endothelial growth factor (VEGF)-α, tumour necrosis factor alpha (TNF-α), and adenosine deaminase (ADA).[13] Also of interest is the association between Epstein-Barr virus (EBV) and nasopharyngeal cancer (NPC).[36] In EBV-NPC, tumour-derived exosomes and microvesicles (infinitesimal membranous particles) are secreted into salivary vesicles.[36] As such, salivary vesicles may also serve as oral cancer diagnostic biomarkers.[36] Finally, using metabolites in saliva enables the detection of oral leukoplakia and oral lichen planus, both of which are precancerous lesions.[24,29]

Oral bacterial diseases

The difficulty in assessing frank, oral disease with bacterial origins lies in the lack of cultivability of these pathogens. The mouth contains over 700 different pathogenic taxa, of which 200 are bacteria and less than 50% are cultivable in vitro.[11] Molecular protein biomarkers in saliva have been identified and linked to oral diseases such as dental caries, gingivitis, and periodontitis.[5,8,11,12] However, these biomarkers are not discriminatory or specific to the aforementioned oral diseases.[8,11,12] A recent systematic review by Martins et al.[37] determined that there is insufficient evidence to link salivary protein biomarkers to dental caries. Another review proposed that lactoferrin could be used for caries prevention,[7] while Glimvall et al.[38] suggest that lactoferrin is a salivary biomarker for chronic periodontitis. Previous investigations have identified the etiopathological microorganisms of periodontitis, namely red-complex pathogens; their correlating salivary biomarkers are matrix metalloproteinases (MMP) -8 and -9 and IL-1β.[8,11,12,25,39–41] Research and experimentation continue by investigating microbial and salivary biomarkers concomitantly.[11,42]

Oral fungal diseases

Oropharyngeal candidiasis (OPC), caused by *Candida albicans*, is the most common oral fungal disease and is highly prevalent in immunocompromised people.[11] Salivary histatin 5 was found to have rapid and considerable antifungal effects in a murine study model, prompting research for human salivary histatin.[7] Human saliva also contains histatin 5 and β-defensin, which have fungicidal properties.[7,8] Detecting and correcting deficiencies in these 2 salivary components may be a plausible way of treating oral *Candida albicans* in the future.[7,8]

Oral inflammatory-based lesions

The etiology of recurrent aphthous ulcers (RAU) is unknown, but histopathological evidence shows noninfectious, nonspecific inflammation of mucosal tissue originating in subepithelial connective tissue.[43] High levels of collagenase are present in the submucosa.[43] The proinflammatory and immunoregulatory cytokine, TNF-α, plays a role in epithelial damage through collagenase induction.[12] Miller et al.[12] report that TNF-α is detectable in saliva. A study by Jagtap et al.[44] measured salivary nitric oxide levels in 20 confirmed cases of patients with RAU, 15 patients with confirmed oral lichen planus (OLP), and 30 healthy controls. Salivary nitric oxide levels were significantly elevated in the RAU and OLP groups compared to the control group.[44] Furthermore, comparison between the RAU and OLP groups showed patients with OLP had statistically significant increased levels of nitric oxide, especially those with erosive OLP.[44] This study propounds that salivary nitric oxide is a differential diagnostic tool for RAU and OLP.[44] Additional research is likely required because of the small sample size.

Salivary biomarkers of common viral diseases

The use of oral fluid in virology is a developed field. Saliva is used to detect HIV antigen and antibodies[4,6,14,19] and deoxyribonucleic acid of EBV.[11,24] Saliva has been shown in large screening programs to be as reliable as urine for the detection of cytomegalovirus.[11] Herpes simplex virus 1 and 2 and varicella zoster virus are detectable and quantifiable in oral fluids.[11,24] Human herpes virus 8 viral load, responsible for oral and systemic Kaposi's sarcoma, has comparable titers in blood and serum compared to saliva.[11] Hepatitis A, B, and C, with hepatitis C virus (HCV) being the most studied virus in salivary transcripts, are also detected in human saliva.[4,6,11,18,19] Secondary Sjögren's syndrome (sSS) is a common sequela of HCV infection.[45,46] Salivary testing for HPV is still being perfected.[11]

Salivary biomarkers of systemic disease

Cardiovascular disease (CVD)

In the United States, coronary artery disease is responsible for one in every 5 deaths; one American dies from a coronary event every minute.[12] Quantifying and qualifying cardiac markers present in saliva may hasten the assessment and identify the stage of CVD, thereby decreasing morbidity and mortality.[11,12,47] The enzyme C-reactive protein (CRP), produced by the liver in response to inflammation, can be monitored via saliva.[11,12,14,24] However, it is a nonspecific inflammatory marker and is detectable in many inflammatory responses, including periodontitis.[11,12] The same is true of IgA, an immunoglobulin known to increase salivary IgA, in particular, in coronary artery disease and also in response to other local and systemic ailments.[11,48]

Mounting evidence shows that groups of salivary biomarkers, using multimarker panels in combination with standard cardiac diagnostic equipment, can complement findings.[11,12,48] For example, markers in saliva such as CRP, myoglobin, and myeloperoxidase used in combination with electrocardiograms show a strong significant correlation with myocardial infarct (MI) patients compared to healthy controls.[11,48] A study by Ahmadreza et al.[47] demonstrated the value of multimarker panel salivary diagnostics in post-MI patients as a predictor of left ventricular systolic dysfunction (LVSD). The ejection fraction in this study was ≤ 40%; low ejection fraction leads to heart failure. Furthermore, elevated lysozyme levels have shown a significant association with hypertension, which is a risk factor for CVD and stroke.[6,11]

Diabetes and nephropathy

Salivary ribonucleic acid (RNA) contains markers specific to diabetes detection,[4,9,18,20] and saliva's composition is altered in individuals with type 1 and 2 diabetes mellitus.[6,7,11] A notable change is a drop in histatin 1, necessary for wound healing stimulation, which could explain impaired tissue regeneration in people with diabetes.[7] A recent discovery found that patients with type 2 diabetes (T2DM) have 65 salivary protein markers that are more than double in quantity, when compared to normoglycemic controls.[11,20] In T2DM, lysozyme, a salivary biomarker for oral infections and hyperglycemia, is elevated.[11] Inflammatory markers are abundant[20] and potentiate inflammatory conditions such as periodontitis[6]; antibacterial saliva proteins are decreased, further contributing to inflammatory response.[7] Salivary biomarkers are used in patients with chronic kidney disease to evaluate hyperphosphatemia, an important cause of cardiac calcification known as porcelain heart.[11,49] These biomarkers are also used to monitor serum creatinine and glomerular filtration rate, which are indicators of renal function.[11] In patients with end-stage renal disease, the associated salivary markers—cortisol, nitrite, uric acid, sodium, chloride, pH, amylase, and lactoferrin—can be used to determine necessity and frequency of hemodialysis.[11]

Anemia

Patients with iron deficiency are subject to oral epithelial changes and symptoms such as atrophic glossitis, glossodynia, angular cheilitis, and pale gingivae.[50] Their detection requires phlebotomy and blood sample analysis. In a pediatric population study, Jagannathan et al.[51] affirmed that children with iron deficiency have significantly higher levels of salivary ferritin compared to controls. Additionally, the salivary testing method employed did not require invasive and traumatic blood sample collection—an advantage for both the pediatric patient and practitioner.[51]

Primary Sjögren's syndrome

Primary Sjögren's syndrome (pSS), an autoimmune disease, is accompanied by salivary protein changes and infiltration of salivary and other lubricating exocrine glands by lymphocytes.[7,13,14,20,30,52] As salivary production is markedly reduced in patients with pSS, analysis of their saliva provides clues about the syndrome.[13,14,20,30,52] A breakthrough in pSS detection using a new antibody profiling method called luciferase immunoprecipitation systems (LIPS) may provide an easy and robust technology for measuring high levels of Ro52 and Ro60 autoantibodies found in saliva of patients with pSS.[30] However, using salivaomics in these patients already provides a high diagnostic capacity.[3,4,10,11,19]

Neuropsychobiological and oxidative stress

Stress response is regulated by the autonomic nervous system and the hypothalamic–pituitary–adrenal axis.[53] Stress disrupts homeostasis and is linked to a number of diseases including CVD, cancer, and T2DM.[53] In response to physiological and psychosocial stress, cortisol, heart rate, and salivary alpha amylase (sAA) increase quickly and substantially, and a significant positive correlation is observed between heart rate and sAA.[11,53,54] As sAA is a reliable correlate of norepinephrine, pain response can also be evaluated through this salivary biomarker in adult populations.[11,55] However, according to Shibata et al.[55] salivary biomarkers are not valid indicators of pain in newborns.

Further oxidative stress and antioxidant status, can also be evaluated through salivary biomarkers.[56] Kamodyova et al.[56] examined the effect of circadian rhythm, tooth brushing, and ascorbic acid (vitamin C) treatment on selected salivary markers of oxidative and carbonyl stress and antioxidant status.[56] Measurements were collected for advanced oxidation protein products (AOPP), thiobarbituric acid reactive substances (TBARS), advanced glycation end products (AGEs), ferric reducing antioxidant power (FRAP), and total antioxidant capacity (TAC).[56] Salivary AGEs and FRAP levels varied throughout the day.[56] Tooth brushing and treatment with 250 mg of vitamin C decreased carbonyl stress and increased antioxidant status.[56] Further studies by Celecova et al.[57] and by Tothova et al.[58] established a relationship between oral hygiene, caries, and periodontal status in adult and pediatric populations. Antioxidant status in saliva seems related to oral hygiene and periodontal status.[58] Salivary TBARS are potential biomarkers of periodontitis, independent of age, and low levels of salivary AOPP are associated with caries.[57,58] Age contributes significantly to salivary markers of oxidative stress.[57,58] Another well-known oxidative stress salivary biomarker, 8-hydroxy-2'-deoxyguanosine (8-OHdG), is present in significant amounts in patients with Down syndrome (DS).[59] This finding suggests clinical features of DS, including premature ageing and high susceptibility to early onset periodontal disease, are consequences of oxidative stress.[59]

Respiratory disease

Respiratory epithelium has direct exposure to the external environment and endogenous oxidants.[60] As such, the respiratory system is susceptible to oxidative stress, a known cause of lung diseases, including lung cancer.[60] Pneumonia in pediatric patients under the age of 5 years is common and is a leading cause of mortality in children in developing countries.[60] Salivary inflammatory/oxidative biomarkers, which gauge the severity of pneumonia, were compared with a serum surrogate to establish correlation.[60] Of the 10 saliva parameters measured, 5 showed statistically significant alterations.[60] Salivary flow, pH, and uric acid were lower, while salivary concentrations of phosphate and total protein were higher.[60] Although not statistically significant, all other evaluated salivary parameters (Ca, Mg, albumin, lactate dehydrogenase, and amylase) were also increased.[60] The results showed that, although hematological testing is obligatory for diagnosis, saliva is, according to the authors, a recommendable monitoring tool for pneumonia progression and treatment success.[60]

Salivary biomarkers of systemic malignancies

Lung cancer

The leading cause of non-gender specific global cancer mortality is lung cancer.[61] Zhang et al.[61] demonstrated in a prevalidation study that saliva from lung cancer patients contains 7 highly differential biomarkers: BRAF, CCNI, EGFR, FGF19, FRS2, GREB1, and LZTS1. A logistic regression model with just 5 of these biomarkers (CCNI, FGF19, GREB1, FRS2, and EGFR) ascertained lung cancer with 93.75% sensitivity and 82.81% specificity.[61] This study provides proof of concept on two fronts: effective and noninvasive lung cancer detection via salivary biomarkers.[4,10,27,61]

Breast cancer

Breast cancer is the leading cause of cancer-related mortality among women.[13,62] Development of the c-erbB-2 or HER-2 prognostication test, using assayed biopsied tissue, revolutionized treatment of advanced breast cancer in those women with the c-erbB-2 oncogene.[13,14] Subsequent research showed that saliva of breast cancer patients contains significantly high levels of a salivary soluble fragment of the c-erbB-2 oncogene and the cancer antigen 15-3 (CA15-3).[6,11,13,14,18,20,24,27,29] Further exploratory studies assessed the value of c-erbB-2, vascular endothelial growth factor (VEGF), EGF, and carcinoembryonic antigen (CEA) as screening and detection tools.[13,62] However, the exploratory tests were based on detection of blood biomarkers found in saliva and not exclusively on salivary biomarkers.[13,62] Recently, Zhang et al.[62] were able to prevalidate and validate 9 salivary biomarkers specific to breast cancer detection: S100A8, CSTA, GRM1, TPT1, GRIK1, H6PD, IGF2BP1, MDM4, and CA6 (carbonic anhydrase VI).[62] This study provides proof of concept for reliable (92% accuracy) and noninvasive breast cancer detection through salivary biomarkers.[62]

Pancreatic cancer

Pancreatic cancer survival rates are extremely poor, as patients are asymptomatic in the early stages

and this cancer goes largely undetected until mid to late stages.[13,29] Precocious detection of this deadly cancer through salivary biomarkers may greatly reduce mortality rates. A prospective sample collection and a retrospective, double-blind validation study were performed to evaluate noninvasive detection of resectable pancreatic cancer.[10,11,13,63] Four salivary markers (KRAS, MBD3L2, ACRV1, and DPM1) were detected; these markers discriminated pancreatic cancer patients from non-cancer control participants.[10,11,13,63] Autoimmune pancreatitis and ductal pancreatic cancer are believed to stem from bacterial pathogens.[64] Farrell et al.[64] showed that variations in oral microbiota collected from saliva are associated with pancreatic disease and cancer; these microorganisms may be used as salivary detectors. It is not known whether the aberrant microbiota are the etiology of pancreatic diseases or a symptom of them, but the hope is that the diseases can be treated or cured through modification of oral flora.[64]

Esophageal cancer

The 8th most common cancer, esophageal cancer (EC), is also the 6th leading cause of global cancer mortality.[65,66] With a 3% to 5% survival rate of 5 years in advanced stages, early diagnosis and treatment is critical.[65,66] The function of microRNA (miRNA) appears to be regulation of gene expression.[65,66] Aberrant expression of miRNAs has been implicated in numerous diseases including cancer.[65,66] Tissue, plasma, and saliva have similar miRNA expression profiles and, as such, are considered valuable oncologic biomarkers.[65,66] A study by Xie et al.[65] demonstrated that saliva supernatant (the liquid lying above a solid residue after crystallization, precipitation, centrifugation or other process) collected from patients with EC contained significantly higher levels of miR-21 compared to healthy controls. This finding suggests that miR-21 is a potential biomarker for EC.[65] Further investigation by Xie et al.[66] for EC biomarkers in whole saliva and supernatant saliva identified five additional miRNAs, namely miR-10b, miR-144, miR-451, miR-486-5p, and miR-634, which may also hold promise as EC biomarkers. Furthermore, this mode of detection is less invasive and less expensive than current EC screening techniques, which consist of endoscopic biopsying.[65,66]

Prostate cancer

Prostate cancer is the 2nd leading cause of cancer-related mortality in men.[13] As free and total ratios of prostate-specific antigen (PSA) in serum and saliva are very similar among normal subjects, the use of saliva to test for the PSA glycoprotein marker may one day become an alternative approach to serum PSA testing.[13] However, elevated PSA does not imply an absolute prostate cancer diagnosis.[67] The use of prostate-specific antigen (PSA) immunoassay is complementary to digital rectal examination in prostate gland cancer screening and detection.[67] While the American Urology Association does not recommend routine screening of PSA, it does recommend shared decision making for PSA screening in men between the ages of 55 and 69 years.[67] Saliva-based PSA home testing kits are available for purchase, but consumers should be wary of the possibility of false-positives or false-negatives.[10,14]

RESULTS AND DISCUSSION

This review pertains to an emerging field. Randomized controlled trials are limited; more common are comparative prevalidation and validation trials, using double-blind prospective and retrospective designs. They are highly scrutinized because of the technology's novelty and complexity.[3,5,8,11,14,15,20,24,29,30,37] Systematic reviews, meta-analyses, feasibility studies, and cross-sectional studies are also available. Review and invited review articles are abundant and expected, as the science is in its infancy.

Through pioneering and innovative research, collective efforts have developed the saliva ontology or salivaomics.[1,2,4,5,9–15,18–20,24,26,29] This branch of science has transformed disease screening, diagnosis, staging, prognosis, recurrence, and monitoring of some high-impact malignant diseases.[4,8,10–14,16,19,20,24,29–37] There have been significant advancements in salivary detection of head and neck cancers, an important consideration in dentistry, for reliable, precocious, and future chair-side diagnostic capabilities.[9,13,15,17,22,26,28,30–36] Early detection of all these cancerous neoplasms is vital to decreasing morbidity, comorbidity, and mortality.

The effects of physiological and psychological stress on salivary constitution are well known.[53–55] Stress is a factor in the development of oral and other diseases. Antioxidant status and oxidative stress biomarkers in saliva of adults and children seem to influence susceptibility to dental caries and periodontitis.[56–58] Disappointingly, definitive diagnostic salivary biomarkers for caries and periodontal disease remain elusive.[11,37] Salivaomics has made little progress in this realm, due to the sheer number of oral microbiota species and the inability to identify distinct salivary markers.[11] However, research continues using a combined approach of searching for and cataloguing both microbial and salivary marker microparticles that overlap in people with caries and periodontal disease.[11,42]

This new science also alters the conventional medical evaluation and diagnosis of systemic diseases or disorders. Clinical applications of this science are used in the fields of diabetology,[4,6,7,9,11,18,20] cardiology,[6,11,12,47,48] nephrology,[7,11,49] oncology,[4,10,11,13,19,24,29,32–34] virology,[4,6,11,14,18,19,24] immunology,[3,4,6,10,11,14,19,30] and rheumatology.[3,4,10,11,19] Salivary diagnosis of viral pathogens is simpler, faster, and as accurate as serum or urine at detecting virus-based illnesses.[4,6,11,14,18,19,24] Viral diseases could feasibly be detected in dental offices and their oral manifestations addressed immediately. Monitoring diabetes and its cardiovascular and renal complications would also be practicable in a dental setting. As salivaomics detects diseases of the salivary glands, ironically through its own secretions, the diagnosis of Sjögren's syndrome has become relatively easy.[3,4,7,10,11,13,14,19,20,30,52] This syndrome causes severe oral sicca symptoms with deleterious effects on the oral cavity. Testing for it, by dental professionals in patients who complain of xerostomia, would be prudent and beneficial.

The consulted literature provides evidence that salivary biomarkers are and will continue to be significant in all aspects of disease management. Salivaomics offers several advantages over current disease detection methods. Safer, quicker, and noninvasive, the collection of saliva samples is more cost-effective overall compared to venipuncture; fewer supplies are required for sample collection; sample storage is uncomplicated; and no highly specialized training is required by collectors.[4,5,10–12,19,20,29]

Currently, there are three main limitations to salivaomics. First, clinical validation of salivary tests is obligatory.[4,10,11,19] Second, a single salivary biomarker is inadequate for an accurate diagnosis and, therefore, further development of multimarker panels is crucial for precision diagnostics.[4,10,11,19] Finally, point-of-care and chair-side testing technologies must be developed, but are contingent on the aforementioned limitations.[4,10,11,19]

CONCLUSION

Enormous advances have been made in understanding saliva's potential as a biomarker of disease, and the emerging field of salivaomics will likely provide dental health care providers with the opportunity to screen for and detect systemic disease too.[4,5,8,10–12,14,19,20,26,29] Predictions are that salivary testing will replace other forms of body fluid testing and developing technologies will permit portable and point-of-care diagnostics.[4,8,10–12,19,20,47,48] Because the acquisition of a saliva samples is simple, does not require phlebotomists, and is consequently pain free, it may be the ideal way to detect disease in children, the elderly, and patients with disabilities and anxiety.[4,5,9–11,13,14,20] It could also prove to be a very economical way to perform large epidemiological studies.[11–13,19] Finally, by knowing the specific salivary biomarkers of a given disease, especially in its early stages, the lapse between diagnosis and treatment could be greatly reduced and positively alter outcomes.[10,12,13,29]

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Methamphetamine use and oral health: Management and treatment considerations

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ABSTRACT

Objective: This article reviews management and treatment considerations for dental hygiene clients who are suffering or recovering from methamphetamine addiction. **Methods:** A search of peer-reviewed and non-peer-reviewed literature was conducted. Databases selected included PubMed, MEDLINE, Ovid, Google scholar, and UBC e-journals/resources. A total of 37 articles and websites, published between 1999 and 2013, were cited. Inclusion criteria incorporated qualitative and quantitative studies from 1999–2013; articles published prior to 1999 were excluded. General drug use statistics were added to provide background information. **Results and Discussion:** Methamphetamine (MA) use is on the rise, and an increasing number of MA-using clients are presenting for dental care. In order to provide optimal care to these clients, dental hygienists must improve their understanding of MA use and its devastating effects on oral health and overall health. Prevalent issues among MA users include cerebral/systemic effects of the drug, hyposalivation, xerostomia, decay, erosion, bruxism, malnourishment, and violent behaviour. Recognition and management of these issues will improve the care that MA users and recovering addicts receive, and also provide opportunities for referrals to substance abuse centres. **Conclusion:** Oral health care professionals can improve the delivery of oral health care services to MA users or recovering addicts by recognizing signs of MA use and employing appropriate management considerations.

RÉSUMÉ

Objet : Cet article revoit les données de gestion et de traitement pour des patients de l'hygiène dentaire, qui souffrent ou se rétablissent d'une dépendance à la méthamphétamine. **Méthodes :** Examen de la littérature revue et non revue par les pairs. Les données de base retenues comprenaient PubMed, MEDLINE, Ovid, Google Scholar et les journaux ou ressources électroniques. En tout, 37 articles et sites Web, publiés entre 1999 et 2013, ont été cités. Les critères d'inclusion y ont intégré des études qualitatives et quantitatives de la même période. Les articles publiées avant 1999 ont été exclus. Les statistiques portant sur l'utilisation générale des médicaments ont été ajoutées comme information de référence. **Résultats et Discussion :** L'utilisation de la méthamphétamine (MA) augmente, et un nombre grandissant de patients utilisant la MA se présentent aux soins buccodentaires. Afin d'offrir à ceux-ci des soins optimaux, les hygiénistes dentaires doivent mieux comprendre l'utilisation de la MA et ses effets accablants sur la santé buccodentaire et la santé en général. Les problèmes qui prévalent chez les utilisateurs de la MA comprennent les effets cérébraux et systémiques du médicament, l'hypoptyalisme, la xérostomie, la décomposition, l'érosion, le bruxisme, la malnutrition et le comportement violent. La reconnaissance et la gestion de ces problèmes amélioreront les soins que reçoivent les usagers de la MA et les patients en désintoxication et fourniront aussi des possibilités de référence à des centres de désintoxication. **Conclusion :** Les professionnels de la santé buccodentaire peuvent améliorer la fourniture de services de soins de santé buccodentaire aux usagers de la MA ou aux anciens toxicomanes en reconnaissant les signes d'utilisation de la MA et en ayant recours aux possibilités appropriées de gestion.

Key words: methamphetamine, methamphetamine and oral health, caries and methamphetamine, meth mouth, methamphetamine and xerostomia

BACKGROUND

The abuse of the illegal street drug methamphetamine (MA) has reached epidemic proportions in many Canadian cities and around the world.[1–7] Canada has been the site of widespread MA use among street youth.[5,6,8] Initially MA use began in the western provinces, particularly surging in Vancouver, and then moved east, infiltrating Quebec and the Atlantic provinces.[8] The 2012 Canadian Alcohol and Drug Use Monitoring Survey (CADUMS) found British Columbia, Manitoba, Nova Scotia, and Alberta, in descending order, to be the provinces with the highest illicit drug use over the previous year.[9] The survey's definition of "drug use" included but was not limited to speed, cocaine/crack, methamphetamine, and ecstasy.[9] In both 2011 and 2012, the CADUMS found that youth aged 15–24 years had used illicit drugs, excluding cannabis, in the previous year, at a rate approximately five times that of individuals aged 25 years or older.[9,10]

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According to a study by the Royal Canadian Mounted Police in conjunction with Health Canada, drugs such as 3,4-methylenedioxymethamphetamine (MDMA), also known as "ecstasy" and classified as an amphetamine but molecularly different from MA, are being laced with MA as the main ingredient without the user's knowledge.[8] Therefore, there are high numbers of ecstasy users who do not realize that they are actually consuming "meth."

Methamphetamine is an extremely addictive drug. It does not discriminate between ethnicities, age or financial status. Since August 2005, Canadian law has included it as a Schedule I drug in the Controlled Drugs and Substances Act.[8] The majority of MA users tend to be between the ages of 10 and 25 because of easy access to the drug and vulnerability to peer pressure.[4–6,11,12] MA has many street names such as "crystal meth," "meth," "tina," "ice," and "chalk."[7,8,11–14] It can be orally ingested, injected, snorted or smoked, and it affects the brain and central nervous system.[7,11,13,15–17] MA is an inexpensive street drug to produce; cold medicines, rubbing alcohol, starter fluid, rock salt, paint thinner, and lithium batteries can all be used in its production.[11,15] The World Health Organization has estimated that MA is used by over 35 million people globally.[14] It has been ranked as the most common drug used worldwide, second only to cannabis, by the United Nations Office on Drugs and Crime.[14]

OBJECTIVE

Oral health care professionals can all make a difference in their practice and the community by recognizing client substance abuse. Dental hygienists have an ethical responsibility to promote and improve the delivery of oral health care services for all clients, including MA users. In light of this responsibility, a literature review was undertaken to promote awareness of the management and treatment considerations regarding the delivery of oral health services to MA abusers or recovering addicts. This transfer of knowledge to other professionals will enhance practice standards and positively affect clients' overall health and wellbeing. It is also evident that collaboration with interprofessional contacts in providing care to this target group is imperative for developing a well-rounded rehabilitation plan, which complements dental hygiene care by providing the highest quality of care for MA clients.[18] This review asks: how can dental hygienists improve the delivery of services to individuals suffering or recovering from methamphetamine addiction?

METHODS

A search of peer-reviewed and non-peer-reviewed literature pertaining to MA use and the oral manifestations and dental considerations that relate to it was conducted. The databases selected to search for literature included PubMed, MEDLINE, Ovid, Google, Google scholar, and UBC e-journals/resources. The literature found included English-language articles and websites published between 1999 and 2013. A total of 37 publications were cited. Inclusion criteria incorporated qualitative and quantitative studies from 1999 to 2013. Articles published prior to 1999 were excluded. General drug use statistics were added to provide background information. The key words used in the search were methamphetamine, methamphetamine and oral health, caries and methamphetamine, methamphetamine and xerostomia, meth mouth.

RESULTS AND DISCUSSION

Very few people understand the broad dangers and effects of methamphetamine use. MA use can seriously damage oral health and overall health, leading to the destruction of a person's dentition and natural ability to chew, causing severe pain, among other debilitating effects which will be further discussed.[3,12,15,19–21] Many studies have encouraged dental hygienists to increase their knowledge of the issues surrounding MA users, including recognition of the signs and symptoms, as well as dental management considerations.[5,6,13,22]

Social trends of MA use

Multiple studies have looked at the factors relating to the initiation of MA use. In a youth study by Sherman et al., the main impetus for drug use was identified as peer pressure.[4] Based on this information, oral health care providers can remind young drug users that although peer pressure to "fit in" with the crowd can be strong, avoiding the beginning of drug addiction is much more important for their overall health since heavy drug users tend not to "fit in," but instead are marginalized by society.[5,12,22–25] In a study by Chi et al. and another by Robbins et al., homeless youth and homeless women were at particular risk of MA use and oral neglect.[24,25] Robbins et al. found that approximately 57% of homeless women in the San Francisco area used MA.[25] Because many of these users also abused other drugs such as cocaine or heroin, there is a need to design studies that either take multiple drug use into account or remove these confounding factors.[25] Similar findings were reported by Chi et al. within the youth population, although the other drugs were lower schedule drugs such as cannabis.[24]

Oral care attitude of drug users

Drug users realize that their poor oral and nutritional health are related to their drug use.[18] Study participants who were recovering addicts noted issues such as low self-esteem, embarrassment, needle phobia, financial constraints or denial as barriers to accessing dental care during their addiction.[18,26] The use of other drugs in conjunction with MA compounds the oral and systemic symptoms but most users avoid seeking care until they either cannot tolerate the oral pain or are in recovery.[18,26,27]

Kerr et al. studied addicts' usage rates of primary and emergency care in Vancouver, Canada, and found that many drug users do indeed seek out these services when in pain.[5] The most common reasons for accessing emergency care were abscesses and cellulitis.[5,6,28] It was also noted that those who had received primary care in the previous year were more likely to access emergency care. These findings emphasize the need for dental hygienists to provide a supportive environment through education and resources to promote healthier practices.

Barriers to accessing care

Aside from feelings of shame and avoidance, many of the participants in studies by Chi et al. and Robbins et al. were discovered to have long-term, unmet oral health needs as they did not have dental insurance or the resources to brush and floss regularly.[24,25] Other studies have found that MA use is not restricted to urban dwellings, but widespread in rural areas where access to care can be limited.[28] Therefore, access to dental care in all demographic areas is a crucial and integral part of a MA user's recovery process.[23–25,29]

Cerebral and systemic effects

Methamphetamine increases levels of the dopamine, serotonin, and norepinephrine neurotransmitters.[30] In turn these stimulate brain cells, enhancing mood and body movement such as tremors and convulsions, and produce paranoia, confusion, agitation, mood disturbances, excessive perspiration, violent behaviour, suicidal or homicidal thoughts, anxiety, depression, psychosis, and prolonged insomnia.[4,12,13,30] Table 1 summarizes the psychological and physiological effects of MA use.

MA's activity on the central nervous system can increase the metabolic rate, resulting in dehydration, and indirectly reduce salivary flow.[30,31] Chronic MA users will suffer from degeneration and toxicity of the neurons leading to serious health consequences including memory loss, and potential heart and brain damage.[4,11,13,30,32] All of these issues can affect MA users for months and even years after discontinuing MA use.[14]

Users of MA quickly develop a physical dependence upon the drug.[7,12,13] Since it produces a rapid and powerful pleasurable feeling followed by feelings of depression, irritability, and violent behaviour when the drug wears off, users will seek to use more MA in order to return to the state of pleasure, resulting in a never-ending cycle of drug use and physical dependence.[3,5,14,16,23,31,33]

Table 1. Cerebral and systemic effects of MA

Psychological effects of MA
Memory loss
Mood swings
Paranoia, hallucinations and delusions
Depression and suicidal behaviour
Violent and aggressive behaviour
Nervousness
Compulsive behaviour
Risky behaviour

Physiological effects of MA
Dangerously high blood pressure
Vasoconstriction
Formication (severely itchy skin) and open sores
Increased infections
Overall or generally gaunt-looking skin
Excessive perspiration
Tremors (similar to Parkinson's disease)
Severe anorexia and malnutrition
Permanent brain damage
Neuromuscular dysfunction

Oral manifestations

Oral irritations

Methamphetamine users display a high incidence of oral effects.[7,13,18,30,34] These effects are summarized in Table 2. MA smokers can present with lesions and/or burns on their lips, gingiva, oral mucosa or hard palate. Those who snort may present with burns in the back of the throat. MA use compromises a person's ability to fight infection, hence oral ulcerations, irritations, and infections cannot heal properly.[1,7,9,11,14,15,19,20,31,34]

Hyposalivation and xerostomia

MA causes a distinct and severe pattern of rampant caries that resembles early childhood caries and is referred to as "meth mouth" (Figure 1).[3,12–5,17,19–21,24,25,27,29–33,35–37] The drug directly affects salivary gland receptors, causing vasoconstriction that results in hyposalivation leading to xerostomia.[31,37] In a recent study, MA users' saliva had significantly more acidic resting pH than non-users' saliva, as well as a decreased buffering action resulting in increased caries risk.[37] Ravenel et al. also suggest a possible increase in oral flora related to MA's tendency to inhibit phagocytosis and antigen response.[37]

Oral neglect

MA causes users to become ambivalent about their personal hygiene, including brushing and flossing.[7,18,30,31,34] As tooth brushing and oral care are of low priority or financially unfeasible, meth users generally present with very poor oral hygiene and rampant dental caries.[7,18,30,31,34] Clients generally also experience a high level of pain and discomfort.[7,18,30,31,34]

Rampant decay and erosion

Extensive tooth decay in meth mouth is attributed to several factors. The pattern of caries in meth abusers is characteristically found in the buccal/facial area.[7,14,18,27,29–31,34] The hyposalivation and xerostomia effects, combined with intense cravings for high-calorie carbonated beverages and consumption of sugars, along with oral neglect, are a recipe for oral health disaster.[21,34] MA is also an appetite suppressant, increasing the likelihood that users will constantly snack on highly cariogenic

Table 2. Summary of oral manifestations of MA abuse

Effects of MA abuse	Signs and symptoms
Cravings for a high cariogenic diet and sugary drinks Poor oral hygiene, self-neglect Increased acidic pH in saliva and decreased buffering action	Rampant dental caries (similar pattern to early childhood caries) Increase in the amount of oral flora
Damaged salivary glands Hyposalivation	Xerostomia Rapid onset of caries
Vasoconstriction leading to compromised nutrient, blood and oxygen flow to periodontium Lack of primary oral health care and home care	Periodontal disease
Vasoconstriction compromising the healing process Compromised immunity Toxic substance contact	Oral irritation, infections, lesions, ulcerations
Increased neuromuscular activities Grinding or clenching from feelings of nervousness and anxiety	Attrition, broken teeth TMD (higher incidence in women than men)

foods rather than eating proper meals.[7,14,27,30,34,36] MA causes excessive thirst, and users frequently crave sugary drinks to quench their thirst.[7,14,27,30,31,34,36] Dental caries spread quickly and extensively in MA users, resulting in a significantly high prevalence of missing teeth as compared to non-MA users.[7,13,18,21,30,34]

New user populations, such as youth, do not always exhibit advanced destruction of the oral cavity, but if the opportunity presents to a dental hygienist who notices early signs of MA use, then intervention and education may prevent a downward spiral.

Figure 1. Sample meth mouth

Source: Holt E, Werner S. An inclusive dental hygiene case of a recovered methamphetamine addict. *Access*. 2012;24(4):18–21. Reprinted by permission of the American Dental Hygienists' Association.

Periodontal disease

Shetty et al. found significantly worse oral health conditions among intravenous (IV) drug users, compared to those who smoke or snort MA.[36] IV drug users had missing teeth 73.3% of the time, compared to MA smokers at 57.2%.[36] On average, these groups had approximately 6 teeth missing.[36] Overall, it was found that MA users have significantly higher dental disease than the control group (non-users).[36] Capillary constriction, which slows down necessary nutrients, blood supply, and oxygen, is responsible for poor blood flow to the periodontium. Coupled with hyposalivation, a lack of professional care, and inadequate home care, capillary constriction leads to severe periodontal disease and bone loss.[7,15,19,29–31,34,36]

Bruxism and attrition

Bruxism and excessive tooth wear may occur frequently among chronic meth abusers. Meth increases energy and neuromuscular activity, which leads to bruxism, broken teeth, and temporomandibular disorders (TMD).[1,7,14,15,20,30,31] Women reported TMD problems more often than men in the MA user and recovering addict populations.[36] MA can also cause the user to feel anxious or nervous, so they often respond by clenching or grinding their teeth. Severe attrition and unnatural wear patterns will be present. Sometimes even biting or chewing soft foods will cause their fragile teeth to crumble. Users will often suck on hard candy or lollipops to keep from grinding or clenching, exacerbating their oral health problems.[1,7,14,15,20,30,31]

TREATMENT AND MANAGEMENT CONSIDERATIONS

Precautions

The stimulant effects of MA are longer lasting than cocaine, contraindicating the use of sedatives, nitrous oxide, and local anesthesia containing vasoconstrictors.[4,7,12,22] MA intoxication can last up to 24 hours after last use.[14,31,33,35]

General anesthesia is also contraindicated for MA users as it can result in sudden death from stroke or cardiac arrest.[14,16,30,31,33] As an alternative method of pain control, NSAIDs (pre- and post-operative) and local anesthesia without epinephrine can be used.[14,31,35]

The cerebral and systemic effects of MA, including aggressiveness, violence, paranoia, hypertension, and shortness of breath, can pose a safety issue for both the client and the dental hygienist.[7,5,19,30]

Treatments and oral hygiene instruction

The use of diagnostic salivary tests for abnormal indices could be useful as a simple chair-side tool in diagnosing MA users.[37] Appropriate oral hygiene instruction and treatments, such as in-office sodium fluoride applications, fabrication of a bruxism guard, periodontal therapy, and dental reconstruction, are important for this target population. Encouraging MA clients to drink more water, brush daily, and use multiple oral hygiene aids is essential for combatting negative effects as well. Recommendations for regular home sodium fluoride applications, use of MI Paste or NovaMin will help to fight decay and restore their oral health, as well as their mental wellness by increasing self-esteem.[7,11,13,16,18,30,33,37] The use of products such as CariFree Boost and Salese may also be used to help neutralize saliva.[37] In turn, the MA client's attitudes will become increasingly positive towards oral health care professionals, and these clients will be more likely to seek out health care in the future when needed.[15,18]

Counselling

Cases of MA use can vary in severity, so each must be managed on an individualized basis. A number of studies offer ways for dental personnel to treat a client presenting with MA addiction.[5,6,13,17] Not all MA users are going to be honest about their drug habits, but a dental hygienist who suspects drug use can assist clients to take better care of their oral cavities, establish a trusting and supportive environment, and provide a substance abuse referral when warranted.

The literature on MA use and oral health illustrates the specific needs of the MA user and recovering addict populations. Dental care professionals must be sensitive to these needs, as MA users can feel ashamed, have low self-esteem, and a negative self-image.[16,18,24,25] Pamphlets in dental offices can be useful to educate clients and staff on the ill effects of drug use, the oral signs and symptoms, and treatment options.[5,18] If a client is willingly open about his or her drug addiction, he or she will be more likely to continue treatment.[18,24,25] Interprofessional referral information for nutritional counselling, local treatment centres, recovery homes, and psychologists should be kept within reach.[7,11,34]

Focusing on the negative effects of MA addiction on both the oral and overall health of an individual would be helpful in achieving client comprehension of how detrimental MA use is. When doing this, one must not accuse anyone of drug use, as some of the signs and symptoms could be a result of other factors. Drug addicts who do choose to disclose such information to a dental hygienist should be treated in the most professional manner.

CONCLUSIONS

There are many risks associated with MA clients, and special consideration of their recognition and management is paramount in addressing specific needs. In order to improve the delivery of health services to individuals suffering or recovering from methamphetamine addiction, oral care professionals should be aware of the characteristics of MA drug use, the treatment and management considerations discussed in this review, and offer support and referrals when necessary. In turn, a dental hygienist who is well versed in the multifaceted issues relating to MA use may actually help the client break his or her addiction through the process of care and interprofessional collaboration, pointing the way to recovery.[5,11,18,22] Most notably, the need for access to care is greater for this group because of the major dental consequences of MA drug use.[5,11,18,22,32] This is also an issue for users who are homeless or who are financially constrained. As discovered in the research, many MA users do tend to use other drugs, which compound their problems. Further research to address these confounding factors should be carried out. Through their contact with dental hygienists, MA users or recovering addicts and their family members can be educated on the associations between oral health and overall health and the negative physical, psychological, and social effects of MA use. The knowledge that addicts or recovering addicts gain from their dental hygienist could also motivate them to seek regular oral care and health services in order to improve and maintain a healthy overall state, and help them to end their needless suffering.[18,22]

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Opinions of administrators and health authority inspectors on implementing and monitoring the oral health regulation in long-term care facilities in British Columbia

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ABSTRACT

Objective: To explore how a government regulation on oral health care in long-term care (LTC) facilities has been implemented in British Columbia (BC). **Introduction:** In 2009, the Government of BC enacted a regulation confirming the joint responsibility of dental professionals and administrators of LTC facilities for the oral health care of LTC residents. This regulation was intended to direct attention to the apparent widespread neglect of oral health of the residents and to improve oral health care in the facilities. **Methods:** Open-ended interviews with two health authority inspectors and five LTC administrators were conducted to determine how the regulation has been implemented in the facilities. Observational notes were made before and after each interview, and participants were selected purposefully to obtain a range of experiences and opinions on the implementation process. The relationships among the various perspectives were analyzed thematically by a constant comparison of responses. **Results:** Two major themes emerged from the interviews: 1) inspection by government officials; and 2) the administrators' perception of oral health care. Inspectors explained that government wanted LTC residents to be examined at least annually by dental professionals. For the most part, however, inspectors do not assess oral health care unless there are complaints from dental professionals or a formal complaint to government. Administrators generally seemed unfamiliar with the regulation, and did not expect that oral health care would be part of the government inspection. **Conclusions:** The regulation on oral health care in LTC facilities in at least two health authorities in BC is not achieving its objectives because health authority inspectors do not usually inspect the specific oral health care practices of the facilities.

RÉSUMÉ

Objet : Examen de la réglementation des modalités d'application des soins de santé buccodentaire de longue durée (SLD) en Colombie-Britannique (C.-B). **Introduction :** En 2009, le gouvernement promulguait une réglementation confirmant la responsabilité conjointe des professionnels et des administrateurs de la prestation des SLD en matière de santé buccodentaire chez les résidents en SLD. Cette réglementation avait pour objet de porter attention à l'apparente évidence de la négligence concernant la santé buccodentaire des résidents et l'amélioration des modalités de prestation des soins buccodentaires. **Méthodes :** Des entrevues à questions ouvertes avec deux inspecteurs en autorité et cinq personnes administratrices de SLD ont cherché à déterminer les modalités d'application de la réglementation. Des notes d'observation ont été retenues avant et après chaque entrevue et les personnes participantes ont été choisies délibérément pour obtenir une gamme d'expériences et d'opinions sur l'application de la procédure. Les relations entre les diverses perspectives ont fait l'objet d'une analyse thématique par comparaison constante des réponses. **Résultats :** Deux thèmes majeurs ont émergé des entrevues : 1) l'inspection par les représentants du gouvernement et 2) la perception des administrateurs de la santé buccodentaire. Les inspecteurs ont expliqué que le gouvernement voulait que les résidents des SLD soient examinés au moins annuellement par les professionnels dentaires. Toutefois, la plupart des inspecteurs n'évaluent pas la santé buccodentaire à moins de recevoir une plainte des professionnels ou si une plainte officielle est présentée au gouvernement. Les administrateurs ne sont généralement pas familiers avec la réglementation et ne s'attendent pas à ce que les soins buccodentaires soient inclus dans l'inspection gouvernementale. **Conclusion :** Pour au moins deux autorités de la santé de la C.-B., la réglementation des soins buccodentaires dans les services de SLD n'atteint pas ses objectifs parce que les inspecteurs des autorités de la santé n'inspectent pas de façon particulière la pratique des soins buccodentaires dans établissements concernés.

Key words: oral health, government regulation, long-term care, frail elders

INTRODUCTION

Long-term care (LTC) facilities, known also as residential, complex or extended care facilities, and nursing homes provide medical, rehabilitative, custodial, social, and residential services to people with chronic cognitive and/or physical disabilities.[1,2] Although little attention seems to be given to mouth care in most facilities, and oral diseases are rampant among the residents,[3–7] administrators generally believe that oral health care is provided satisfactorily.[8–11] However, there is little agreement on how care should be regulated in LTC facilities,[12] and there are significant gaps in policy, education, and clinical standards to guide oral care.[13] So, apart from the possibilities that administrators are overwhelmed by conflicting priorities of care[10] or that some are disengaged from the daily needs

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of residents,[11] it is not clear why this apparent neglect and misunderstanding occur. There have been reports that many care-aides lack the skills to clean the mouths of residents with complex oral conditions.[10,14–16] A survey of and interviews with the staff and administrators of a facility in British Columbia (BC) some years ago found that "issues such as time, increased workload, limited staff, and the lack of an accountability structure are disenabling factors for provision of daily mouth care" in the facility.[17] In addition, the cultural divide between dentistry and medicine has effectively excluded dentistry from the interprofessional teams that organize and deliver health care in most LTC facilities.[18] Professional segregation of dentistry from medicine almost everywhere frequently precludes oral care as an integral part of geriatric care,[12,19] and in-house training of care-staff for mouth care rarely translates into sustainable improvements in care to residents.[20–22]

The neglect of mouth care in LTC facilities is compounded certainly by the limited education of dental professionals in dental geriatrics,[23,24] and by the concerns of clinicians that they are not paid adequately for their domiciliary services when compared to in-office services.[25] Furthermore, outside of BC, Alberta, Saskatchewan, Manitoba, Ontario, and Nova Scotia, dental hygienists in Canada can provide clinical care only under the supervision of a dentist.[12]

Moreover, publicly and privately funded LTC facilities in Canada operate under various health care policies and payment systems.[12,26] Two-thirds of the facilities in BC are licensed by municipal health authorities under the provincial *Community Care and Assisted Living Act* (CCALA) (SBC 2002, c75), while the others are licensed either as private hospitals or extended-care units of public hospitals and regulated by the provincial *Hospital Act* (RSBC 1996, c200). Nonetheless, all of the facilities, no matter how they are licensed, are "subject to the regulations" of the CCALA (*Hospital Act*, RSBC 1996, c200, part 1, 4[3]). Oral health care is identified in the most recently amended CCALA as a Residential Care Regulation (BC Reg 96/2009), which states in section 54 (3) that a licensee must

1. encourage persons in care to be examined by a dental health care professional at least once every year; and
2. assist persons in care to
   i. maintain daily oral health;
   ii. obtain professional dental services as required; and
   iii. follow a recommendation or order for dental treatment made by a dental health care professional.

This regulation (henceforth referred to as the "Regulation") applies to the six health authorities in the province, and is supposed to form part of the annual inspection of LTC facilities by health authority inspectors or licensing officers.[27] However, in BC this legislation, like similar legislation in Sweden and elsewhere in Canada, is vague on how it should be implemented and monitored.[15,28] Aka et al.[29] contend that the legislation does little to ensure that administrators are accountable for providing a uniform standard of care. Consequently, the research questions underlying our qualitative investigation were as follows: a) What was the intent of the Residential Care Regulation (BC Reg 96/2009) in BC? b) How has it been implemented? and c) How has it been monitored over the past two years?

METHODS

Consistent with the methodological principles of grounded theory as interpreted by Corbin and Strauss,[30] we conducted open-ended personal interviews with two health authority inspectors and five LTC facility administrators in BC (Table 1). All interviews were audio recorded. Approval for the investigation was granted by the Providence Health Care Research Ethics Board (H10-02941).

Based on existing information about conflicting priorities of care,[10] we selected participants on the principle of theoretical sampling from the roughly 200 LTC facilities for seniors in BC to document a range of opinions and experiences related to the Regulation.[27,30] We used a snowball approach to extend the scope of the investigation by soliciting from each participating administrator the names of colleagues who might have additional information or different perspectives on the Regulation.[31] Three administrators were selected from facilities licensed under the *Hospital Act*, whereas the other two were from facilities licensed under the CCALA. Both before and after each interview, and with informed consent, we made field observations on the daily operation of each of the five facilities in order to provide a context to the analysis of each interview.[31]

Table 1. Characteristics of the facilities and their administrators

Facilities			Administrators	
Identification	*Regulation*	*Number of residents*	*Education*	*Years of experience*
A1	*Hospital Act**	100	Nursing	0.5
A2	*Hospital Act**	150	Social Work	1.5
A3	*Hospital Act**	80	Nursing	10
A4	CCALA**	117	Nursing	3
A5	CCALA**	90	Business	8

**Hospital Act* (RSBC 1996, c200)
***Community Care and Assisted Living Act* (SBS 2002, c75)

Telephone calls to each of the five health authorities in the province revealed that these authorities employ about 150 health inspectors who are responsible for monitoring a range of services including child care, food safety, and LTC facilities, but only about 12 of them inspect the LTC facilities. Written requests and follow-up telephone calls to each authority yielded only two inspectors (a nurse [#1] and a dental hygienist [#2]) who were willing to participate in our study. Each inspector represented one health authority and offered insights into regional variations in enforcement policies and practices.

An interview guide was constructed prior to the first

interview from the results of previous interactions with administrators of LTC facilities in BC,[10,32] and focused on how the administrator felt about the implementation of the Regulation. All interviews used a nonjudgmental approach, with questions such as "What do you know about mouth care regulations?" and "How have you been involved with the licensing inspections?" which were designed to allow participants to respond freely. After analyzing the verbatim transcript of the first interview, we identified issues needing clarification or further development, and modified the interview guide accordingly for the next interview using the principles of constant comparison.[33] The transcripts were imported to a computer program (*NVivo 9*, Burlington, MA: QSR International Inc. USA) that helped us to manage the iterative process of the analysis. Relevant units of text were coded openly, axially, and selectively by the two authors to produce categories of information that most aptly explained the beliefs and behaviours of the participants relevant to our research questions.[31(p462–468),33,34]

The credibility of each interview was determined by comparing the responses against the web-posted results of each facility's inspection by the regional health authority and by cross-checking them against the results of the other interviews. The participants received our summary of their interview and were asked to check it for accuracy and clarity.[35] This process of constant comparison continued until a saturation of our analysis was achieved. Sampling was discontinued when the new recruits confirmed the information provided by previous participants without adding any new information.[31(p246)]

RESULTS

Inspectors' perception of the oral health regulation

Regardless of the type of license that a LTC facility has, the municipal health authorities are currently responsible for all inspections. Both of the inspectors explained that, although they inspect facilities regulated by the *Hospital Act*, they had no legal mandate to enforce the requirements in the Residential Care Regulation. Nonetheless, the LTC facilities operated typically from protocol manuals derived from the Residential Care Regulation. Inspector #1 admitted hesitantly that "oral care, to be honest with you, is a very small part in our inspection. We don't get a lot of things [inspected] when we have two hundred [licensing requirements to inspect]."

Both inspectors explained that oral care would only be inspected if the health authority had received a complaint. Over one-third (40%) of the inspections in one health authority between February and August 2011 included assessments of oral health, and all of the facilities met the oral health care requirement.[36] As described by inspector #1, these public reports correspond to a similar trend observed over the previous seven years during which no oral health-related violations were documented. Inspector #2 explained that dental professionals who were dissatisfied with a resident's oral health often did not complain formally lest they "not [be] welcomed back." The absence of complaints usually led an inspector to assume that the facility was in compliance with the Regulation. Furthermore, both inspectors were sensitive to the likelihood that residents who had not seen a dentist regularly before admission were unlikely to seek one after entering the facility. They were aware also that "some residents may only want to receive care from one specific care-aide who may only work part-time," which made it difficult to provide adequate daily mouth care. Both inspectors also emphasized that, under the Regulation, LTC administrators are only required to "encourage" residents to obtain an annual examination. While the Regulation requires LTC staff to customize oral care plans based on the annual examination and recommendations from dental professionals, LTC staff were absent when dental professionals were examining residents. Moreover, the dental recommendations were written without input from the reviewers of the care plan.

The website for the Ministry of Health describes the general role of a health authority inspector.[27] However, both of the inspectors who were interviewed explained that the role of inspectors in each health authority depended on the resources and needs of the local population. For example, inspector #2 was employed specifically to inspect and support the development of oral health care programs within the region and to educate other health inspectors about oral health care. According to inspector #2, this education component meant that

> inspectors were then able to understand the complexity of oral health and how it relates to overall health. Thus, they were able to look critically at the oral care plans of the residents with the idea that it was adequate or that improvements were needed. They could call upon the oral inspector if they felt there were inadequacies that needed to be addressed in order to bring the residence into compliance with the regulations.

Although some administrators are aware of the Regulation, Inspector #2 explained that "they weren't quite clear on how to comply." She explained further that she looked for evidence that "the administrator [made] oral care… a priority… [with] oral care supplies" and also helped them to establish oral care programs, procure oral care supplies, and find dental professionals to help the residents when necessary. However, she complained that administrators continuously identified a lack of funds as a reason for neglecting oral care even though the

> regulations are quite clear… we don't deal with money, we don't give them more money if they say they don't have enough. So that would not be our problem… and we don't let them use that as an excuse, but they don't stop using it. They use it all the time.

Inspector #2 did have the authority to intervene on behalf of the residents, and occasionally issued a requirement that residents receive "chlorhexidine twice a day" as a

mouth rinse. Apparently, some administrators resented this intervention while others appreciated the advice and the educational role combined with the regulatory role of the inspector. Inspector #2 told us how she

> didn't go in as an inspector saying oh this is what you're doing and this is what you're not doing.... I tried to help them get to where they needed to be... so it was more of an education-support role.

Despite requests from other authorities, it seems that this educational support was limited to facilities in the health authority where Inspector #2 worked. Facilities elsewhere, she said, funded their own educational programs in oral health care or had to "rely on private dental personnel to come in to provide it."

Neither inspector was familiar with the standards of oral health care required by the other four health authorities in BC. The inspection forms used by both inspectors required that "[p]ersons in care [be] assisted in daily oral healthcare and [be] encouraged to have a dental exam once a year." Only one authority specified that "assistance [be] provided to obtain dental services and to maintain recommended or ordered dental treatments."[36]

Inspector #1 explained that health authority inspectors throughout the province generally check that residents with a toothache are attended to appropriately:

> They'd ask what [LTC staff] do if Mrs. Smith has a toothache... [and whether or not] the form gets posted... in the part of the chart that's supposed to be looked at; [and a] three day follow up written down somewhere.

Inspector #1 told us also that he and others would randomly check for compliance with specific care plans and whether or not the records indicated that recommendations or orders from dental professionals were met. They do not, he said, "check whether they have toothbrushes... we just monitor their system... [of] how the oral health[care] is carried out."

Administrators' perception of the regulation

One of the five administrators interviewed was familiar with the Regulation, in part because her facility had obtained funds from the provincial dental association to establish an oral care program for residents. Two of the administrators in facilities regulated by the Hospital Act (RSBC 1996, c200) knew that they were subject to the general Residential Care Regulation but they were unfamiliar with the section on oral health care. Nonetheless all of the administrators interviewed believed that health inspectors "have final authority on everything... [they] look at the residents, talk to them, [check the] environmental situation [and] nursing-related issues ... but [they have] nothing to do with oral care"(interviewee A3). As a result, none was particularly concerned about the standard of oral health care provided by their staff. Each administrator, at some point during his or her interview, used the terms "guidelines," "protocols," and "policies" interchangeably. Four of them claimed to have a mouth care policy in place but were unaware of the operational details and could not provide a copy because, as one of them explained,

> I have my resources and my support people and they tell me what I need to know as I need to know it. So I wouldn't be [familiar with] mouth-care policy [which] is one policy out of thousands of nursing policies (interviewee A2).

Another administrator told us that oral care was similar to other types of care:

> [we] don't really have a policy on oral care ... but it's handled with our systems in a "completion of care plan." If a person needs anything out of the ordinary with oral care it would be expected to be put on the care plan (interviewee A4).

"The normal policy," according to another administrator (A4), "ensures that everyday [the residents] brush their teeth... in the morning [and] before they go to bed."

The administrators all shared the belief that accountability for oral health can and should be delegated entirely to dental professionals. One explained that their staff could not "do oral care as well as the professional [since mouth care is not] as high up there as perhaps bathing... because [it] is a more difficult job" (interviewee A1). Yet, she told us that she was willing to coordinate visits by dental professionals whom she expected would identify the need for follow-up treatment. Another showed us a document with, as she pointed out, "a place for the hygienist [to report] any concerns" (interviewee A3), yet we heard also how "we'll encourage people to go see the dentist... [but] we can't fund things we don't have the money for" (interviewee A5) .

Difficulties in getting the nursing staff to comply with orders from dental professionals are ongoing. One administrator, for example, explained the challenge of getting her staff to change from "toothettes" to toothbrushes following the recommendation of a dental professional:

> It was a big battle to [remove] the little toothettes that had sponges on the ends of them...because [residents] didn't have to have the mouth open... [the care-aides] were ordering them all the time to try to get them back (interviewee A1).

Another administrator explained how similar problems could be overcome by involving the staff in decisions to change because "nothing works better than when people develop [a guideline] themselves and understand it ... and they can work with it" (interviewee A5).

Consequently, all of the administrators assigned to their nurse managers the responsibility for assessing oral health, which in one facility included "chewing problems, mouth pain or swallowing problems ... [or] debris present

in the mouth prior to going to bed at night"(interviewee A3). In addition, they all mentioned that they reviewed the daily care plans for each resident. Two of them used the "Point of Care*" computer program based on the Minimum Data Set† as the protocol for a quarterly audit of the care plans. Daily mouth care in one facility was recorded in a "daily record of events" confirmed by a care-aide's signature and checked by a nurse. Yet, another administrator acknowledged that this did "not always correspond exactly to what you see in [the resident's] mouth" (interviewee A4). Two other administrators (A1, A3) explained that they had audits in place, because health authority inspectors reviewed care plans randomly without looking inside the mouths of residents.

Other administrators unfamiliar with the Regulation assured us that they provided mouth care supplies to their residents. One believed that "there is some cost-benefit" (interviewee A1) to providing the supplies, although another questioned the cost-benefit of this service because audits of oral care are unusual and the residents' families rarely complained.

DISCUSSION

The most significant and unsettling finding of this study was that administrators and health inspectors generally make little effort to implement the Regulation. Four of the five participating administrators were unfamiliar with the Regulation, and seemed only mildly concerned about this oversight because they expect dental professionals to address oral health care needs periodically. Perhaps more importantly, they know that health authority inspectors also tend to overlook oral health care. Compliance with a similar regulation in Australia was enhanced by formally auditing and re-auditing the activities of nurses.[37] McNally[38] and Pruksapong[39] suggest that public accountability for oral health care in Canadian LTC facilities would improve if oral health were considered an integral part of the mainstream healthcare system. Aka et al.[29] believe that citations by inspectors for non-compliance with health regulations can hold LTC administrators accountable, but that inconsistencies in the enforcement of regulations, as revealed by our study, impede the quality of care.[40]

The developers of the Regulation expected that LTC staff would be mentored in oral health care by the oral health professionals who conducted the annual dental examination.[32] Clearly this was not happening in the facilities we visited, nor has it happened in Sweden under similar circumstances,[15] probably because the care staff did not help with the oral examinations or pay much attention to the recommendations of the oral health professionals. Daily mouth care interventions by nurses and care-aides can improve general health,[41] yet our study participants seemed reluctant to attach much significance to the possibility of oral health care enhancing general health, possibly because they lacked a standard of oral health.[42]

Administrators should enhance strategies to communicate the recommendations of care plan conferences attended by multiple care providers.[40] In addition, professional segregation of dental professionals from medicine and nursing requires further study. In Sweden, a study by Andersson et al.,[18] although not extensive, shows quite clearly that some physicians in Sweden believe that the mouth and teeth are the sole responsibility of dental professionals. In our experience, their findings are relevant to BC. A framework for evaluating oral health care in LTC facilities based on a combination of quality assurance and health-program evaluation has been proposed to provide formative evaluations from multiple perspectives,[39] and in the hope that it would lead to more morally defensible outcomes in the facilities as a result of increased priority afforded to oral health by administrators.[43] Administrators of a facility can distribute workloads to include healthy mouth care for residents,[44,45] and the care-aides or nurse managers can provide formative and summative feedback on the outcome of this care.[46] However, only efficient communication among all members of staff will ensure an acceptable quality of care.[46,47]

This qualitative research focused on understanding the perspectives of a few select experts: administrators and health inspectors of LTC facilities in two regional health authorities in BC. An important limitation of our study is that we were unable to recruit inspectors from the other three health authorities in BC due to caseload conflicts and nonresponsiveness. However, the lack of response in some ways supports our findings by suggesting that interest in oral health care is not a high priority for health inspectors. Like all surveys and selective interviewing, it is uncertain how much can be inferred generally from the opinions and experiences of our participants. There is no doubt that oral health care continues to be managed poorly in LTC facilities globally.[3–6,17] Consequently, any light cast on the cause of this neglect is helpful. Certainly, the cause is much more complicated than the simple negligence of administrators. Future considerations could be given to the fact that, as the study participants stated and our field observations confirmed, the LTC environment is convoluted, and oral health is but one of many concerns that needs attention.[10,22,23] Computer software with standardized assessment protocols relating to oral health care might better align dental audits with general care plans and care pathways in LTC.[3,48–50] A review of electronic documentation might also be revealing in terms of the general health and quality of life of elderly people who are frail and dependent on others for daily mouth care. This study of the perceptions and experiences of administrators and health inspectors is one of the few that explores the problems of oral health and neglect in LTC facilities from the standpoint of experts other than dental professionals.

* "Point of Care (POC)" is a computer program that populates assessments and expedites documentation for nursing staff to monitor the care of residents (PointClickCare POC © 2013 PointClickCare.com).

† Minimum Data Set is a protocol for assessing a resident's general weaknesses and strengths, and customizing a care plan. (Centers for Medicare & Medicaid Services, United States Department of Health and Human Services).

CONCLUSION

The reasons for the failure to implement the Regulation in BC effectively are as follows:

1. Health authority inspectors assess compliance of facilities in response to complaints from residents, their families, and oral health care professionals. Most inspectors do not assess the specific oral health care practices of the facilities.
2. Administrators are unconcerned about the Regulation because inspectors from the health authorities typically attend only to specific complaints.

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Assessing and taking action on oral health for older adults in Canada

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ABSTRACT

Oral care for older adults, particularly those in long-term care, is increasingly gaining national attention as needs and potential solutions are identified among health care providers across Canada. Interprofessional research, education, and practice are needed to implement and sustain strategies and policies that promote best practices for older adult oral care. A national symposium held in Edmonton, Alberta, in November 2012 provided an opportunity to discuss older adult oral health from a multidisciplinary perspective so that common ground might be established and shared publicly. Invited participants were from a range of roles and professions, including dental hygiene, dentistry, nursing, medicine, occupational therapy, and nutrition. Presentations informed small group discussions which focused on 6 areas of action, identifying challenges and potential solutions. Specific recommendations were made regarding each of the 6 action areas.

Continued dedication and leadership will support the development of the symposium network to realize the action recommendations.

RÉSUMÉ

Les soins buccodentaires pour adultes âgés, notamment les soins de longue durée, éveillent de plus en plus l'attention alors que les fournisseurs de soins en identifient les besoins et les possibilités de solution à travers le Canada. La recherche, la formation et l'exercice interprofessionnel ont besoin de stratégies d'application et de soutien pour promouvoir les meilleures pratiques de soins buccodentaires chez les adultes âgés. Un symposium national, tenu à Edmonton, Alberta, en novembre 2012, a permis de discuter des soins buccodentaires pour personnes âgées dans une perspective multidisciplinaire afin de pouvoir établir un champ de convergence et une participation publique. Les participants invités provenaient d'une vaste gamme de rôles et de professions, notamment l'hygiène dentaire, la dentisterie, les soins infirmiers, la médecine, l'ergothérapie et la nutrition. Les exposés, présentés par petits groupes de discussion et concentrés sur 6 champs d'action, ont identifié les défis et les possibilités de solution. Les recommandations particulières ont porté sur chacun des 6 champs d'action.

Le dévouement et le leadership soutiendront le développement d'un réseau pour réaliser les activités recommandées.

Key words: oral health, older adults, seniors, interprofessional healthcare, symposium network

INTRODUCTION

A national, interprofessional symposium, entitled "Assessing and Taking Action on Oral Health for Older Adults in Canada," was held in Edmonton, Alberta, 29–30 November 2012. The symposium was hosted by Dr. Sharon Compton and Dr. Minn Yoon from the Dental Hygiene Program, University of Alberta, and Dr. Joanne Clovis from the School of Dental Hygiene, Dalhousie University. The symposium was designed specifically to give researchers, educators, health professionals, administrators, and program policy leads from across Canada an opportunity to address the issue of oral health for older adults. Many health professions were represented, including dental hygiene, nursing, geriatric medicine, dentistry, occupational therapy, and nutrition.

OBJECTIVES

The symposium objectives were to

- Establish a national, interprofessional network of researchers, practitioners, and educators focused on oral health for older adults.
- Explore opportunities for knowledge creation and translation by bringing researchers together with policy makers and knowledge users to create an interprofessional network.
- Establish the foundation for an evidence-informed system of older adult oral health care.
- Identify major knowledge gaps in Canadian research programs.
- Identify other disciplines' research areas that might benefit from including an oral health element.
- Publish the symposium discussion, summary, and recommendations for action including future research and practice modification.

METHODS

Prior to the symposium, two reviews were conducted to identify relevant research and grey literature pertaining to older adult oral health in Canada. The grey literature search revealed reports from Oral Health Task Force groups, and these included recommendations for addressing issues pertaining to the state of oral health of older adults in Canada.[1–17] The symposium planning

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team identified 6 areas for future development and action from the reports (Table 1). These 6 areas for action formed the basis for the symposium's small group discussions. They have the potential to

- Establish a common focus and direction for various groups across Canada.
- Attract others who wish to join the network.
- Provide important foci for collaborative research endeavors among oral health researchers, practitioners, and health system leaders.
- Support educators in understanding directions for required competencies, curricula, and learning designs.
- Support decision makers in identifying key areas for resourcing research and innovation initiatives as well as policy and program development aimed at improving the systems of support for older adults in Canada.

SYMPOSIUM OVERVIEW

The symposium began with presentations by leading researchers and clinicians on oral health research and programs in 5 provinces (Table 2). In addition, 4 students from various disciplines—dental hygiene, nursing, and interdisciplinary studies—presented their current research and future possibilities for knowledge generation in the field. Following each presentation, the symposium facilitator led participants through a deeper inquiry session during which the content presented was further questioned and clarified. The inquiry process was designed to ensure that all participants had a clear understanding of the relevant work completed or in progress across Canada, prior to beginning the small group discussions for each of the 6 areas for action.

Using information from the oral presentations and inquiry sessions, participants discussed specific strategies for each of the 6 areas for action, as presented in Table 1. These strategies aimed to provide guidance for researchers, educators, professionals, administrators, and policy makers. Information gleaned from inquiry sessions was captured on large paper sheets that were displayed throughout the room for continual reference as needed throughout the small group discussions. Information from each small group discussion was recorded by each group, presented in plenary, and later submitted to the planning team. The planning team independently reviewed the recommendations for future action and through consensus developed the succinct outcomes as presented in the next section.

RESULTS

The specific recommendations for each of the 6 areas for action are presented in Table 3.

In addition to producing and distributing the symposium proceedings (available from the University of Alberta or at www.seniorscouncil.net/uploads/files Edmonton%20Symposium%20ReportNov%202012%2FINAL.pdf), the symposium network has undertaken the following initiatives.

- A scoping review of Canadian research specific to older adult oral health is in progress.
- The symposium established a foundation for national action by creating a common agenda (based on the 6 areas for action) to engage a broad cross-section of Canadian researchers, educators, health professionals, administrators, and program policy leads. This foundation, along with the relationships that were initiated or strengthened, and through them the connections to broader networks, will help to build a knowledge and learning network for the next generation of effort in taking action on older adult oral health across Canada.
- A network for ongoing communication of inter-related initiatives will be further developed in order to facilitate maximum participation in all areas of action.
- Efforts continue to secure funding to support collaborative research, education, and practice initiatives for the oral health of older adults.

CONCLUSION

The symposium engaged participants with the aim of developing relationships for a sustainable, national, interprofessional network of researchers, practitioners, and educators who can contribute to the wellbeing of older adults. Continued dedication and leadership will support the expansion of the network to realize the action recommendations.

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Table 1. Six areas for action in older adult oral health

Areas for action
1. Enhance the didactic and clinical geriatric components in existing undergraduate, graduate, residencies, and continuing education curricula to increase the comfort level of all professionals and staff working with older adults.
2. Raise awareness of the importance of oral health for older adults by educating the younger and older senior population, families, caregivers, oral health professionals, other health and social professionals, government, and the public.
3. Develop and promote standards and evidence-based practice guidelines.
4. Develop innovative care delivery models for older adult oral health.
5. Engage regulatory bodies of pertinent health professionals to address issues of older adult oral health in order to implement and promote policy change.
6. Increase government funding for oral adult oral health services to reduce financial barriers and increase access to care.

Table 2. Summary of presentations on oral health research and programs

Province	Examples of oral health initiatives for older adults	Key themes
British Columbia	The University of British Columbia (UBC) has engaged in research, education, and action in this area since 1977. Two examples are as follows: • UBC ELDERS program (Elders Link with Dental Education Research and Service)[18–20] • UBC Geriatric Dentistry program[18–20]	There is a need to engage broad, interprofessional groups in programs for older adults.
Nova Scotia	For the past 10 years, Dalhousie University has conducted research focusing on oral health of older adults. There has been close collaboration among researchers, educators, practitioners, administrators, and policy makers.[21]	Strengths in knowledge translation and exchange were highlighted as part of the university's successful projects and programs to date. There is an ongoing need to engage researchers from diverse fields.
Ontario	There are several networks and initiatives engaged in collaboration and dissemination of oral health knowledge and practices in Ontario.	There is an ongoing need to engage researchers from diverse fields.
Manitoba	The University of Manitoba operates the Centre for Community Oral Health (CCOH)[22] Health Promotion Unit and Caregiver Education, first established in 1985.	There is an ongoing need for programs for people with developmental disabilities and for dependent older adults.
Alberta	The University of Alberta's School of Dentistry/Dental Hygiene Program is developing its research program on older adult oral health. It is also incorporating older adult oral health into its curriculum through initiatives including: • an external practicum in long-term care for senior dental hygiene students • Glenrose Rehabilitation Dental Clinic involving dentistry and dental hygiene students in care delivery primarily for older adults In addition, independent dental hygiene practitioners offer mobile services to some long-term care facilities, and the Provincial Oral Health Office of Alberta Health Services is developing an oral health plan for older adults.	Providing students with experience in working with older adults can improve their comfort level in caring for this population.

Table 3. Recommendations for future action

Area for action	Outcomes
Enhance the didactic and clinical geriatric components in existing undergraduate, graduate, residencies, and continuing education curricula in order to increase the comfort level of all professionals and staff working with older adults.	• Work with students to help them develop an understanding of the whole person as well as an appreciation of the roles of professionals and paraprofessionals "on the ground" (e.g., the reality of the health care aide's role and work patterns). • Revise curricula to foster an understanding of the facility and organizational context of long-term care as this is fundamental to working collaboratively and effectively in such a care setting. • Develop different learning strategies to support the first two outcomes.
Raise awareness of the importance of oral health for older adults by educating the younger and older senior population, families, caregivers, oral health professionals, other health and social professionals, government, and the public.	• Raise awareness of the role and importance of all sectors and stakeholders in improving oral health for older adults. A group self-titled "Network of Noise" was formed, committed to meet using virtual technologies, and welcomed anyone with an interest in the activities to join them. • Prepare briefing notes for various audiences on older adult oral health issues. • Explore possibilities for collaboration with different professional groups.
Develop and promote standards and evidence-based practice guidelines.	• Develop a common template for health care legislation across provincial and territorial jurisdictions. It was suggested that the template include a high-level statement regarding oral care for older adults that addresses assessment, daily care, and access to care; be shaped by stakeholders; and be substantiated by evidence. • Encourage people in different associations and provinces who are working on similar initiatives to share information and strategies where possible. • Invite Canada's Chief Dental Officer to contribute to the development of standards and practice guidelines.
Develop innovative care delivery models for older adult oral health.	• Review and learn from existing programs in BC, Alberta, Manitoba, Ontario, and Nova Scotia. • Develop comprehensive and integrated models, in which all professionals and paraprofessionals as well as the family and close friends are recognized and understand their various roles and responsibilities. • Build on the potential for dental hygienists to become more involved in home care and long-term care. • Recognize the importance of family involvement and advance the role of the family through the newly developed "Network of Noise."
Engage regulatory bodies of pertinent health professionals to address issues of older adult oral health in order to implement and promote policy change.	• Effect more immediate change by working within the existing structure of legislation in the short term rather than trying to change the legislation. • Ensure that oral health initiatives are strategically sound before they are presented in order to gain support from other health professions and their respective professional associations. • Substantiate the need for an oral care specialist at long-term care sites. Such an initiative could be supported by a) conducting cost (economic) analyses for hospitalization caused by oral disease; b) evidence from research demonstrating the benefits of preventive oral care for long-term care populations; and c) stories from families of those affected by oral neglect in long-term care and their requests for action.
Increase government funding for older adult oral health services to reduce financial barriers and increase access to care.	• Use government-approved data such as data recorded with the Resident Assessment Instrument (RAI) to begin building the case for a Canadian older adult oral health strategy. RAI data related to oral health should be reviewed and compared to oral assessments by a dental professional in order to validate the findings from the RAI. Based on these results, a recommendation could be made or a report developed for submission to government. At the same time, a working group could be convened to develop an improved oral health assessment tool and/or to revise the oral health related items on the RAI. • Develop and make a recommendation of a best practice model for oral health within long-term care facilities. • Conduct a workload study not only to examine what is needed to maintain a model of oral health within a facility, but also to identify where good oral health program models are present in facilities, which could be used as positive examples to assist in creating a sustainable oral health program model. • Promote and include oral care as a standard of care, and recognize competence in care providers through a provider certificate program in oral care, which could be developed based on provincial continuing care standards. • Review the Canada Health Act[23] in order to determine how oral health is addressed and the potential for inclusion of some aspects of oral health in the medical care system. It is critical to understand provincial interpretations and delivery systems. Ten years ago, the First Ministers agreed on the Accord on Health Care Renewal[24]; the first priority was that all Canadians should have timely access to care. A clear understanding of the Accord is central to work on improving oral health for older adults and determining whether or not the priorities have been addressed. • Highlight the older adult population and resulting healthcare workforce issues. Consider the role of the family and informal caregivers in addition to that of staff responsible for care. The group suggested identifying caregiver and advocacy support groups. • Design educational resources that are appropriate for caregiver and advocacy groups using concepts and principles of health literacy to promote comprehension and engagement with the content.

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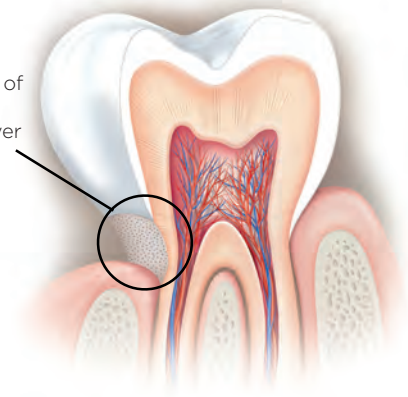
- Cleans and polishes teeth and provides immediate and long lasting sensitivity relief in a single application[2]
- Unique NovaMin® calcium-phosphate technology
- Available in four flavors and two grits (polish and stain removal)
- Dye-free, Gluten-free, SLS-free[3]

NovaMin® releases the natural building blocks of teeth to help build an enamel-like mineral layer



For more information, call **1.800.263.1437** or visit **www.nupro-sensodyne.com**.

NUPRO® SENSODYNE® PROFESSIONAL

POWERED BY NOVAMIN®

Performance Meets Protection™

For better dentistry
DENTSPLY CANADA

 SEN01-0512-1.3 Rev. 4

Reference:
1. J.L. Milleman, K.R. Milleman, et al. Nupro Sensodyne prophylaxis paste with NovaMin for the treatment of dentin hypersensitivity: A 4-week study. Am J Dent 2012; 25: 262-268.
2. Data on file.
3. Sodium lauryl sulfate.

The New Philips Sonicare FlexCare Platinum

More innovation. Less plaque between teeth.

NEW INTERCARE BRUSH HEAD TECHNOLOGY

- Deeper interdental cleaning
- Removes up to 7x more plaque between teeth[1]

NEW PRESSURE SENSOR

- Resonates when too much pressure is applied
- Interactive guidance for proper brushing technique

ADJUSTABLE MODES AND INTENSITY SETTINGS

- Clean: Low, Medium and High
- White: Low, Medium and High
- Gum Care: Low, Medium and High

Sonicare FlexCare Platinum removes significantly more plaque than Oral-B Professional Care 5000 in all areas of the mouth.[2]

Contact your Sonicare representative to set up a demonstration or to purchase a specially priced trial unit.

philipsoralhealthcare.com (800) 278-8282

PHILIPS sonicare

1 Than a manual toothbrush. M. Ward, K. Argosino, W. Jenkins, J. Milleman, M. Nelson, S. Souza. Comparison of gingivitis and plaque reduction over time by Philips Sonicare FlexCare Platinum and a manual toothbrush. Data on file, 2013.
2 Defenbaugh J, Liu T, Souza S, Ward M, Jenkins W, Colgan P. Comparison of Plaque Removal by Sonicare FlexCare Platinum and Oral-B Professional Care 5000 with Smart Guide. Data on file, 2013. Single use study.