CANADIAN JOURNAL OF DENTAL HYGIENE · JOURNAL CANADIEN DE L'HYGIÈNE DENTAIRE
THE OFFICIAL JOURNAL OF THE CANADIAN DENTAL HYGIENISTS ASSOCIATION

CJDH JCHD

OCTOBER 2017 · VOL. 51, NO. 3

PM40063062

Influence of diabetes control on gingival health following oral hygiene instructions and use of a triclosan dentifrice

Education strategies that best engage Generation Y students

Implications of xerostomia and caries in community-dwelling older adults

EDITORIAL

Evidence revisited: Making the best clinical decisions

ULTRASONIC SCALING

A **USEFUL TIP** FOR YOUR PRACTICE

Ultrasonic Insert & Tip Trade-In Program

DID YOU KNOW...worn tips can significantly diminish your scaling efficiency? Just like scalers, inserts wear with use and replacing them can be costly. Check your inserts weekly to maintain optimal performance and trade in your old ones with **Hu-Friedy's Ultrasonic Insert and Tip Trade-In Program.**

REPLACEMENT OF WORN INSERTS ENHANCES SCALING EFFICIENCY

1 mm loss can result in **25% efficiency loss**

2 mm loss can result in **50% efficiency loss**

GET 1 INSERT OR PIEZO TIP FREE
AFTER YOU PURCHASE 2 & TRADE-IN ANY 3*

#10 Universal | *#100 Thin* | *Direct Flow® #1000 Triple Bend* | *Swivel XT™* | *XT Triple Bend* | *USP3* | *US100* | *USP10*

Visit **Hu-Friedy.com/321TradeIn** to learn more about the Ultrasonic Insert & Tip Trade-In Program.

Call 1-800-Hu-Friedy or contact your authorized Hu-Friedy representative for more information.

 *The three traded inserts or tips can be from any manufacturer. The free insert must be of equal or lesser value to the two being purchased. Visit the website for Trade-In details. Offer applies to Magnetostrictive inserts and piezo tips.

How the best perform Hu-Friedy®

CJDH JCHD

Publisher
Canadian Dental Hygienists Association
1122 Wellington St W, Ottawa, ON K1Y 2Y7
Tel: 613-224-5515 or 1-800-267-5235
Fax: 613-224-7283; Email: journal@cdha.ca

Managing Editor
Megan Sproule-Jones, MA

Production
Mike Roy, Tim Logan, Daniel Bianchi

Advertising
Peter Greenhough Media Partners Inc.
647-955-0060 ext. 101 or
pgreenhough@pgmpi.ca

Front cover: ©www.gettyimages.ca | Studio-Pro, modified to represent the seasonal publication of the journal.

ISSN 1712-171X (Print)
ISSN 1712-1728 (Online)

Canada Post Publications Mail agreement #40063062. Return undeliverables to CDHA, 1122 Wellington St W, Ottawa, ON K1Y 2Y7

THE CANADIAN DENTAL HYGIENISTS ASSOCIATION
L'ASSOCIATION CANADIENNE DES HYGIÉNISTES DENTAIRES

The mission of the *Canadian Journal of Dental Hygiene* is to publish high-quality, credible, and accessible research to inform practice, education and policy, and promote the oral health and well-being of the public.

CONTENTS

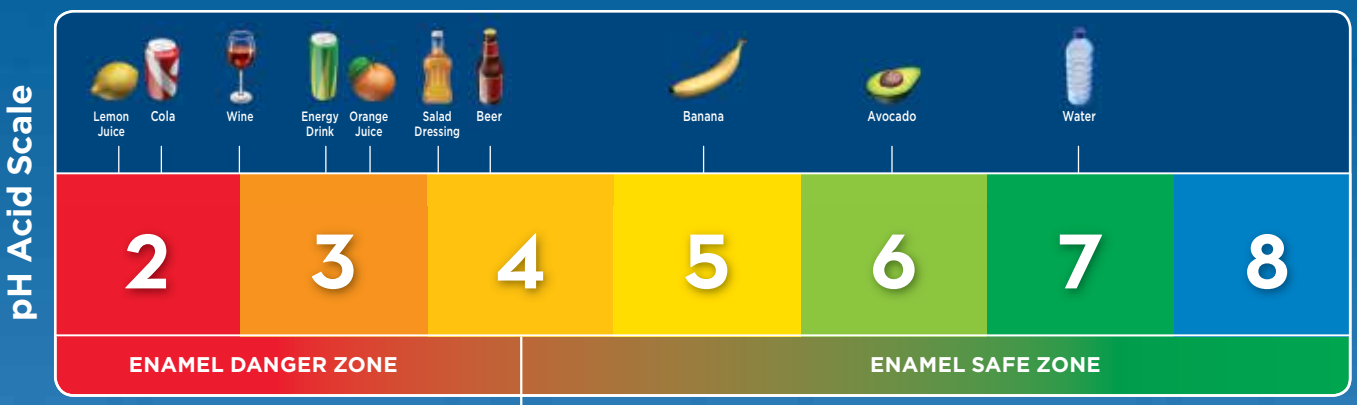
OCTOBER 2017 VOL. 51, NO. 3

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

CJDH is indexed in the following databases: CINAHL; EBSCOhost; ProQuest; Scopus; Thomson Gale

Crest PRO-HEALTH™

PATENTED PROTECTION
AGAINST DIETARY ACID EROSION



ENAMEL BEGINS TO SOFTEN AT pH 4.0.
CREST® PRO-HEALTH™ WITH STANNOUS FLUORIDE PROVIDES SIGNIFICANTLY GREATER PROTECTION FROM CALCIUM LOSS DUE TO ENAMEL EROSION CAUSED BY DIETARY ACIDS VS. SODIUM FLUORIDE IN LOWER pH.

NEW, IMPROVED FORMULA!*

- Smooth*, Great Taste
- Gentle & Bead-Free
- No Sloughing†
- Non-Staining Formula

Crest
PATENTED STANNOUS FLUORIDE FORMULA

*smoother formula vs. Crest® Pro-Health™ Advanced toothpastes
†beyond regular fluoride toothpaste

 ORAL-22045

Evidence revisited: Making the best clinical decisions

Salme Lavigne, PhD, RDH

Salme Lavigne

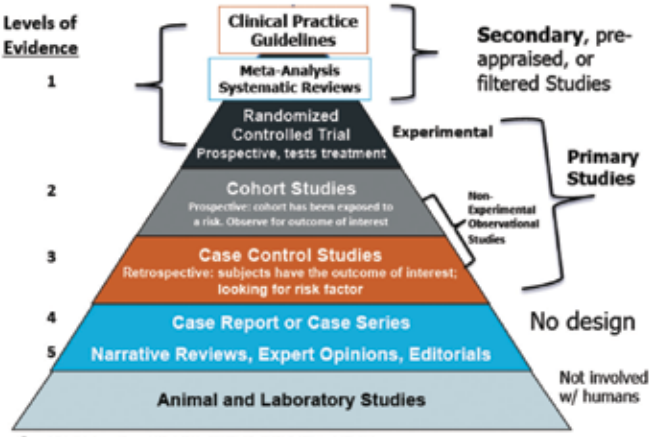
Almost 3 decades ago, both the medical and dental professions were introduced to the concept of "evidence-based decision making" in order to encourage clinical decisions that incorporated the most current available scientific evidence. Until that point, health professionals made clinical decisions mostly based on what they learned at school and often on their professional experience and individual preferences, which did not always take into consideration new evidence on emerging treatments and products. This major paradigm shift was intended to change the way clinicians made decisions and to assist them in selecting the care that best suited each client rather than opting for a "one treatment fits all" approach.

The concept of evidence-based decision making involves 4 basic principles: (a) scientific evidence; (b) professional experience and judgement; (c) client preferences or values; and (d) clinical/client circumstances.[1] All 4 principles must be taken into consideration when formulating decisions regarding client care and answering client questions. Scientific evidence alone does not replace the experience and judgement of the clinician. However, it complements the decision-making process. In order to guide clinicians in evaluating the scientific literature and distinguishing between stronger and weaker forms of evidence, a hierarchy of evidence was developed. The original hierarchy ranked randomized controlled trials (RCTs) at the top of the pyramid as they were considered the highest level of evidence.

This original evidence pyramid, however, has undergone numerous iterations over the years and currently lists clinical practice guidelines at the top, followed by meta-analyses and systematic reviews.[1] These types of Level 1 evidence are "secondary," pre-appraised or filtered studies that are designed to provide summaries of the evidence gleaned from primary studies, translating the most current evidence into practice. The 3 types of studies that follow on the pyramid are considered "primary" studies, with the RCT offering the highest level of evidence (also Level 1) followed by cohort studies (Level 2) and case–control studies (Level 3). Levels 4 and 5 consist of case reports, narrative reviews, and editorials, none of which involve a research design.[1] The bottom of the pyramid comprises animal and laboratory studies, which are important beginnings to the research process, but do not involve human subjects and therefore should not influence decisions regarding client care.[1]

You may wonder why textbooks do not appear on the evidence pyramid. They normally take years to write and publish, may or may not have lengthy references, and often the information is already outdated by the time the book is published. Additionally, the peer-review process for textbooks is not as stringent as for articles published in scholarly journals.

Figure 1. Hierarchy of research evidence[1]



Reprinted with permission

This entire evaluation process may appear to be overwhelming to busy clinicians who just want to know the "bottom line." The best solution in that case is to search for well-conducted systematic reviews, preferably with meta-analyses, which combine and analyse the data from numerous similar studies, to answer your specific

Correspondence: Dr Salme Lavigne, CJDH Scientific Editor; scientificeditor@cdha.ca

clinical question. Remember that systematic reviews are very different from literature reviews. They involve a comprehensive, unbiased review process conducted by a team of independent researchers, who locate, appraise, and synthesize evidence from the highest level of scientific studies available. They are highly structured and follow a stringent methodology that includes specific inclusion and exclusion criteria. Narrative reviews should not be confused with systematic reviews either. Narrative reviews involve a review of the literature on a broader topic area, and often do not have well-defined criteria, nor do they typically appraise the quality of the studies included in the review. The findings in a narrative review are based solely on the authors' opinions and are considered Level 4 evidence, along with case reports, expert opinions, and editorials.

Since any one study, even a randomized controlled trial, does not provide sufficient evidence to prompt a change to the way you practise, systematic reviews are an excellent foundation on which to base your clinical decisions. They evaluate numerous studies and are conducted by seasoned researchers who have the expertise to assess the quality of the study design, the statistical analyses, and, thus, the credibility of the results. Study clubs are one way that clinicians can quickly build a library of recent systematic reviews to aid in their clinical decision making. However, remember to regularly update your information as research is a dynamic process and the evidence is ever-changing!

Absence of evidence is not evidence of absence![2]

REFERENCES

1. Forrest JL, Miller SA. *EBDM in action: Developing competence in EB practice.* 1st Ed. Colbert, WA: ebdLibrary, LLC; 2016. Available from: www.ebdLibrary.com
2. Altman DG, Bland JM. Absence of evidence is not evidence of absence. BMJ 1995;311:485.

ISSUE AT A GLANCE

The journal's editorial board is pleased to publish the winning entry from its inaugural national student essay competition on pages 126–31. The essay, by **Hazel Joyce Manlapaz**, explores xerostomia and caries in community-dwelling older adults. In addition, the October issue includes reviews of *Clinical Photography in Dentistry: A New Perspective* by **Teresa La Chimea** (pp. 133–34) and *Medical Microbiology and Immunology for Dentistry* by **Rees Kelly** (pp. 137–38), and a letter to the editor regarding oral care for seniors from **Julie DiNardo** (p. 141). Finally, the October issue features the following research articles.

Costa KLL, Taboza ZA, Rodrigues RS, Angelino GB, da Silveira VRS, Rego RO. Influence of diabetes control on gingival health following oral hygiene instructions and use of a triclosan dentifrice. *Can J Dent Hyg.* **2017;51(3):111–117.**
Type 2 diabetes is a significant risk factor for periodontal disease, and periodontal disease can hinder efforts to regulate blood glucose levels, leading to further systemic health problems for individuals with diabetes. As a result, there is a need to identify therapies that can prevent the onset of periodontal disease in this population. This original research study examines the impact of oral hygiene instruction on the gingival health of 37 individuals with type 2 diabetes. Participants with either moderate or poor glycemic control and gingival bleeding were instructed to brush their teeth 3 times daily with a triclosan toothpaste and to floss once a day. After 4 weeks, there was a statistically significant reduction in gingival bleeding in participants with moderately controlled glycemic levels. While those participants with poorly controlled glycemic levels also experienced a reduction in bleeding, the difference was not significant, suggesting that they would need enhanced oral hygiene care to prevent periodontal disease. Further studies are required to support these results, given the small sample size in this investigation.

Battersby L. Education strategies that best engage Generation Y students. *Can J Dent Hyg.* **2017;51(3):118–25.**
Generation Y students (those born between 1980 and 2000) have different learning styles from students in the past, which means that educators may have to adjust their teaching methods to ensure that they are meeting the needs of today's learners. This review examines the characteristics of Generation Y students and identifies action-oriented educational strategies that may help to engage them more successfully in the classroom. The author highlights activities and teaching methods that would be of particular benefit to Generation Y students in dental hygiene education programs.

The keyword and author index to Volume 51 (2017) begins on page 145.

Complete care for a healthier mouth

The new Philips Sonicare DiamondClean Smart toothbrush

Reduces gingival inflammation up to **70% better** than Oral-B 7000 with CrossAction brush head[1]

innovation you

Smart Sensor Technology

Personalized coaching for better coverage, reduced scrubbing and ideal pressure via the Philips Sonicare app

Smart Brush Head Recognition Technology

Automatically chooses the optimal mode and intensity level and monitors brush head lifetime

High Performance Brush Heads

Up to: 10x better plaque removal,[2] 7x healthier gingiva[2] and 5x more stain removal[3]

Bluetooth®

№1 Dental Professional recommended
Sonic toothbrush brand worldwide

Learn more about **Philips Sonicare DiamondClean Smart** at philips.ca/smart

1. In Deep Clean, non-connected modes using Premium Plaque Control brush head
2. vs. a manual toothbrush 3. vs. a manual toothbrush using a leading whitening toothpaste

Phone not included.

PHILIPS

sonicare

PHILIPS

To you,
it's a healthy mouth.

To your patients,
it's pure confidence.

From the oral care experts at Sonicare, Philips Zoom can unleash a healthy, white smile that boosts the confidence of your patients.

- **In-office efficacy** – whitens up to 8 shades in 45 minutes[1]
- **Take-home results** – the most advanced formulas in take-home whitening

Introduce your patients to the trusted, healthy whitening of **Philips Zoom**.

innovation + you

Philips Zoom ***WhiteSpeed***

Philips Zoom ***DayWhite / NiteWhite***

Philips Zoom ***Whitening Pen***

№1 whitening brand

Most used by dental professionals

Call now for your **free trial**, **(800) 278-8282**
or visit **www.philips.com/ZoomPortfolio**

1 With Philips Zoom WhiteSpeed. Not including prep time.

PHILIPS

ZOOM!

Influence of diabetes control on gingival health following oral hygiene instructions and use of a triclosan dentifrice

Katia Linhares Lima Costa*, DDS, MS, PhD; **Zuila Albuquerque Taboza***, DDS, MS; **Richelle Soares Rodrigues***, DDS, MS; **Gisele Barreto Angelino**[§], DDS; **Virginia Regia Souza da Silveira**[‡], DDS, MS, PhD; **Rodrigo Otavio Rego**[Δ], DDS, MS, PhD

WHY THIS ARTICLE IS IMPORTANT TO DENTAL HYGIENISTS

- Type 2 diabetes is a risk factor for periodontal disease, and periodontitis can impair glycemic control
- Maintaining good oral hygiene instruction in clients with diabetes is essential to the control and prevention of periodontal disease
- Oral hygiene instruction coupled with specific motivational strategies may be particularly beneficial to individuals with poorly controlled diabetes

ABSTRACT

Purpose: The aim of this cohort study was to evaluate the influence of glycemic control on the gingival bleeding of type 2 diabetic clients after brushing 3 times daily with a triclosan toothpaste for 4 weeks following oral hygiene instructions (OHI). **Methods:** Thirty-seven subjects were distributed into 2 groups according to their glycated hemoglobin (HbA1c) levels. The moderately controlled group (MOD) had 18 individuals with HbA1c <9%; the poorly controlled group (PLY) had 19 individuals with HbA1c ≥9%. After clinical examination, all study participants received OHI which included brushing 3 times daily with a toothpaste containing triclosan using the Bass technique and the daily use of dental floss. Between group differences were analysed using unpaired *t* tests, while within group differences were calculated with paired *t* tests. **Results:** Gingival bleeding index (GBI) was assessed at baseline (MOD = 65.1±15.1%; PLY = 67.6±20.2%) and after 4 weeks. At the end of the study period, a significant reduction in GBI was noted in the MOD group (40.2±18.5%; $p < 0.001$) but not in the PLY group (56.5±21.2%). When comparing the 2 study groups, a statistically significant difference ($p = 0.017$) between groups was found. A significant association was also observed for a 25% GBI reduction in the MOD group in comparison with the PLY group ($p = 0.026$) as determined with the Fisher's exact test. **Conclusions:** Type 2 diabetic clients with moderate glycemic control showed improvements in gingival bleeding after oral hygiene instructions and use of a dentifrice containing triclosan. However, no significant improvements were found in the poorly controlled diabetic clients. This regimen seemed insufficient to improve the bleeding status of the poorly controlled group. Incorporating more specific motivational strategies may be needed.

RÉSUMÉ

Objectif : Cette étude de cohortes visait à évaluer l'influence du contrôle de la glycémie sur l'état gingival des clients diabétiques de type 2 qui, après avoir reçu des instructions d'hygiène buccale (IHB), se sont brossé les dents 3 fois par jour pendant 4 semaines avec un dentifrice contenant du triclosan. **Méthodes :** Trente-sept sujets ont été séparés en 2 groupes en fonction de leur taux d'hémoglobine glycosylée (HbA1c). Le groupe ayant un diabète modérément contrôlé (MOD) comprenait 18 individus au taux de HbA1c < 9 % et le groupe, dont le diabète était mal contrôlé (MAL), comprenait 19 individus qui avaient un taux de HbA1c ≥ 9 %. Après avoir subi un examen clinique, tous les participants de l'étude ont reçu pour instruction de brosser leurs dents 3 fois par jour avec un dentifrice contenant du triclosan en utilisant la technique de brossage Bass et d'utiliser la soie dentaire quotidiennement. Les différences entre les groupes ont été analysées au moyen de tests *t* non appariés alors que les différences au sein des groupes ont été analysées au moyen de tests *t* appariés. **Résultats :** L'indice de saignement gingival (ISG) a été évalué au départ (MOD = 65,1±15,1 %; MAL = 67,6±20,2 %) et après 4 semaines. Après 4 semaines de brossage au moyen d'un dentifrice contenant du triclosan, une réduction considérable de l'ISG a été signalée dans le groupe MOD (40,2±18,5 %, $p < 0,001$), mais pas dans le groupe MAL (56,5±21,2 %). Lorsque les groupes de l'étude ont été comparés, une différence statistiquement considérable ($p = 0,017$) a été trouvée entre les groupes. Une association importante a aussi été observée chez le groupe MOD en matière de réduction proportionnelle de l'ISG par rapport au groupe MAL ($p = 0,026$), telle que déterminée au moyen de la méthode exacte de Fisher. **Conclusions :** Les clients diabétiques de type 2 ayant un contrôle glycémique modéré ont présenté une amélioration statistiquement considérable en matière de saignement gingival après avoir reçu des IHB et utilisé un dentifrice contenant du triclosan. De telles améliorations n'étaient pas significatives chez les clients au diabète mal contrôlé. Ce schéma thérapeutique semblait insuffisant pour améliorer la santé buccodentaire des individus au diabète mal contrôlé. L'intégration de stratégies de motivation peut être nécessaire.

Keywords: blood glucose; diabetes; gingivitis; glycated hemoglobin; oral hygiene; triclosan

*Department of Clinical Dentistry, Graduate Program in Dentistry, Federal University of Ceara, Fortaleza, Brazil
[§]School of Dentistry, Federal University of Ceara, Sobral, Brazil
[‡]Assistant professor, Department of Dentistry, School of Dentistry, Federal University of Ceara, Sobral, Brazil
[Δ]Associate professor, Department of Dentistry, School of Dentistry, Federal University of Ceara, Sobral, Brazil

Correspondence: Dr. Rodrigo Otavio Rego; rodrigorego@yahoo.com
Submitted 14 February 2017; revised 5 October 2017; accepted 10 October 2017

INTRODUCTION

Type 2 diabetes is a metabolic disease characterized by insulin resistance and inadequate compensatory secretion of insulin. According to the American Diabetes Association, it is the most prevalent form of diabetes, affecting 90% to 95% of diabetic clients.[1] Studies have shown that type 2 diabetes is a significant risk factor for periodontal disease,[2,3] and that periodontitis can also impair the glycemic control of those with diabetes.[4,5] Chronic hyperglycemia observed in clients with poorly controlled diabetes can affect neutrophils, fibroblasts, and collagenases. It can also induce the production of advanced glycation end products (AGEs), which can contribute to greater tissue damage and reduced repair capacity.[6] An improved response to periodontal therapy, along with significant improvements in evaluated clinical parameters, has been demonstrated in well-controlled diabetic clients compared to poorly controlled ones.[7]

Since gingivitis precedes periodontitis, it would be important from a preventive perspective to analyse the effects of gingivitis therapy among individuals with diabetes. There is, however, a lack of studies addressing this issue.[8] Dental treatment including daily plaque removal is of extreme importance in establishing gingival and periodontal health.[9,10] Toothbrushing, associated with the use of dentifrices, is the most common method of oral hygiene used at home by clients and, in most instances, results in removal of dental biofilm, leading to improved gingival and periodontal health.[11] The addition of triclosan, a broad-spectrum antimicrobial agent with low toxicity, to dentifrice formulations is intended to improve plaque control, since it possesses anti-inflammatory effects and has been shown to suppress acute and chronic mediators of inflammation.[12] The most common formulation includes a copolymer (polyvinylmethyl ether maleic acid [PVM-MA]), which enhances the retention of triclosan.[13] Studies have shown significant reduction of gingival indices, including gingival bleeding, in participants with gingivitis using this formulation compared to sodium fluoride dentifrices.[14,15] It is unknown if products containing triclosan would have similar effects on clients with diabetes whose glycemic levels are moderately controlled compared with those who are poorly controlled. Therefore, the aim of this study was to evaluate the influence of glycemic control on gingival bleeding in type 2 diabetic clients following oral hygiene instructions and thrice-daily brushing with a dentifrice containing triclosan over a 4-week period.

MATERIALS AND METHODS

Study design

This was a cohort study with a duration of 28 days, in which type 2 diabetic clients attending the City Public Health Department, Sobral, Ceara, Brazil, were distributed into 2 groups according to HbA1c levels. Moderately controlled type 2 diabetic clients (HbA1c <9%) were placed in the group MOD, while the poorly controlled diabetic clients (HbA1c ≥9%) were placed in the group PLY.[16] This study complies with the recommendations in the STROBE guidelines.[17]

Participants

Both males and females diagnosed with type 2 diabetes and presenting with a minimum of 40% gingival bleeding sites were included in the study. Other inclusion criteria were the presence of at least 6 teeth; age 40 years or older; and use of oral hypoglycemic medications. Subjects with periodontitis were also included. The periodontal status of participants was classified according to the Centers for Disease Control and Prevention and the American Academy of Periodontology classification.[18] Smokers, clients who had received periodontal therapy in the past 6 months, those taking medications associated with gingival overgrowth (phenytoin, cyclosporine, and calcium channel blockers), and women who were pregnant or breastfeeding were excluded from this study. All subjects were evaluated at the Public Dental Specialty Center of Sobral, Brazil, between May and December 2012.

The study protocol was reviewed and approved by the Research Ethics Committee of the School of Medicine of the Federal University of Ceara, Brazil. All study participants agreed and signed the informed consent form.

Outcome

The primary outcome was determined to be the reduction in gingival bleeding 4 weeks after receiving oral hygiene instructions and brushing 3 times daily with a dentifrice containing triclosan, compared with baseline bleeding scores.

Clinical and laboratory procedures

Glycated hemoglobin values were requested at the first visit to determine the glucose control of each study participant. This test was performed at the Public Health Laboratory, Sobral, Ceara, Brazil, using the ion exchange chromatography method (Glico-Teck, Katal Biotecnologica Industria e Comercio Ltda, Belo Horizonte, MG, Brazil). Gingival bleeding was assessed using the gingival bleeding index (GBI)[19] in all teeth, at 2 time points: baseline and 28 days. The GBI evaluates occurrence of bleeding 10 seconds after gentle probing along the gingival crevice at the vestibular, palatine or lingual, mesial, and distal surfaces. The number of positive sites is then expressed as a percentage of the number of gingival margins examined.[19] An experienced periodontist, blind to group distribution, performed all clinical examinations using the UNC 15 periodontal probe (Trinity Industria e Comercio Ltda., São Paulo, SP, Brazil). If supragingival calculus was present it was removed with an ultrasonic instrument.

After clinical examination, subjects received oral hygiene instructions including on the use of a toothbrush and dental floss. The Bass technique[20] was recommended

as the brushing technique, and subjects were instructed to brush for 2 minutes, at least 3 times a day for 4 weeks. A toothbrush (Colgate Professional Extra-Clean, Colgate Palmolive Company, São Paulo, SP, Brazil) and toothpaste containing triclosan and the copolymer maleic acid polyvinylmethylether (Colgate Total 12, Colgate Palmolive Company, São Paulo, SP, Brazil) were provided. It was estimated that one tube of toothpaste would be sufficient to last the entire study period. No attempt was made to track the frequency of toothbrushing by study subjects.

Study sample size

Sample size was determined (G*Power version 3.0.5, Heinrich-Heine University, Dusseldorf, German) based on a pilot study using the same methodology, which included 24 subjects. Based on the means and standard deviation of test and control groups obtained in the pilot study, the sample size was calculated considering a power of 80% and alpha error of 0.05, which indicated the need for 17 subjects in each group. However, a 20% loss to follow-up was expected, and the sample size was increased to 20 subjects per group who began the study.

Statistical methods

After normal distribution was verified, the unpaired *t* test was applied to evaluate differences in GBI, HbA1c, age, and tooth count between the 2 groups. The paired *t* test was applied to evaluate GBI changes after follow-up within the same group. Fisher's exact test was used to compare proportions of gender and periodontal condition between them as well as to evaluate the association between reduction of gingival bleeding and glycemic control. Reduction in gingival bleeding was determined as absolute reduction as well as proportional reduction of 25% and 50% after 4 weeks, and the relative risk was determined for each cut-off. SPSS software (SPSS, IBM Corporation, Armonk, NY, USA) was used for all analysis and significance was set at 0.05.

RESULTS

Thirty-seven subjects completed the study. Of the participants enrolled in the study, 3 were lost to follow-up; 2 in the MOD group and 1 in the PLY group. Baseline data on glycemic control, age, gender, tooth count and periodontal condition are presented according to study groups in Table 1. Statistically significant differences at baseline were observed between groups only for glycemic control (mean HbA1c). Fisher's exact test did not reveal significant differences between groups regarding gender or periodontal condition. In addition, there was an equivalent proportion of different forms of periodontitis in both groups (i.e., mild, moderate, and severe). Baseline values of GBI were not statistically different between the 2 groups (Table 2).

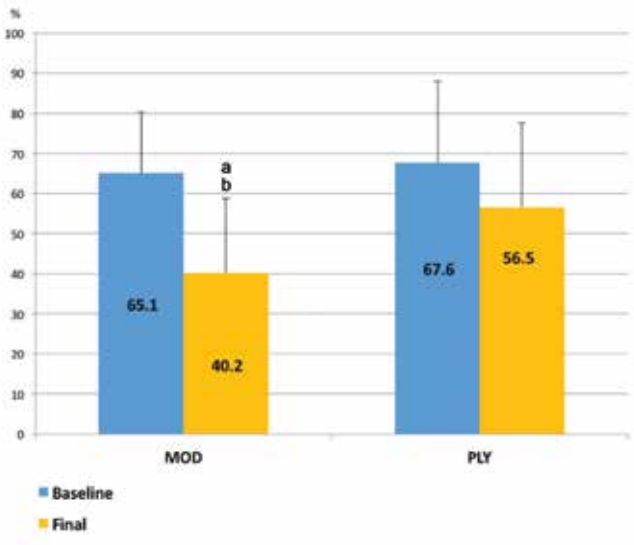
After 4 weeks of brushing with the triclosan dentifrice, a statistically significant reduction in GBI was noted within the MOD group (40.2±18.5%) ($p < 0.001$) as illustrated in Table 2 and Figure 1. The same trend was observed in the PLY group (56.5±21.2%) but was not statistically significant. Between group comparisons at 4 weeks

Table 1. Baseline demographic and clinical characteristics

	MOD group (HbA1c <9%)	PLY group (HbA1c ≥9%)
Number of participants	18	19
HbA1c (%) (Mean±SD)	7.6±0.8	10.7±1.6[a]
Gender	5 males, 13 females	10 males, 9 females
Age (Mean±SD)	58.1±7.6	56.8±8.5
Tooth count (Mean±SD)	14.6±7.1	14.2±6.4
Gingivitis	7 (39%)	8 (32%)
Periodontitis	11 (61%)	11 (58%)
Mild	4(22%)	4(21%)
Moderate	5(28%)	4(21%)
Severe	2(11%)	3(16%)

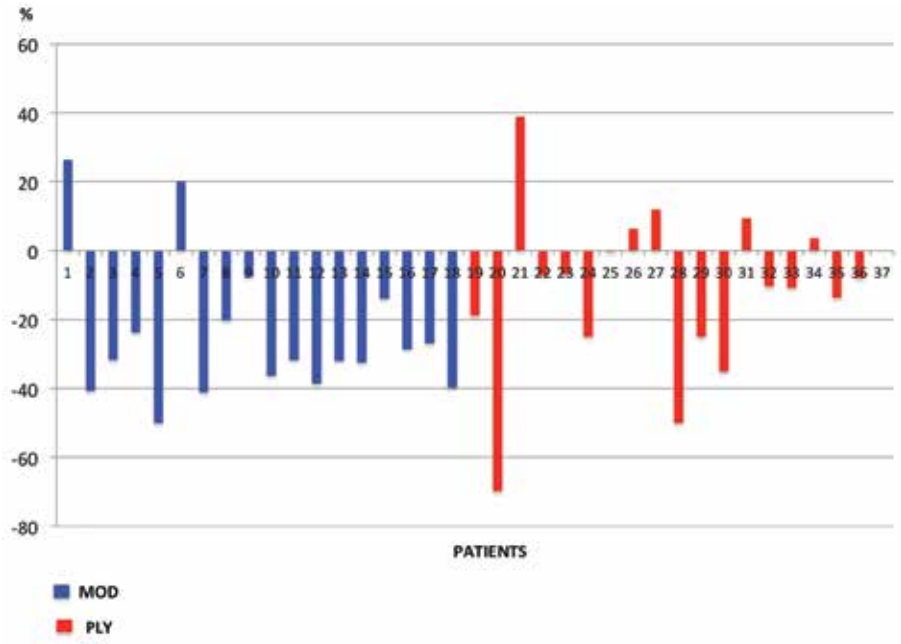
HbA1c = glycated hemoglobin; SD = standard deviation
[a]statistically significant ($p < 0.001$, *t* test)

Figure 1. Mean values of Gingival Bleeding Index (%)



[a]Significant within group difference between baseline and 4-week data ($p < 0.001$ by paired *t* test)
[b]Significant difference between MOD and PLY groups ($p = 0.017$ by unpaired *t* test)

Figure 2. Plots of GBI changes between baseline and 4 weeks in MOD and PLY groups



Negative values indicate GBI reduction

Table 2. Changes in GBI from baseline to 4 weeks

	MOD group (n = 18)	PLY group (n = 19)
Baseline GBI (%, SD)	65.1 (±15.1)	67.6 (±20.2)
Four-week GBI (%, SD)	40.2 (±18.5)[a]	56.5 (±21.2)[b]

[a]Significant difference between baseline and 4-week data ($p < 0.001$ by paired *t* test)
[b]Significant difference between MOD and PLY groups ($p = 0.017$ by unpaired *t* test)

Table 3. Reduction of bleeding sites (number and proportion of subjects) per group and statistical analysis

Reduction in GBI	MOD group (n = 18)	PLY group (n = 19)	Fisher's exact test (*p* value)	Relative risk (95% CI)
Absolute	16 (89%)	14 (74%)	0.404	1.9 (0.6–6.3)
≥25%	12 (67%)	5 (26%)	0.026[a]	2.5 (1.1–5.7)
≥50%	1 (6%)	2 (11%)	0.588	0.5 (0.1–5.3)

GBI = Gingival Bleeding Index; CI = confidence interval
[a]Statistically significant

revealed a significant difference, with the MOD group presenting a lower bleeding index than the PLY group ($p = 0.017$) (Table 2). Figure 2 further illustrates the results with line plots of reductions in bleeding per study participant.

Table 3 presents the number and percentage of participants who had reduced bleeding sites, categorized as absolute, 25% or 50% GBI reduction. Individuals in both groups experienced a reduction in the GBI—89% of subjects in the MOD group and 74% in the PLY group. No association between glycemic control and absolute reduction in GBI between groups was found. However, when the 25% cut-off value for GBI proportional reduction was established, a significant association was observed (MOD = 67%; PLY = 26%), where the relative risk was 2.5 (95% Confidence interval: 1.1–5.7, $p = 0.026$). Only 3 subjects achieved GBI reductions equal to or greater than 50%, one in the MOD group and 2 in the PLY group with no statistically significant differences observed.

DISCUSSION

At the commencement of this study, both groups presented with similar gingival bleeding scores despite being in 2 different glycemic control categories. Both the moderately controlled and the poorly controlled groups had elevated GBI levels, with no significant differences between the 2 groups, thus, allowing for a realistic view of the influence of the proposed therapy on the GBI. After

oral hygiene instructions and brushing with a dentifrice containing triclosan for 28 days, participants in both groups experienced a reduction in GBI, which reflects improvement in the oral hygiene standards of the study participants. However, a statistically significant reduction in GBI from baseline values was only observed in the moderately controlled group (MOD). When the changes in GBI at 4 weeks were compared between the 2 groups, there was a statistically significant difference demonstrating the PLY group did not respond to the intervention in the same way as did the MOD group. This finding was validated through further analysis of 2 proportional reduction cut-offs points—25% and 50%—revealing that the moderately controlled individuals had 2.5 times better odds of reducing 25% of bleeding sites in comparison with the participants with poorly controlled diabetes. One possible explanation for the lack of a significant reduction in GBI in the poorly controlled group is that the higher HbA1c levels in this group influenced the way they responded to the intervention. If this is the case, these results suggest that more poorly controlled diabetic clients respond differently to oral hygiene practices than those who are moderately controlled.

Since type 2 diabetes and periodontal diseases have been shown to have a bidirectional relationship,[2-5] proper oral hygiene instruction must be recommended to prevent periodontal diseases. Studies have reported that individuals with uncontrolled diabetes tend to present more complications such as periodontitis, which has its onset as gingivitis.[2,3] Literature suggests that, in order to be effective, oral hygiene should include daily mechanical and chemical plaque control by motivated clients.[9,10] Mechanical plaque control is achieved with brushing and flossing, where the dental biofilm is disrupted and physically removed. However, in a systematic review evaluating the effects of plaque control with a manual toothbrush, van der Weijden et al.[11] concluded that the quality of mechanical plaque control was not effective enough to promote resolution of gingivitis. It has been suggested that oral hygiene products containing antimicrobial agents contribute to the resolution of gingivitis, with their effects exceeding those of brushing and flossing.[21] Triclosan is an antimicrobial agent with anti-inflammatory properties that, when associated with copolymer, has its substantivity increased and can reduce gingival inflammation in the proportion of 23% to 49% for a period of 6 months, depending on the gingival index used.[14,15,22]

Study investigators included the use of a dentifrice containing triclosan in this study in order to employ a combination of both mechanical and chemical approaches to plaque control as well as oral hygiene instruction as a motivational strategy. Interestingly, the combination of these 3 strategies was successful with diabetic clients who were moderately controlled, while unsuccessful with those who had poorly controlled diabetes.

To evaluate improvements in oral hygiene, gingival bleeding was chosen as a surrogate clinical parameter in this study and was measured by the GBI.[19] The reason for this choice was the greater clinical significance that this parameter has on periodontal disease.[14,23] Additionally, it is a good indicator of oral hygiene control in the long term, unlike the plaque index which is only indicative of the moment of evaluation. Gingival bleeding has also been considered a significant risk factor for the progression of periodontitis.[23] A longitudinal study, with 26 years of follow up, evaluated gingival bleeding as a risk factor for periodontitis.[23] Lang and colleagues observed that gingival sites that bled had 70% more attachment loss than those that did not bleed. These results allowed the authors to conclude that persistent gingivitis is a risk factor for periodontal attachment loss and tooth loss.[23]

Only one study similar to the current one has been reported.[8] Almas et al. evaluated the effects of oral hygiene instructions on diabetic clients with moderate to severe periodontal disease compared with systemically healthy clients with periodontitis.[8] However, the follow-up period was only 7 days compared with 28 days in this current study. Additionally, the index used to evaluate gingival inflammation (CPITN) differed between these 2 studies. The CPITN used in the Almas et al. study measures not only inflammation but also pocket depth. Improvements in the plaque index were observed in all 3 study groups, but the CPITN score did not change in the diabetic group with advanced periodontal disease. Given the differences in the measuring indices as well as the study length, it is not reasonable to compare the results from this study with the current study results.

In an investigation by Yuen and colleagues[24] exploring the efficacy of plaque removal after oral self-care demonstration among diabetic subjects, the mean percentage of plaque removal was found to be only half of what was expected, and only 10% of participants achieved 50% or more plaque removal. Gingival bleeding, however, was not evaluated and thus also precludes comparision with the current study.

The poorly controlled diabetic group in the current study did not show significant gingival bleeding reduction following oral hygiene instruction and the brushing intervention. This result could be attributed to either biological factors as suggested in the study hypothesis or behavioural factors or the possible interaction between the two. From a biological point of view, chronic hyperglycemia observed in poorly controlled diabetic clients can affect the immune system and induce the production of advanced glycation end products, which can contribute to greater tissue damage and reduced repair capacity.[6] Since those participants with poorly controlled diabetes followed the same study protocol as those in the moderately controlled group, severity of glycemic control can be considered a reasonable explanation for the outcomes of this study.

Insofar as behavioural factors are concerned, clients with uncontrolled diabetes have been reported to be less committed to oral health measures, including oral hygiene and frequency of dental visits.[25] In addition, the manipulation of a manual toothbrush requires hand dexterity, which can be impaired in individuals with diabetes due to hand abnormalities.[24] Tomar et al. reported that the main reason diabetic clients did not visit visiting the dentist was the belief that it was not a necessity.[26] Therefore, educating clients about the effects of diabetes on oral health can be a way of motivating them to improve oral care.[27] Client motivation is an important factor, which may have possibly affected the results of the present study. However, since adherence to the study protocol was not measured, that cannot be assumed. Some authors have reported that many individuals with diabetes do not know that good oral hygiene can be a tool for the control of diabetes.[28,29] Findings from a survey conducted by Moore et al.[28] revealed the majority of respondents, who were adults with diabetes, were unaware of the oral complications associated with the disease. They were also found to be less likely to spend time and money on oral care compared to non-diabetic clients.[28] It is important to note that more women were enrolled in the MOD group in the current study. However, although studies have demonstrated that women seek care more often than men[30] and present better oral hygiene practices,[27,31] in the current study, no significant difference was observed when gender proportion between groups was evaluated.

This study tested the effects of a home care intervention on individuals with both moderately controlled and poorly controlled diabetes. Its findings should be interpreted considering both its limitations and its strengths. This study has 2 major limitations, the first being the decision not to document the adherence of participants to the thrice-daily brushing and dentifrice intervention. The second is the small sample size, which limits its generalizability beyond the current study.

In contrast, the evaluation of gingival inflammation has positive clinical implications since it is more closely related to real life. This study has demonstrated that, for type 2 diabetic clients with moderate glycemic control, frequent oral hygiene home care interventions that include thrice-daily brushing with a dentifrice containing triclosan can improve oral health. This was not the case for those with poor glycemic control. Those individuals with poorly controlled diabetes may need more aggressive interventions including the incorporation of more specific motivational strategies. Further studies are required with larger sample sizes as well as the incorporation of targeted motivational strategies and measurements of adherence in order to determine effective home care control of gingivitis in clients with poorly controlled diabetes.

Since there is a bidirectional relationship between diabetes and periodontal diseases,[2-5] the early identification of diabetes and hyperglycemia can contribute to better outcomes for both diseases. Dental personnel must be aware of this condition and help to identify undiagnosed or poorly controlled diabetes. To facilitate such a diagnosis, a new screening tool has been developed for the chairside testing of gingival crevicular blood collected at the dental visit that can be used to screen for diabetes and monitor glycemic control.[32] Additionally, if clients who present with diabetes risk factors receive a more detailed explanation of their condition and specific follow-up, improved client outcomes may be achieved.[33]

CONCLUSIONS

Within the limitations of this study, it can be concluded that daily use of a dentifrice containing triclosan following oral hygiene instruction in type 2 diabetic clients with moderate glycemic control produced a significant reduction in gingival bleeding over a 4-week period. However, the sample size of 37 study participants limits the generalizability of the findings. Gingival bleeding in clients with poorly controlled diabetes did not show improvements by the end of the observation period. This finding suggests that oral health professionals, mainly dental hygienists, may need to incorporate more specific motivational strategies into their preventive regimens to improve the home oral care efforts of this vulnerable population.

ACKNOWLEDGEMENTS

This study was sponsored by grants from the Brazilian Research Agencies CAPES (PROCAD NF 2313/2008) and FUNCAP (266010009).

REFERENCES

1. American Diabetes Association. Diagnosis and classification of diabetes mellitus. *Diabetes Care.* 2014;37 Suppl 1:S81–90.
2. Garcia D, Tarima S, Okunseri C. Periodontitis and glycemic control in diabetes: NHANES 2009 to 2012. *J Periodontol.* 2015;86(4):499–506.
3. Tsai C, Hayes C, Taylor GW. Glycemic control of type 2 diabetes and severe periodontal disease in the US adult population. *Community Dent Oral Epidemiol.* 2002;30(3):182–92.
4. Lalla E, Papapanou PN. Diabetes mellitus and periodontitis: A tale of two common interrelated diseases. *Nat Rev Endocrinol.* 2011;7(12):738–48.
5. Costa KL, Taboza ZA, Angelino GB, et al. Influence of periodontal disease on changes of glycated hemoglobin levels in patients with type 2 diabetes mellitus: A retrospective cohort study. *J Periodontol.* 2017;88(1):17–25.
6. Taylor JJ, Preshaw PM, Lalla E. A review of the evidence for pathogenic mechanisms that may link periodontitis and diabetes. *J Clin Periodontol.* 2013;40 Suppl 14:S113–34.

7. Engebretson S, Kocher T. Evidence that periodontal treatment improves diabetes outcomes: A systematic review and meta-analysis. *J Periodontol.* 2013;84(4 Suppl):S153–169.
8. Almas K, Al-Lazzam S, Al-Quadairi A. The effect of oral hygiene instructions on diabetic type 2 male patients with periodontal diseases. *J Contemp Dent Pract.* 2003;4(3):24–35.
9. Chapple IL, van der Weijden F, Doerfer C, et al. Primary prevention of periodontitis: Managing gingivitis. *J Clin Periodontol.* 2015;42 Suppl 16:S71–76.
10. Tonetti MS, Eickholz P, Loos BG, et al. Principles in prevention of periodontal diseases: Consensus report of group 1 of the 11th European Workshop on Periodontology on effective prevention of periodontal and peri-implant diseases. *J Clin Periodontol.* 2015;42 Suppl 16:S5–11.
11. van der Weijden GA, Hioe KP. A systematic review of the effectiveness of self-performed mechanical plaque removal in adults with gingivitis using a manual toothbrush. *J Clin Periodontol.* 2005;32 Suppl 6:214–28.
12. Barros SP, Wirojchanasak S, Barrow DA, Panagakos FS, Devizio W, Offenbacher S. Triclosan inhibition of acute and chronic inflammatory gene pathways. *J Clin Periodontol.* 2010;37(5):412–18.
13. Ciancio SG. Improving our patients' oral health: The role of a triclosan/copolymer/ fluoride dentifrice. *Compend Contin Educ Dent.* 2007;28(4):178–80, 182–83.
14. Davies RM, Ellwood RP, Davies GM. The effectiveness of a toothpaste containing triclosan and polyvinyl-methyl ether maleic acid copolymer in improving plaque control and gingival health: a systematic review. *J Clin Periodontol.* 2004;31(12):1029–1033.
15. Riley P, Lamont T. Triclosan/copolymer containing toothpastes for oral health. *Cochrane Database Syst Rev.* 2013;12:CD010514.
16. Berkey DB, Scannapieco FA. Medical considerations relating to the oral health of older adults. *Spec Care Dentist.* 2013;33(4):164–76.
17. von Elm E, Altman DG, Egger M, et al. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: Guidelines for reporting observational studies. *Lancet.* 2007;370(9596):1453–57.
18. Eke PI, Page RC, Wei L, Thornton-Evans G, Genco RJ. Update of the case definitions for population-based surveillance of periodontitis. *J Periodontol.* 2012;83(12):1449–54.
19. Ainamo J, Bay I. Problems and proposals for recording gingivitis and plaque. *Int Dent J.* 1975;25(4):229–35.
20. Bass CC. The optimum characteristics of toothbrushes for personal oral hygiene. *Dental Items Interest* 1948;70(9):921–34.
21. Teles RP, Teles FR. Antimicrobial agents used in the control of periodontal biofilms: effective adjuncts to mechanical plaque control? *Braz Oral Res.* 2009;23 Suppl 1:39–48.
22. Svatun B, Sadxton CA, Huntington E, Cummins D. The effects of three silica dentifrices containing Triclosan on supragingival plaque and calculus formation and on gingivitis. *Int Dent J.* 1993;43(4 Suppl 1):441–52.
23. Lang NP, Schatzle MA, Loe H. Gingivitis as a risk factor in periodontal disease. *J Clin Periodontol.* 2009;36 Suppl 10:3–8.
24. Yuen HK, Tress ME, Salinas CF, Slate EH. Effectiveness of oral self-care among adult Gullah-speaking African Americans with diabetes. *Spec Care Dentist.* 2009;29(3):128–33.
25. Karjalainen KM, Knuuttila ML, von Dickhoff KJ. Association of the severity of periodontal disease with organ complications in type 1 diabetic patients. *J Periodontol.* 1994;65(11):1067–1072.
26. Tomar SL, Lester A. Dental and other health care visits among U.S. adults with diabetes. *Diabetes Care.* 2000;23(10):1505–510.
27. Strauss SM, Stefanou LB. Interdental cleaning among persons with diabetes: Relationships with individual characteristics. *Int J Dent Hyg.* 2014;12(2):127–32.
28. Moore PA, Orchard T, Guggenheimer J, Weyant RJ. Diabetes and oral health promotion: A survey of disease prevention behaviors. *J Am Dent Assoc.* 2000;131(9):1333–341.
29. Eldarrat AH. Awareness and attitude of diabetic patients about their increased risk for oral diseases. *Oral Health Prev Dent.* 2011;9(3):235–41.
30. Aggarwal A, Panat SR. Oral health behavior and HbA1c in Indian adults with type 2 diabetes. *J Oral Sci.* 2012;54(4):293–301.
31. Wiener RC, Wu B, Crout RJ, et al. Hygiene self-care of older adults in West Virginia: Effects of gender. *J Dent Hyg.* 2012;86(3):231–38.
32. Strauss SM, Rosedale MT, Pesce MA, et al. The potential for glycemic control monitoring and screening for diabetes at dental visits using oral blood. *Am J Public Health.* 2015;105(4):796–801.
33. Lalla E, Cheng B, Kunzel C, Burkett S, Ferraro A, Lamster IB. Six-month outcomes in dental patients identified with hyperglycaemia: A randomized clinical trial. *J Clin Periodontol.* 2015;42(3):228–35.

Education strategies that best engage Generation Y students

Leslie Battersby*, BDSc, PID, MHS, RDH

WHY THIS ARTICLE IS IMPORTANT TO DENTAL HYGIENISTS

- Generation Y students have different learning styles from students in the past
- Educators need to identify and employ strategies to engage Generation Y students more fully in their learning
- Action-oriented educational strategies that incorporate technology and experiential activities may enhance learning

ABSTRACT

It has been suggested that Generation Y students, both adults and youth, have different learning styles than students of the past, and may require different teaching strategies to engage them. Educators may need to adapt their classroom approach in order to successfully involve and teach this newer generation of students. **Objective:** The purpose of this review is to determine what education strategies will best engage Generation Y students and to highlight how these strategies can be assimilated into dental hygiene education programs. **Methods:** Literature searches of the following databases were conducted: Athabasca Library, Cochrane Library, ProQuest Nursing, Google Scholar, PubMed, and EBSCOhost. Key words included Generation Y, Millennial student, action oriented learning, collaborative classroom, and dental hygiene educators. Articles were selected based on purpose of study and relevance, year published, authors' credentials, and study design. **Results:** Thirty eight articles were included in this review. The literature confirmed the differing characteristics and learning styles of Generation Y students. Literature analysis resulted in suggestions for best engaging this learner group and developing specific successfully integrated teaching strategies for dental hygiene programs. **Conclusion:** Generation Y students benefit from action-oriented learning strategies that engage them more fully in the classroom. More research is needed to determine which strategies work best and why some educators have not changed their teaching style to best engage these students.

RÉSUMÉ

Selon certains, les étudiants de la génération Y, jeunes et adultes, ont des styles d'apprentissage qui diffèrent de ceux des générations précédentes et peuvent demander des stratégies d'enseignement différentes pour susciter leur intérêt. Les enseignants auraient besoin d'adapter leur approche en classe afin de faire de leur enseignement une réussite auprès de cette nouvelle génération d'étudiants et les faire participer. **Objectif :** La présente étude vise à définir les stratégies pédagogiques qui permettront de susciter l'intérêt des étudiants de la génération Y et à souligner comment ces stratégies peuvent être intégrées aux programmes de formation en hygiène dentaire. **Méthodes :** Des recherches documentaires ont été effectuées dans les bases de données des bibliothèques Athabasca et Cochrane, de ProQuest Nursing, de Google Scholar, de PubMed et de EBSCOhost. Les mots clés utilisés comprenaient génération Y, étudiants du millénaire, apprentissage axé sur l'action, salle de classe collaborative et enseignants en hygiène dentaire. Les articles ont été sélectionnés en fonction de l'objectif et de la pertinence de l'étude, de l'année de publication, des attestations d'études des auteurs et du modèle de l'étude. **Résultats :** Trente-huit articles ont été retenus dans le cadre de cette étude. La littérature a confirmé les caractéristiques et les styles d'apprentissages différents des étudiants de la génération Y. L'analyse documentaire a permis d'énoncer des suggestions qui permettent de mieux susciter l'intérêt de ce groupe d'apprenants et de créer des stratégies gagnantes d'enseignement ciblées et intégrées destinées aux programmes d'hygiène dentaire. **Conclusion :** Les étudiants de la génération Y tirent profit des stratégies d'apprentissage axées sur l'action qui les encouragent à participer avec dynamisme en classe. D'autres études sont nécessaires pour préciser les stratégies qui seront les plus efficaces et les raisons pour lesquelles certains enseignants n'ont pas changé leur style d'enseignement pour mieux susciter l'intérêt de ces étudiants.

Key words: action oriented learning, collaborative classroom, dental hygiene educators, education strategies, Generation Y learners, Millennial student

INTRODUCTION

For many years educators in postsecondary institutions have used a passive approach to teaching—the student listens while the instructor lectures.[1,2] Although this is a more traditional approach to teaching, evidence suggests that students today, also referred to as Generation Y or Millennials, may be more engaged and learn better when there are different teaching approaches incorporated into the educational environment.[1–4] In order to be effective educators, teachers should consider incorporating a variety of different strategies of engagement that support the changing dynamics of learners.[1–5] Understanding the characteristics of Generation Y students will give instructors a better appreciation for what these learners are all about, what motivates them, and how best to teach them.

Generation Y is defined as those individuals who were born between 1980 and 2000.[3,5] This cohort is currently between 17 and 37 years of age and comprises the vast majority of current postsecondary students. Most were

*Instructor, College of New Caledonia, Prince George, British Columbia, Canada

Correspondence: Leslie Battersby; battersbyl@cnc.bc.ca

Submitted 24 November 2016; revised 27 February, 25 May, 16 August 2017; accepted 23 August 2017

raised in two-income families with their parents often away from home.[5,6] Despite this, Generation Ys tend to have stronger relationships with their parents than previous generations.[5] Literature suggests that parents of this generation focused on filling every moment of their children's lives with well-structured and well-supervised education and activities.[5] Mayhew argues that Generation Ys' confidence and need for variety and challenge come from their busy schedules and expanded educational opportunities.[6] They have been told by their parents that they can do anything. They are often called the "Everybody Gets a Trophy" generation because of their parents' insistence that all childhood experiences be positive and inclusive.[4–6] Generation Ys have been brought up working in teams with shared rewards and a desire to be coached or mentored. These students tend to enjoy and encourage group work and group activities.[2,4,7,8] They want to know they have access to an open door to ask questions, and this usually means they will ask many questions.[3,6] Even though they may view faculty as authority figures they may feel it is acceptable to socialize with faculty outside of class.[7] It has also been documented that Generation Y students expect a lot of praise as well as second, third, and even fourth chances.[6] As adult learners they want to be told often that they are on the right track and doing well.[6] Werth and Werth[5] report that educators can expect parental involvement if the Generation Y learner does not do well in their educational environment, a situation that was not typical in the past in postsecondary education. This type of parental involvement presents other ethical issues for educators given that postsecondary students are adults and thus privacy laws must be considered.

Another key difference in this generation of learners is that they were raised with technology.[3] As a result, they are proficient in a world with computers and a variety of software programs, mobile phones, gaming devices, MP3 players, and the Internet.[5,9] They have not known life without technology and thus they are very comfortable with it. They can email, text, and use computers and programs without difficulty or hesitation.[5] For them, social media platforms (Facebook, blogging, YouTube, Twitter, Instagram, etc.) are a normal way to communicate with the outside world on a daily basis. As a result, they are less concerned about privacy or confidentiality and are willing to share intimate details about themselves with complete strangers.[9] For this generation, hanging out with friends means talking to them over cell phones, sending emails, sharing pictures and text messages. Consequently, they may lack face-to-face communication skills.[10] In fact, Generation Ys are so comfortable with technology it stands to reason that they are also born multitaskers.[11] With this preference for multitasking, however, comes a dark side, which mental health experts are calling "acquired attention deficit disorder."[6] While Millennials are able to complete many tasks at once, each task gets divided attention, and this generation may be losing the ability to focus and analyse lengthier, complex information.[6,9] This inability to focus has led Generation Ys to have short attention spans, which means that information must be delivered in rapid, short bursts if it is to be understood.[6,9,11]

The last consideration when looking at the characteristics of the Millennials is that most of their childhood extracurricular activities involved groups or teams; consequently, they are very team oriented.[4,12] This generation tends to be more social and inclined to participate in learning activities that promote social interactions.[2,4] Millennial students are described as optimistic, assertive, positive, friendly, and cooperative team players who desire to make a difference in the world.[2,4] Generation Y also reportedly thrives on instant gratification.[6]

Educators today are challenged with incorporating teaching methods that appeal to this changing demographic of students. The task of determining which strategies to employ that would be most beneficial for this group of learners may be daunting for some. Despite growing awareness of the Generation Y learner, there is a need to investigate the evidence of this group's teaching and learning preferences in order to inform dental hygiene educators on how best to meet their needs. This review identifies what education strategies have been shown to best engage Generation Y students and discusses how they might be incorporated into dental hygiene education programs.

METHODS

A thorough search of the following databases was undertaken: Athabasca Library, Cochrane Library, ProQuest Nursing, Google Scholar, PubMed, and EBSCOhost. Key words used were Generation Y, Millennial students, action oriented learning, collaborative classroom, and dental hygiene educators. In an attempt to find the most credible and current research, the search was limited to peer-reviewed, full-text articles published within the past 10 years. Articles that were not directly related to the purpose of this study were excluded from the analysis.

As a result of the literature search, 63 articles were retrieved and 38 sources were included in this review. Articles were critiqued and excluded based on the purpose of the study, year published (although 3 articles more than 10 years old were included as the information was deemed relevant to the topic), the appropriateness of the data collected, and the credentials of authors. Of the articles included, only 6 were original studies using primary data; 2 were systematic reviews. Table 1 lists the original research studies that were included in this literature review and summarizes their findings. The remaining 30 articles were either literature reviews, books or reports using secondary data. A review of all sources revealed numerous strategies that have been shown to enhance the learning of Millennial students.

Table 1. Overview of original research included in this review

Author(s), year	Methods	Participants	Academic program	Conclusions
Blue CM[4], 2009	Exploratory study implementing a survey to discover Generation Ys' preferences for learning	101 dental hygiene students	Dental hygiene	Results from study revealed that dental hygiene students do exhibit learning style preferences consistent with Millennial learners.
Henry RK[7], 2011	Comparative study using a qualitative survey to compare the expectations for the didactic environment of faculty and students in a dental hygiene program	20 faculty and 94 students completed surveys	Dental hygiene	Students change with each generation and it is important for faculty to examine the expectations of their students and change technologies and methodologies in order to meet the students' needs.
Beebe C, Gurenlian J, Rogo E[9], 2014	Exploratory study using original surveys	14 dental hygiene programs, with a total of 122 participants	Dental hygiene	Technology implemented in dental hygiene programs has improved access to learning resources and is preferred by students.
McCann A, Schneiderman E, Hinton R[11], 2010	Faculty members conducted a focus group to develop a survey tool to identify student preferences for teaching and learning with electronic technology	432 dental hygiene students were surveyed	Dental hygiene	About two-thirds of the students found college e-resources effective for learning. They preferred printed text over digital (64%) and wanted e-materials to supplement but not replace lectures (74%). They reported e-materials would "extensively" enhance learning, such as e-lectures (59%), clinical videos (54%), and podcasts (45%). They reported the need for a central location for e-resources (98%) and an e-syllabus for every course (86%) in a standard format (77%).
Hills C, Levett-Jones T, Lapkin S, Warren-Forward H[12], 2017	Systematic review to identify the teaching and learning preferences of Generation Y health care professional students	5 studies, with a total of 1159 participants	Nursing and dental hygiene	While many commentators claim that Generation Y students have unique teaching and learning preferences, this assertion is not supported by this systematic review. Because only 5 studies were identified for review, however, generational differences in students' teaching and learning preferences remain inconclusive.
Boctor L[13], 2013	A case study implementing a Jeopardy-style game with 26 questions in 5 categories to determine students' preparation for a standardized final exam	39 students played and evaluated the game	Nursing	Students found this action-oriented learning method enjoyable and beneficial to learning. More research is recommended regarding learning outcomes when using a game as an active learning strategy.
Everly MC[14], 2013	A report on the process of transforming a lecture course into an active-learning model of teaching, including analysis of a mid-semester feedback survey of students and comparison of test scores from lecture-only students and those using active learning methods.	139 students	Nursing	Analysis revealed test scores were higher in the groups being taught with the innovative methods, and students perceived improved learning with active learning over lecture alone.
Blakely G, Skirton H, Cooper S, Allum P, Nelmes P[15], 2009	A systematic review of empirical studies that compared gaming with didactic methods to investigate the use of games to support classroom learning in health sciences. The interventions used in each of the studies involved a game format such as team quizzes, a TV game show, card games, and board games.	16 studies reviewed with sample sizes ranging from 16 to 237	Nursing, occupational therapy, neurology, and medicine	This review suggests that gaming makes a positive contribution to the learning process. It would be as appropriate to recommend the continued use of games as an action-oriented strategy for teaching and learning.

RESULTS AND DISCUSSION

The systematic review by Hills[12] did not find that Generation Y students have unique teaching and learning preferences. This study did, however, state that, because only 5 studies were identified for review, generational differences in students' teaching and learning preferences remain inconclusive. All of the other articles analysed in this review support the premise made in the introduction, namely that Millennial learners require various and different learning strategies. Numerous strategies were identified through empirical studies that support their use with this group of learners.[4,7,9,11,13–15] Survey results from Boctor[13] confirm that students find the action-oriented learning method of a Jeopardy game enjoyable and beneficial to learning. Boctor recommends, however, that more research be undertaken to assess learning outcomes when using a game as an active learning strategy. In regards to implementing technology in dental hygiene programs, Beebe and colleagues[9] confirm that technology improves access to learning resources and is preferred by students. The research by McCann et al. [11] also reports that students find college e-resources effective for learning. Study participants noted that e-materials would "extensively" enhance learning, such as e-lectures (59%), clinical videos (54%), and podcasts (45%).[11] The original research study by Everly[14] documents the process of incorporating new active learning strategies into a traditional lecture course. The study evaluated whether students perceived these new methods as improving their learning, as measured by survey feedback and a comparison of examination results from control and test groups. (The control group received in-class lectures, while the two test groups received content prior to class via PowerPoint, quiz at the beginning of class, and small group discussions based on case scenarios.) Using a mixed methods approach for data analysis, the author reveals that test scores were higher in the groups being taught with the innovative methods, and students perceived improved learning with active learning over lecture alone.[14] The second systematic review by Blakely and colleagues[15] also concludes that gaming as an action-oriented strategy makes a positive impact on learning and reports that it would be appropriate for teachers to continue using games as one aspect of their teaching.[15] This body of research supports the findings of many other studies stating that interactive teaching methods are not only preferred by students but can also produce better results.[3,12–17]

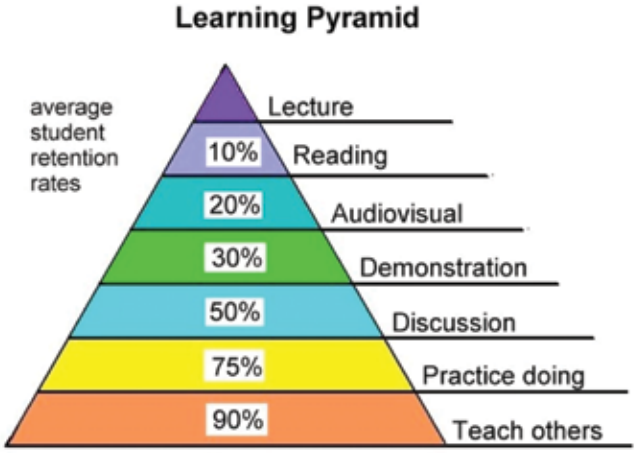
It has been reported that educators typically teach the way they have been taught.[12,16] However, with the changes in attitudes, attention span, and expectations of these Millennial learners who comprise most postsecondary students today, educators are challenged with having to adapt their teaching and leadership styles to more effectively engage these students. Findings from the systematic review by Hills et al.[12] reveal that today's students are no longer the people our educational systems were designed to teach.[12] Millennials have different expectations and learning styles than previous generations.

Traditional health care education typically consists of classroom lectures and class discussion; however, studies show that this type of learning environment can limit retention of knowledge and understanding for today's learners.[3,13] According to Herrman,[17] lectures and class discussion are not necessarily an ineffective teaching method for this group, but the research suggests that the addition of adjunctive creative strategies, such as interactive games, simulations, videos, small group activities, and larger group exercises, helps to emphasize key concepts, clarify confusing material, and reinforce ideas.[2,4,9,10,14] Story and Butts[18] suggest that, rather than simply lecturing to students, educators should invite participants to think actively about content through the use of games or activities, which would help to create a comfortable, enjoyable, and safe learning environment.[9,15] Burruss and Popkess[19] support this concept and propose that faculty "...continually think creatively as they develop interactive learning environments to foster students' successful learning" (p. 15).

Giddens and Brady[20] describe a concept-based curriculum which requires "...an active learner-centered approach" (p. 68) and therefore places responsibility and freedom to learn on the student, with educators introducing the concepts and facilitating innovative techniques for engagement and exploration, such as "flipping the classroom." Many active learning strategies present educators with the challenge of utilizing a variety of teaching styles to meet the learning needs of students today.[2–4,9,14] Gee[21] argues that students today learn best when they are exploring, manipulating, observing, using various sensory modalities, experimenting, and generating their own questions about subject matter.[19] Cekada[22] concludes that Generation Ys typically prefer to learn through visual methods such as pictures and videos, rather than reading text. These findings suggest that students are no longer satisfied with the passive learning methods employed in the past.[3] Generation Y can learn well by working in groups or teams and sharing ideas.[4,9,20] This is a demanding group that wants to be continuously entertained.[2,9,20]

In general, students today require learning activities that promote teamwork, are exciting and entertaining. and incorporate technology.[1,2,4,5,8,10–12,14] Research suggests that educators today need to develop a collaborative classroom environment for successfully reaching these learners.[1,5,10,14,17,23] In a collaborative situation, learners are more active, they master knowledge by constructing content rather than by listening passively to faculty and memorizing information, and they are also involved in their assessment decisions.[23] The Learning Pyramid developed by the National Training Laboratories in the 1960s (Figure 1) is a well-known concept for educators; research suggests that retention of material increases with

Figure 1. Learning pyramid



Source: NTL Institute for Applied Behavioral Science, 300 N. Lee Street, Suite 300, Alexandria, VA 22314 USA.

participatory active learning methods due to the extent of reflection and deep cognitive processing. It is widely cited that students remember 10% of what they hear and 20% of what they read; students involved in action-oriented activities such as problem-based learning, computer-based training and simulation, case-based learning, and other constructivist activities have much higher retention rates.[13] Experiential learning allows students to achieve more complex educational objectives on Bloom's taxonomy.[24–27] This taxonomy provides a very effective approach to formulating educational objectives using appropriate action verbs, beginning with lower level verbs such as "list" and "define," then building up to higher level verbs such as "analyse" and "evaluate." As the learning expands, a richer sense of what kinds of involvement an educator might want to target with various educational activities can also emerge.[26]

Other strategies include providing timely feedback on assignments and exams to satisfy the need for instant gratification[2,7,28]; setting goals and offering rewards for goal accomplishment[1]; and use of more innovative technology.[9,11,29] Setting challenging goals and offering rewards for goal accomplishment have been shown to be effective in motivating, empowering, and satisfying the learners of today, resulting in better performance and higher compliance.[1] This strategy focuses on both motivation of followers and provision of instant positive feedback, as suggested by Bracy et al.[28] In addition, Gaberson and Oermann explain that today's learners are accustomed to multimedia environments when seeking academic, personal, and professional growth.[9,29] Thus the use of teaching strategies involving more innovative technology should be considered in order to meet the diverse learning needs of students.

Application of these strategies for dental hygiene students

As previously stated, understanding the characteristics of the Generation Y learner will help educators diversify their teaching strategies to meet the needs of these more contemporary students. However, not all Millennials have the same learning style, thus, numerous strategies should be employed to best meet the learning needs of all students.

Technology

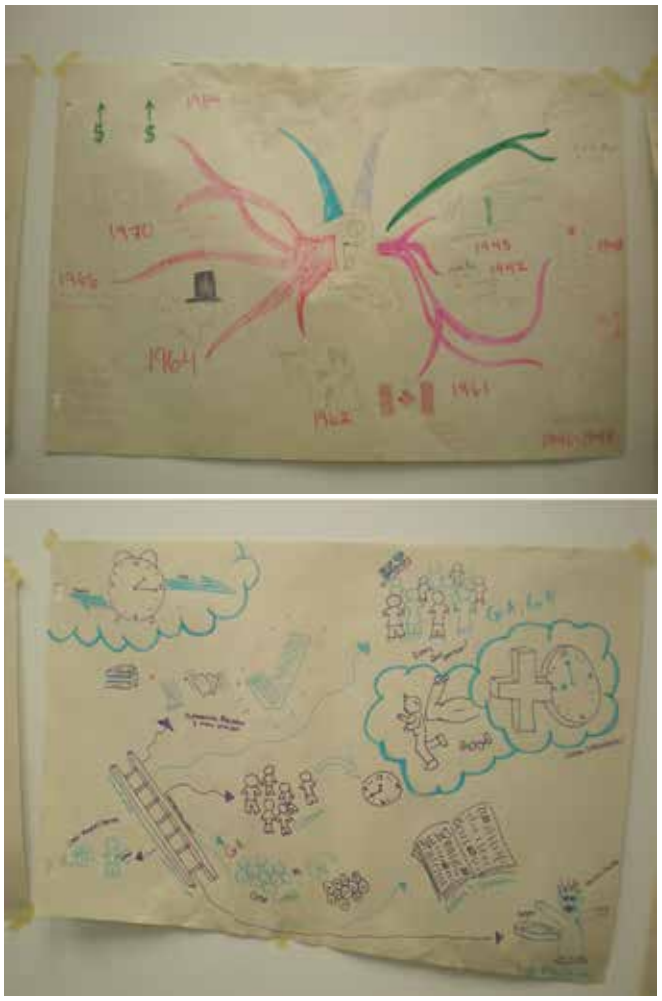
Although all of these general strategies apply to dental hygiene education, there are a variety of ways in which they can be more specifically customized. Technology, such as digital radiography, computer software for dental and periodontal charting, use of intraoral video, paperless charts, electronic billing, e-textbooks, and classroom clickers, etc., are tools that Generation Y students could easily relate to and use.[9] Because today's students live in an online world, they have come to expect electronic resources to be as readily accessible in their education as in other areas of their lives.[11] Students expect to customize their learning experiences with e-resources; this intense involvement with their materials is when learning has been shown to take place.[11] Millennials prefer a variety of active learning methods incorporated into the curriculum to help them learn.[3,8] Educators need to be constantly changing their methods, for example, from lecture to discussion, to watching a video, to group work, in order to hold the attention of Millennials.[8] Dental hygiene faculty could incorporate different electronic teaching and learning techniques within the classroom, such as PowerPoint, Prezi, blogs, video assignments, Moodle, and clickers.

Service-learning experiences

As further illustration of this generation's group orientation and desire to make a difference in the world, Millennials also enjoy participating in community activities.[4] Dental hygiene students are unique in that a large part of their education has traditionally involved "real-life" practice. This generation in particular enjoys involvement with "real-life" issues that matter to them and thus enjoy participating in volunteer or service-learning experiences.[2,4,24] Although this may seem like a new approach in education, the philosophy of service learning is rooted in the ideas of Dewey and Kolb.[24] Dewey believed that the student needs to be an active participant in learning and to address social issues.[27] Regarding the nature of experience, Dewy wrote: "when we experience something we act on it, we do something with it, then we suffer the consequences" (p. 164).[27] It is perhaps from the consequences that the learner is then forced to reflect upon these experiences and learn from them. In addition, Kolb's theory states that the impetus for the development of new concepts is provided by new experiences.[26] He believed that "learning is the process whereby knowledge is created through the transformation of experience" (p. 38).[26]

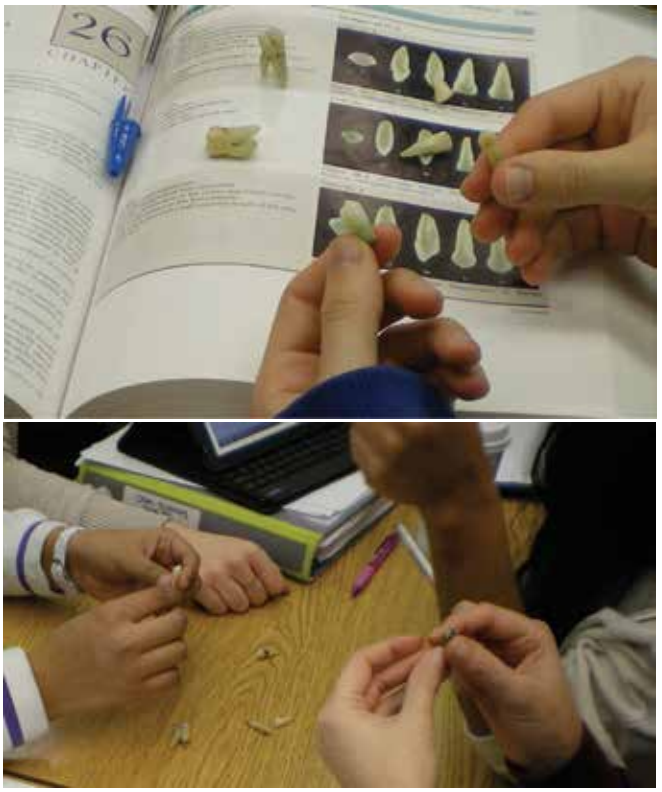
Examples of service learning activities in dental hygiene programs include participating in a community fluoride varnish project for high caries risk populations,

Figure 2. Examples of student mind mapping exercises



Source: College of New Caledonia, Prince George, British Columbia, Canada

Figure 3. Tooth anatomy visualization exercise



Source: College of New Caledonia, Prince George, British Columbia, Canada

organizing and implementing a cancer screening event, providing education to various community social groups or setting up a mobile dental hygiene service at a long-term care facility or for homeless people.

Mind mapping

Other action-oriented teaching strategies that could be adapted for dental hygiene students in the classroom include mind mapping (Figure 2), games, puzzles and crosswords, simulations, role playing, videos, debating, case-based learning, face painting to teach the muscles of facial expression, and hands-on visualization for teaching dental anatomy (Figure 3).

A mind map is a pictorial representation of hierarchical information, which includes a central idea surrounded by connected branches of associated topics.[30] It is a visual form of note taking that offers an overview of a topic and its complex components, allowing students to comprehend, create new ideas, and build connections. Through the use of colours, images, and words, mind mapping encourages students to begin with a central idea and expand outward to more in-depth sub-topics. Mind maps also provide teachers with insight into their students' thought processes regarding a specific topic. By asking students to create mind maps, teachers are able to understand what a student's prior knowledge is and how well the student understands the assignment or the material being taught. This is a very effective way of evaluating students'comprehension.[30]

Games and puzzles

The adoption of games as an educational strategy is also becoming very popular in classroom teaching as an alternate method of student engagement.[31,32] Crosswords have also appeared in medical and nursing journals as a means of reviewing and summarizing information in an engaging manner. It is claimed that crosswords expand the vocabulary and stimulate the mind.[32] Crossword puzzles and word search puzzles could be developed as a fun class activity to assist in learning.

Simulations and debates

Simulations are instructional scenarios in which the learner is placed in a world defined by the teacher.[33] They represent a reality within which students interact. The teacher controls the parameters of this "world" and uses it to achieve the desired instructional results. Students experience the reality of the scenario and gather meaning from it. A simulation is a form of experiential learning. It is a strategy that fits well with the principles

of student-centred learning and teaching, and promotes critical and evaluative thinking.[33] Debating is another effective method of student interaction used by dental hygiene educators. Though logical consistency, factual accuracy, and some degree of emotional appeal to the audience are important elements of the art of persuasion, in debating, one side often prevails over the other side by presenting a superior perspective of the issue.[34] Debating as an assignment is a great way of promoting active learning and teamwork in the classroom.

Case-based learning

Case-based learning or problem-based learning has been employed in the education of health professionals for decades. It is an effective method of stimulating classroom discussion and collaborative analysis.[35] Case teaching involves the interactive, student-centred exploration of realistic, complex, and specific situations.[35,36]

FUTURE RESEARCH

This review revealed that, despite all of these suggested action-oriented strategies to choose from, there is a gap in the literature regarding which of these strategies are the most effective. Additionally, it is unknown why some educators are unmotivated to change their teaching methods to better accommodate the new learners from Generation Y. It could also be argued that older generations have always criticized younger generations and that further evidence from longitudinal studies is required to verify the existence of these generational differences.[37] Other questions that remain unanswered include the following:

- Are all students the same?
- Is the label "Generation Y" an unhelpful stereotype?
- Are all Generation Y students technologically savvy?
- Do all students fit the Generation Y age category?
- Is it possible that all students, regardless of age, would prefer more action-oriented learning?[38]

Further research is required to answer these questions.

CONCLUSION

The characteristics of Generation Y students differ from previous generations and, therefore, the teaching strategies that may have worked in the past may not necessarily work as effectively now. Learning about each new generation and being open to new ideas for teaching will help educators engage and connect with each new generation. The evidence suggests that, to best engage Generation Y or Millennial learners, educators must incorporate action-oriented teaching strategies (such as interactive activities, providing information in shorter segments as well as creating more experiential activities) into their teaching to enhance learning. When instructors implement a variety of action-oriented educational strategies, learning is enriched, not only for Generation Y learners, but for the educator. Additionally, because Generation Y students have assimilated technology into their daily lives, new educational approaches that incorporate technology would accommodate these different learning preferences. Additional research is necessary for determining exactly which action-oriented educational approaches are preferred by Generation Y learners, and more studies are required to understand why some educators are reluctant to change their teaching styles to accommodate these new learners.

ACKNOWLEDGEMENTS

I would like to thank the College of New Caledonia for permitting the publication of classroom images in this article. I would also like to thank Jason Battersby for his patience and support during this writing and editing process for publication.

REFERENCES

1. Daft R. *The leadership experience*. 6th ed. Stamford, CT: Cengage Learning; 2015.
2. Evans L, Hanes P. Online cultural competency education for Millennial dental students. *J Dent Educ*. 2014;78(6):867–76.
3. Pew Research Center. *The Millennials: Confident. Connected. Open to change* [executive summary]. Washington, DC: Pew Research Center; 2010 [cited 2016 Nov 20]. Available from: www.pewsocialtrends.org/2010/02/24/millennials-confident-connected-open-to-change/
4. Blue CM. Do dental hygiene students fit the learning profile of the Millennial student? *J Dent Educ*. 2009;73(12):1372–78.
5. Werth EP, Werth L. Effective training for Millennial students. *Adult Learning*. 2011;22(3):12–19.
6. Mayhew B. Multigenerational differences [Internet]. Available from: www.brucemayhewconsulting.com/best-ideas-2/
7. Henry RK. A comparison of Millennial dental hygiene student and faculty classroom expectations. *J Dent Hyg*. 2011;85(3):229–39.
8. Price C. "Why don't my students think I'm groovy?" The new Rs for engaging Millennial learners. *Essays Excellence Teach*. 2010;9:29–34.
9. Beebe C, Gurenlian J, Rogo E. Educational technology for Millennial dental hygiene students: A survey of US dental hygiene programs. *J Dent Hyg*. 2014;78(6):838–50.
10. Twenge J. Generational changes and their impact in the classroom: Teaching Generation Me. *Med Educ*. 2009;43:398–405. doi:10.1111/j.1365-2923.2009.03310.x

11. McCann A, Schneiderman E, Hinton R. E-teaching and learning preferences of dental and dental hygiene students. *J Dent Educ.* 2010;74(1):65–78.
12. Hills C, Levett-Jones T, Lapkin S, Warren-Forward H. Generation Y health professional students' preferred teaching and learning approaches: A systematic review. *The Open Journal of Occupational Therapy.* 2017;5(1):Article 12. Available from: http://dx.doi.org/10.15453/2168-6408.1278(1, Article 12). doi: 10.15453/2168-6408.1278
13. Boctor L. Active-learning strategies: The use of a game to reinforce learning in nursing education. A case study. **Nurse Educ Pract.** 2013:13(2):96–100. doi:http://dx.doi.org/10.1016/j.nepr.2012.07.010
14. Everly MC. Are students' impressions of improved learning through active learning methods reflected by improved test scores? *Nurse Educ Today.* 2013;33:148–51.
15. Blakely G, Skirton H, Cooper S, Allum P, Nelmes P. Educational gaming in the health sciences: systematic review. *J Adv Nurs.* 2009 Feb;65(2):259–69.
16. Royse MA, Newton SE. How gaming is used as an innovative strategy for nursing education. *Nurs Educ Perspec*t. 2007;28(5):263–67.
17. Herrman JW. Keeping their attention: Innovative strategies for nursing education. *J Cont Educ Nurs.* 2011;42(10):449–56.
18. Story L, Butts JB. Compelling teaching with the four Cs: Caring, comedy, creativity and challenging. *J Nurs Educ.* 2010;49(5):291–94.
19. Burruss N, Popkess A. The diverse learning needs of students. In DM Billings & JA Halstead, editors. *Teaching in nursing: A guide for faculty.* St. Louis, MO: Saunders; 2012. pp 15–33.
20. Giddens JF, Brady DP. Rescuing nursing education from content saturation: The case for a concept-based curriculum. *J Nurs Educ.* 2007;46(2):65–69.
21. Gee JP. *Good video games + good learning.* Collected essays on video games, learning and literacy. New York: Peter Lang Publishing, Inc; 2007.
22. Cekada TL. Training a multigenerational workforce. *Professional Safety.* 2012;57(3):40–44.
23. Kane KO, Harms J. *Getting started: A guide to collaboration in the classroom.* Honolulu, HI: Center for Teaching Excellence, University of Hawaii at Mānoa; n.d. Available from: www.cte.hawaii.edu/publications/Collab_web.pdf
24. Lautar CJ, Miller FY. Service learning and dental hygiene: A literature review. *J Dent Hyg.* 2007;81(3):64.
25. McLeod SA. Kolb—Learning styles [Internet]. Simply Psychology website, updated 2013. Available from: www.simplypsychology.org/learning-kolb.html
26. Kolb DA. *Experiential learning: Experience as the source of learning and development,* Vol. 1. Englewood Cliffs, NJ: Prentice-Hall; 1984.
27. Dewey J. Experience and thinking. In: *Democracy and education.* New York: The Macmillan Company; 1916. pp 163–78 [cited 2006 Dec 22]. Available from: https://en.wikisource.org/wiki/Democracy_and_Education/Chapter_XI#The_Nature_of_Experience
28. Bracy C, Brevill S, Roach T. The millennial generation: Recommendations for overcoming teaching challenges. *Proceedings of the Academy of Educational Leadership.* Allied Academies International Conference, Las Vegas. 2010;15(2).
29. Gaberson KB, Oermann MH. V*irtual reality and game-based clinical education. Clinical teaching strategies in nursing,* 3rd ed. New York: Springer Publishing Company; 2010. pp 183–212.
30. Mind mapping [Internet] [cited 2016 Nov 20]. Available from: http://www.mindmapping.com/
31. Henderson D. Games: Making learning fun. In MH Oermann & KT Heinrich, editors. *Annual review of nursing education: Strategies for teaching, assessment and program planning.* New York, NY: Springer Publishing Company; 2005. pp. 165–83.
32. Saxena A, Nesbitt R, Pahwa P, Mills S. Crossword puzzles: Active learning in undergraduate pathology and medical education. *Arch Pathol Lab Med.* 2009;133(9):1457–62.
33. Merriam-Webster online, .s.v. "simulation" [cited 2016 Nov 20]. Available from: www.merriam-webster.com/dictionary/simulation
34. Free Dictionary.com, s.v. "debating" [cited 2016 Nov 200. Available from: www.thefreedictionary.com/debating.
35. Centre for Teaching and Learning, Queen's University. *Case-based learning* [Internet] [cited 2016 Nov 20]. Available from: www.queensu.ca/ctl/what-we-do/teaching-and-assessment-strategies/case-based-learning
36. Popil I. Promotion of critical thinking by using case studies as teaching method. *Nurse Educ Today.* 2011;31(2):204–207.
37. Bennett S, Maton K, Kervin L. The "digital natives" debate: A critical review of the evidence. *Br J Educ Technol.* 2008;39(5):775–86. doi: 10.1111/j.1467-8535.2007.00793.x
38. Sternberg J. "It's the end of the university as we know it (and I feel fine)": The Generation Y student in higher education discourse. *Higher Educ Res Dev.* 2012;31(4):571–83. doi: 10/1080/07294360.2011.55919

CJDH STUDENT ESSAY AWARD

In 2016, the editorial board of the *Canadian Journal of Dental Hygiene* launched an essay award competition for dental hygiene students in their 2nd, 3rd or 4th year of a Canadian diploma or baccalaureate program. This competition, proudly sponsored by PHILIPS Sonicare, encourages students to develop a love for writing and research and to recognize the possibilities that such endeavours offer for personal and professional growth. The editorial board is delighted to publish the winning entry from its inaugural competition. The essay below ably addresses the Canadian Dental Hygienists Association's 2015–2018 dental hygiene research agenda category of "risk assessment and management."

Implications of xerostomia and caries in community-dwelling older adults

Hazel Joyce Manlapaz*, DipDH, RDH

INTRODUCTION

Aging refers to the biological changes that occur over a life time.[1] The health-related changes that people experience as they grow older can be correlated to the cumulative trauma on the cells and molecules over time.[1] In recent years, there has been an increasing number of studies examining the health care of elderly people due to their ever-growing demands for health care services. In Canada, the population of older adults (ages 65 and older) increased by 29.1% between 2006 and 2011, making it the most rapidly growing population group in the country.[2] In fact, there are more Canadians over 65 years of age than under 14 years of age for the first time in history.[3] This increase in the population of older adults necessitates that health care professionals respond to the needs of Canada's aging population. The health and socioeconomic status of older adults, as well as their diverse cultural and educational backgrounds must be considered when providing oral care.[4] Furthermore, 80% of elderly people are living in private homes in urban areas (community dwelling) while the remainder live in health care-related facilities.[4,5] As a result, oral health care professionals need to provide individualized care for a diverse population of older adults, each with unique health needs.

Generally speaking, the ability of the body to respond to environmental stimuli and maintain optimal health declines as individuals grow older.[6] In recent years, life expectancy has increased along with improvements in general well-being, due in large part to medical advancements.[4,7] However, having a longer life implies that the likelihood of developing chronic diseases increases over an individual's life span.[4] Some of the chronic diseases that are commonly seen in older adults include cardiovascular diseases, chronic pulmonary obstructive disease, pneumonia, arthritis, and diabetes mellitus.[4,6,8]

There are physiological changes related to aging, including changes in oral health and immune functions, which increase the risk of developing acute and chronic diseases.[6] Many changes to oral health are associated with systemic diseases and the medications prescribed for the treatment of these diseases.[6] Frequently, oral health takes a back seat to other health concerns that are viewed as more important. However, oral health is crucial for quality of life (QOL) in that it plays a role in nutrition, socialization, emotional state, daily functioning, and life satisfaction.[9] People are now keeping their teeth longer, which thereby decreases edentulism rates for this age group.[8] However, longer retention of the dentition is not the only factor that determines older adults' oral health-related quality of life (OHRQOL).[8] Reduced salivary flow (hyposalivation) can also influence the OHRQOL among older adults.[8] The reduction in salivary flow negatively impacts the oral mucosa as it can lead to difficulty swallowing, chewing, speaking, and oral discomfort.[7] In addition to its effect on daily functioning, hyposalivation increases the risk of developing oral diseases, such as candidiasis, and for those retaining their teeth, periodontal diseases and caries.[7,10]

To improve the QOL of community-dwelling older adult clients, oral health care professionals should focus on early intervention.[8] Using age-specific assessment tools will facilitate the provision of quality oral health care services for the members of this age group.[7] Comprehensive examination tools should include all factors that apply to older adults, as they have different needs compared to other age groups.

This essay reviews the literature on oral health-related changes associated with aging among community-dwelling older adults ages 65 to 75. Specifically, the essay focuses on salivary flow changes, caries risk, and assessment tools

*Alumna, School of Dental Hygiene, College of Dentistry, University of Manitoba, Winnipeg, MB, Canada

Correspondence: Hazel Manlapaz; manlapazhazeljoyce@yahoo.com

that can be adapted in practice to facilitate the prevention and early detection of oral conditions that may impact QOL. A search was conducted on PubMed and in the American Dental Association Center for Evidence-Based Dentistry database (http://ebd.ada.org/en/evidence/evidence-by-topic) for studies and publications that provide evidence of oral health changes among community-dwelling older adults and their implications for dental hygiene practice.

AGING AND SALIVARY FLOW

Saliva is essential for speech, chewing, and digestion.[6,7] It plays a vital role in maintaining the integrity of the oral cavity by providing lubrication as well as antimicrobial effects.[6,7,11] Additionally, saliva helps to maintain the stability of the dentition by remineralizing enamel through provision of minerals such as calcium and phosphate ions.[11] A decrease in salivary flow can affect oral health and QOL as it can increase the risk of caries, periodontal diseases, and candidiasis, and lead to discomfort and difficulty chewing and swallowing.[6-8,11,12] A decline in the cellular functions that occurs as part of the aging process can impact the quality and quantity of saliva.[6,11,13] Among community-dwelling older adults, reduction of salivary flow (hyposalivation) is one of the factors that negatively influences their OHRQOL.

According to a literature review and a cross-sectional study there are significant reductions in the whole saliva, submandibular, and sublingual salivary flow rates among older adults compared to younger individuals.[11,14] These changes were thought to be associated with a decrease in the function of the salivary gland. Reductions in both stimulated and unstimulated whole saliva, as well as submandibular and sublingual salivary flow rates, were found to be related to the process of aging.[11] A cross-sectional study on 540 adults also reported age-related changes in salivary flow among older adults.[14] Another cross-sectional study found that, in comparison to young and middle-aged adults, older adults have lower stimulated salivary flow rates.[15] These results support the hypotheses that salivary flow decreases as a consequence of aging and that age-related hyposalivation is one of the factors contributing to xerostomia among older adults.[11,14,15]

In addition to the impact of aging on salivary flow, there is strong evidence that hyposalivation leading to xerostomia is secondary to systemic conditions and the medications used to treat them.[8] Older adults are more likely to be taking multiple medications compared to the rest of the population.[13,16,17] Xerostomia has been reported as a side effect of systemic medications. A cross-sectional study found that the prevalence of xerostomia among the participants who were taking at least one medication was 28%, compared to 7.5% for those who were not taking medications.[18] In that study, medication exposure was deemed to have a stronger association to xerostomia than age or gender.[18] This finding was confirmed in another cross-sectional study on the impact of medication on salivary flow among older adults, which contributes to the feeling of dryness in their mouth.[18,19] Age, gender, and edentulism appear to have less of an effect on xerostomia than medications.[19] Furthermore, a longitudinal study found that exposure to aspirin and antidiuretics contributes to xerostomia.[20] In addition, anticholinergic agents were found to be associated with xerostomia.[13,16]

When examining the evidence in the literature, there are conflicting findings regarding whether or not salivary flow decreases with age alone. As noted earlier, there are factors other than the aging process that are significantly associated with a dry mouth. Medication is strongly associated with these changes, more so than the process of aging alone. Individuals who are on medications are more likely to experience reduction in salivary flow, which contributes to xerostomia.[18,19] Regardless of the cause, the significant reduction in the salivary flow found in older adults contributes to a decline in their quality of life.[11-20] In order to pinpoint the impact of aging on salivary flow among community-dwelling older adults, more research is needed.

The number of older adults who experience dry mouth is steadily increasing as a consequence of improved life expectancy. This situation puts more demand on oral health professionals as they need to respond to an increasing number of clients with dry mouth. Effective assessment and management should be adapted for older adult clients to ensure enhancement of their QOL.[21,22]

AGING AND CARIES RISK

An issue that is gaining more attention in the literature is the prevalence of caries among older adults. According to the Public Health Agency of Canada, "96% of adults have had a history of cavities."[23] The presence of caries is one of the factors that contributes to the decline in QOL for this age group. Some of the risk factors associated with caries development include history of caries, presence of plaque, gingival recession, systemic diseases, salivary flow, fluoride sources, acid challenge, and smoking.[8,24-27] The presence of these factors may not only increase the individual's caries risk but also affect the health of the periodontium in general. It is important for oral health professionals to be aware of all the factors that contribute to an increased caries risk among older adults. Emphasis on prevention and early detection is essential in order to maintain or improve QOL.

A literature review revealed that older adults are a more caries-active group compared to adolescents.[24] The explanation given was that older adults tend to develop more caries due to the use of prosthodontic appliances. Specifically, the use of a partial denture was reported to have caused the difference in caries incidence between adolescents and older adults.[24] This study found, moreover, that older adults experience more coronal caries than root surface caries.[24]

In contrast, many other studies report a higher prevalence of root surface caries among older adults.[25-29] Furthermore, a longitudinal study concluded that there is a high prevalence of root caries among older individuals living independently.[25] In particular, it was reported that 53.3% of the study participants had at least one filled or root surface with a carious lesion, and 25.7% had at least one root caries.[25] Another study found that older adults have a higher risk of developing root surface caries due to significant gingival recession found in this age group.[26] International studies of the incidence and prevalence of root surface caries in countries such as India, Sri Lanka, China, and Sweden also support these findings.[27-30] Specifically, these studies indicate that the risk of root caries increases with age in the presence of predisposing factors such as hyposalivation, recession, and plaque.[28-30] This being said, the presence of multiple predisposing factors determines the likelihood of caries development among older adults.

There is strong evidence documenting the high prevalence of root surface caries in older adults. However, the prevalence of root caries is not a consequence of aging alone. In addition to the predisposing factors mentioned earlier, other factors such as cumulative damage to the periodontium may contribute to root caries.[6,20] The use of appropriate assessment tools will allow early detection of oral conditions found in the older population.

ASSESSMENT TOOLS

Older adults have different human needs deficits from the rest of the population. The use of a comprehensive oral health assessment tool will allow clinicians to provide care specific to each client's needs provided that the clinicians consider the client's systemic health and the factors that may affect their QOL.

The Geriatric Oral Health Assessment Index (GOHAI) is an assessment tool designed for geriatric clients "to assess oral health status on two-levels: the patient level and the population level."[31] It can be used by both dental and non-dental health care providers to facilitate the assessment of older adults' QOL and the need for referral to other health professionals such as dietitians, speech language pathologists, and medical doctors.[31] According to a cross-sectional study, in comparison to the Oral Health Impact Profile (OHIP), the GOHAI was found to have more sensitivity in terms of assessing the impact of occlusal and masticatory forces on the participants' QOL.[32] Additionally, several cross-sectional studies also favoured the GOHAI over the OHIP because of its sensitivity in assessing decayed, missing and filled (DMF) teeth as well as the need for dental care.[33,34] Although both GOHAI and OHIP were found to be valid and reliable assessment tools when used in community-dwelling older adults, the GOHAI provides more comprehensive assessment findings than the OHIP.[32-34] Specifically, it measures the person's ability to chew and swallow, any concerns with teeth or dentures in relation to speech, psychosocial limitations, pain, and discomfort.[31] GOHAI facilitates the gathering of data on physiological, functional, psychological, and social symptoms that impact QOL (Table 1). With the information gathered through this assessment tool, clinicians can make decisions that may include referral to specialists.

Table 1. Geriatric Oral Health Assessment Index (GOHAI)

Item In the past three months...	1 (always, often)	2 (sometimes, seldom)	3 (never)
How often did you limit the kinds or amounts of food you eat because of problems with your teeth or dentures?			
How often did you have trouble biting or chewing any kinds of food, such as firm meat or apples?			
How often were you able to swallow comfortably?			
How often have your teeth or dentures prevented you from speaking the way you wanted?			
How often were you able to eat anything without feeling discomfort?			
How often did you limit contacts with people because of the condition of your teeth or dentures?			
How often were you pleased or happy with the looks of your teeth and gums, or dentures?			
How often did you use medication to relieve pain or discomfort from around your mouth?			
How often were you worried or concerned about the problems with your teeth, gums, or dentures?			
How often did you feel nervous or self-conscious because of problems with your teeth, gums, or dentures?			
How often did you feel uncomfortable eating in front of people because of problems with your teeth or dentures?			
How often were your teeth or gums sensitive to hot, cold, or sweets?			

Source: Atchinson K, Dolan T. Development of the Geriatric Oral Health Assessment Index.[31]

CLINICAL IMPLICATIONS FOR THE DENTAL HYGIENIST

Oral health professionals should aim for disease prevention and management.[5] Utilization of a comprehensive assessment tool will allow early detection of oral health-related problems among older adults. The use of age-specific assessment tools such as the GOHAI can guide the decision-making process when planning needed care. Improving QOL for older adults can be challenging due to the heterogeneity of the members of this age group. Each individual is different. The factors that determine a client's health should be considered critically by dental hygienists when building client-specific care plans. In addition, the presence of multiple factors such as medication use, systemic health conditions, gingival recession, history of caries, and hyposalivation should always be given consideration when providing care for older adults. For instance, the prevention of caries can be facilitated by managing the factors associated with it through oral health education, use of a saliva substitute or stimulator for clients with xerostomia, in-office and at-home fluoride applications, and nutritional counselling for those who have a high-sugar diet.[13,20,35]

Based on the 2010 Canadian Health Measures Survey results, 53% of Canadians ages 60 to 79 years do not have any dental insurance.[23] Having no dental insurance may act as a barrier to oral care for older adults in need. Cost-effective interventions should be used to ensure that their QOL does not decline due to financial barriers. For example, the atraumatic restorative treatment (ART) technique can be a cost-effective caries management intervention for community-dwelling older adults who are having financial difficulties as it offers a temporary and sometimes permanent solution to active caries. ART involves the removal of the infected carious tooth structure with hand instruments and the application of a highly viscous fluoride-releasing glass-ionomer in the cavity.[36,37] This approach is widely used for the management of caries in children, clients with anxiety, and those with special needs.[37] Using ART could facilitate the management of carious lesions among older adults, especially since it does not require a large quantity of dental materials, equipment or extensive training to achieve acceptable results.

Another cost-effective intervention that can be used with older adults is silver diamine fluoride (SDF). The silver component works as an antimicrobial agent while the fluoride functions as a remineralizing agent.[38] SDF is effective in the management of both carious lesions and dentin hypersensitivity.[38] It was reported to be effective in arresting root surface caries in older adults.[39,40] It was also found to be most effective in preventing new and arresting current root caries when applied annually.[39] In fact, it was approved by the Food and Drug Administration (FDA) and made available in the United States in April 2015, and has now been approved for use in Canada by Health Canada.[40,41] SDF can potentially facilitate caries prevention and management in Canadian older adults in a cost-effective manner. However, the side effects of SDF include darkening of carious lesions and a metallic or bitter taste in the mouth.[38] Clinicians need to inform their clients of the advantages and disadvantages of SDF and make decisions with the clients' best interest in mind.

CONCLUSION

Oral health changes in older adults affect their QOL. The process of aging is associated with a decline in cellular functions. However, many of the reported oral health changes seen in older adults are secondary to systemic diseases and the medications used to treat them. In particular, there are inconsistencies in the explanations for the prevalence of hyposalivation and xerostomia in older adults. Furthermore, there is strong evidence that supports the high prevalence of root surface caries among older adults. Nevertheless, the changes in the oral health of older adults significantly alter their QOL, and it is the oral health professional's role to help their clients improve their QOL. There is a pressing need to focus on the prevention of oral diseases now that people have a higher life expectancy and are retaining their teeth longer. The etiology of age-related oral health changes and their management should be given more attention in the literature. Overall, oral health professionals play a vital role in helping older adults to achieve their optimal well-being and maintain their QOL through the prevention and management of oral–systemic conditions.

ACKNOWLEDGEMENTS

I thank my mentors, Professor Mary Bertone, Dr. Robert Schroth, and Mickey Emmons Wener, for providing me with insights and feedback that helped me write this literature review.

REFERENCES

1. World Health Organization. Ageing and health [Internet]. Geneva: World Health Organization; 2015 [cited 2017 Jan 16]. Available from: www.who.int/mediacentre/factsheets/fs404/en/
2. Statistics Canada. The Canadian population in 2011: Age and sex [Internet]. Ottawa: Statistics Canada; 2015 [cited 2016 Dec 30]. Available from: https://www12.statcan.gc.ca/census-recensement/2011/as-sa/98-311-x/98-311-x2011001-eng.cfm
3. Statistics Canada. The Daily — Canada's population estimates: Age and sex, July 1, 2015 [Internet]. Ottawa: Statistics Canada; 2017 [cited 26 April 2017]. Available from: www.statcan.gc.ca/daily-quotidien/150929/dq150929b-eng.htm
4. Public Health Agency of Canada. Chapter 3: The Health and well-being of Canadian Seniors - The chief public health officer's report on the state of public health in Canada 2010 - Public health agency of Canada [Internet]. Public Health Agency of Canada; 2010 [cited 2017 Jan 16]. Available from: www.phac-aspc.gc.ca/cphorsphc-respcacsp/2010/fr-rc/cphorsphc-respcacsp-06-eng.php
5. Schoenborn C, Heyman K. Health characteristics of adults aged 55 years and over: United States, 2004–2007. *Natl Health Stat Reports.* 2009 Jul;(16):1–31.
6. Abrams A, Thompson L. Physiology of aging of older adults: Systemic and oral health considerations. *Dent Clin North Am.* 2014 Oct;58(4):729–38. doi: 10.1016/j.cden.2014.06.002.
7. Batchelor P. The changing epidemiology of oral diseases in the elderly, their growing importance for care and how they can be managed. *Age and Ageing.* 2015 Nov;44(6):1064–1070. doi: 10.1093/ageing/afv148.
8. Lamster I. Geriatric periodontology: How the need to care for the aging population can influence the future of the dental profession. *Periodontol 2000.* 2016 Oct;72(1):7–12. doi: 10.1111/prd.12157.
9. Sischo L, Broder H. Oral health-related quality of life: What, why, how, and future implications. *J Dent Res.* 2011 Nov;90(11):1264–270. doi: 10.1177/0022034511399918.
10. Ouanounou A. Xerostomia in the geriatric patient: Causes, oral manifestations, and treatment. *Compend Contin Educ Dent.* 2016 May;37(5):306–311.
11. Affoo R, Foley N, Garrick R, Siqueira W, Martin R. Meta-analysis of salivary flow rates in young and older adults. *J Am Geriatr Soc.* 2015 Oct;63(10):2142–151. doi: 10.1111/jgs.13652.
12. Hopcraft M, Tan C. Xerostomia: an update for clinicians. *Aust Dent J.* 2010 Sep;55(3):238–44. doi: 10.1111/j.1834-7819.2010.01229.x.
13. Gupta A, Epstein J, Sroussi H. Hyposalivation in elderly patients. *J Can Dent Assoc.* 2006 Nov;72(9):841–46.
14. Pedersen W, Schubert M, Izutsu K, Mersai T, Truelove E. Age-dependent decreases in human submandibular gland flow rates as measured under resting and post-stimulation conditions. *J Dent Res.* 1985 May;64(5):822–25.
15. Smith C, Boland B, Daureeawoo Y, Donaldson E, Small K, Tuomainen J. Effect of aging on stimulated salivary flow in adults. *J Am Geriatr Soc.* 2013 May;61(5):805–808. doi: 10.1111/jgs.12219
16. Turner M, Ship J. Dry mouth and its effects on the oral health of elderly people. *J Am Dent Assoc.* 2007 Sep;138 Suppl:15S–20S.
17. Van Lancker A, Verhaeghe S, Van Hecke A, Vanderwee K, Goossens J, Beeckman D. The association between malnutrition and oral health status in elderly in long-term care facilities: A systematic review. *Int J Nurs Stud.* 2012 Dec;49(12):1568–581. doi: 10.1016/j.ijnurstu.2012.04.001.
18. Field E, Fear S, Higham S, Ireland R, Rostron J, Willetts R, et al. Age and medication are significant risk factors for xerostomia in an English population, attending general dental practice. *Gerodontology.* 2001 Jul;18(1):21–24.
19. Loesche W, Bromberg J, Terpenning M, Bretz W, Dominguez B, Grossman N, et al. Xerostomia, xerogenic medications and food avoidances in selected geriatric groups. *J Am Geriatr Soc.* 1995 Apr;43(4):401–407.
20. Thomson W, Spencer A, Slade G, Chalmers J. Is medication a risk factor for dental caries among older people? *Community Dent Oral Epidemiol.* 2002 Jun;30(3):224–32.
21. Villa A, Connell C, Abati S. Diagnosis and management of xerostomia and hyposalivation. *Ther Clin Risk Manag.* 2014 Dec;11:45–51. doi: 10.2147/TCRM.S76282.
22. Wiener R, Wu B, Crout R, Wiener M, Plassman B, Kao E, et al. Hyposalivation and xerostomia in dentate older adults. *J Am Dent Assoc.* 2010 Mar;141(3):279–84.
23. Public Health Agency of Canada. Chronic diseases in Canada [Internet]. Ottawa: Public Health Agency of Canada; 2010 [cited 2017 Feb 9]. Available from: www.phac-aspc.gc.ca/publicat/hpcdp-pspmc/30-4/preface2-eng.php
24. Thomson W. Dental caries experience in older people over time: What can the large cohort studies tell us? *Br Dent J.* 2004 Jan;196(2):89–92.
25. Hayes M, Da Mata C, Cole M, McKenna G, Burke F, Allen P. Risk indicators associated with root caries in independently living older adults. *J Dent.* 2016;51:8–14. doi: 10.1016/j.jdent.2016.05.006.
26. Sugihara N, Maki Y, Okawa Y, Hosaka M, Matsukubo T, Takaesu Y. Factors associated with root surface caries in elderly. *Bull Tokyo Dent Coll.* 2010;51(1):23–30.
27. Bharateesh JV, Kokila G. Association of root caries with oral habits in older individuals attending a rural health centre of a dental hospital in India. *J Clin Diagn Res.* 2014 Nov;8(11):ZC80–ZC82. doi: 10.7860/JCDR/2014/8771.5165.
28. Kularatne S, Ekanayake L. Root surface caries in older individuals from Sri Lanka. *Caries Res.* 2007;41(4):252–56.
29. Liu L, Zhang Y, Wu W, Cheng M, Li Y, Cheng R. Prevalence and correlates of dental caries in an elderly population in Northeast China. *PLoS One.* 2013 Nov;8(11):e78723. doi: 10.1371/journal.pone.0078723.
30. Fure S. Ten-year cross-sectional and incidence study of coronal and root caries and some related factors in elderly Swedish individuals. *Gerodontology.* 2004 Sep;21(3):130–40.
31. Atchinson K, Dolan T. Development of the Geriatric Oral Health Assessment Index. *J Dent Educ.* 1990 Nov;54(11):680–87.
32. Ikebe K, Hazeyama T, Enoki K, Murai S, Okada T, Kagawa R, et al. Comparison of GOHAI and OHIP-14 measures in relation to objective values of oral function in elderly Japanese. *Community Dent Oral Epidemiol.* 2012 Oct;40(5):406–414. doi: 10.1111/j.1600-0528.2012.00683.x.

33. El Osta N, Tubert-Jeannin S, Hennequin M, Bou Abboud Naaman N, El Osta L, Geahchan N. Comparison of the OHIP-14 and GOHAI as measures of oral health among elderly in Lebanon. *Health Qual Life Outcomes.* 2012 Oct;10(1):131. doi: 10.1186/1477-7525-10-131.
34. Rodakowska E, Mierzyńska K, Bagińska J, Jamiołkowski J. Quality of life measured by OHIP-14 and GOHAI in elderly people from Bialystok, north-east Poland. *BMC Oral Health.* 2014 Aug;14:106. doi: 10.1186/1472-6831-14-106.
35. Gil-Montoya J, Silvestre F, Barrios R, Silvestre-Rangil J. Treatment of xerostomia and hyposalivation in the elderly: A systematic review. *Med Oral Patol Oral Cir Bucal.* 2016 May;21(3):e355–e366.
36. Frencken J, Leal S, Navarro M. Twenty-five-year atraumatic restorative treatment (ART) approach: A comprehensive overview. *Clin Oral Investig.* 2012 Oct;16(5):1337–346. doi: 10.1007/s00784-012-0783-4.
37. Holmgren C, Roux D, Doméjean S. Minimal intervention dentistry: part 5. Atraumatic restorative treatment (ART)—a minimum intervention and minimally invasive approach for the management of dental caries. *Br Dent J.* 2013 Jan;214(1):11–18. doi: 10.1038/sj.bdj.2012.1175.
38. Horst J, Ellenikiotis H, Milgrom P. UCSF protocol for caries arrest using silver diamine fluoride: rationale, indications and consent. *J Calif Dent Assoc.* 2016 Jan;44(1):16–28.
39. Zhang W, McGrath C, Lo E, Li J. Silver diamine fluoride and education to prevent and arrest root caries among community-dwelling elders. *Caries Res.* 2013;47(4):284–90. doi: 10.1159/000346620.
40. Li R, Lo E, Liu B, Wong M, Chu C. Randomized clinical trial on arresting dental root caries through silver diamine fluoride applications in community-dwelling elders. *J Dent.* 2016;51:15–20. doi: 10.1016/j.jdent.2016.05.005.
41. Health Canada. Chemical substance — Silver diamine fluoride [Internet]. Ottawa: Health Canada; 2017 [cited 2017 Apr 24]. Available from: http://webprod.hc-sc.gc.ca/nhpid-bdipsn/ingredReq.do?id=13946&lang=eng

One in four has it.[1]

Many don't know it.[2]

They also may not know the oral health consequences.*

They're waiting for your guidance.

Dry Mouth is an oral health concern that affects people on multiple medications the most.[3] Yet some people aren't aware that it's a problem.[2] Talk to your patients about Dry Mouth and how Biotene® can help provide relief.†

www.biotene.ca

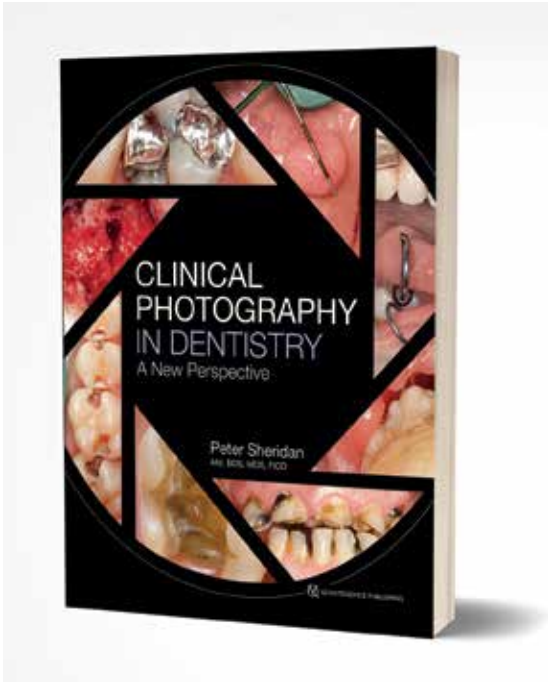
biotène®

* Dry mouth can disrupt the oral health environment and lead to halitosis, demineralization, and increased caries.[4,5]
† Mouthwash, Gel and Spray.
‡ As measured in a 28-day clinical study.[6]

1. GSK data on file. Biotène dry mouth growth opportunity (with Canadian U&A data). July 16, 2014. **2.** Dawes C. How much saliva is enough for avoidance of xerostomia? *Caries Res.* 2004;38:236–240. **3.** Sreebny LM, Schwartz SS. A reference guide to drugs and dry mouth, 2nd edition. *Gerodontology.* 1997;14:33–47. **4.** Turner MD, Ship JA. Dry mouth and its effects on the oral health of elderly people. *J Am Dent Assoc.* 2007;138:15S–20S. **5.** Fox PC. *J Clin Dent.* 2006;17(Spec Iss):27–28. **6.** GSK data on file 2014, RH01986.

Clinical photography in dentistry: A new perspective

By Peter Sheridan
Chicago: Quintessence Publishing Co., Inc; 2017. 222 pp with index
ISBN 978-0-86715-722-2; available from Quintessence Publishing (www.quintpub.com)



In his book, *Clinical Photography in Dentistry: A New Perspective*, Dr. Peter Sheridan provides an inspirational perspective on the importance of digital photography to clinical practice. He encourages oral health care professionals to broaden their scope of practice, acknowledge what is possible, and ultimately integrate dental photography into their everyday practice. A moment in time may be captured with a single photograph, and intraoral conditions can be monitored over time using a series of detailed photographs. With proper equipment, effective techniques, positioning, and application of photographic principles, digital photography can be instrumental in building complete records for the client and enhancing communication. This book explores the principles of macrophotography and emphasizes the clinical relevance of capturing high-quality images of the oral cavity.

A dentist for over 40 years, Peter Sheridan is a fellow of the International College of Dentists and a clinical lecturer in the Faculty of Dentistry at the University of Sydney, New South Wales, Australia. In addition to working in private dental practice, he offers courses and lectures on photography for beginners and experienced photographers alike, postgraduate students, and academic presenters. As an accomplished, accredited professional photographer and author of two earlier photographic reference books, Sheridan's work has been featured in museum catalogues, fine art journals, art galleries, and print media. His extensive experience and knowledge of both advanced photography and dentistry qualify him as an authority on the value of clinical photography for dental and dental hygiene practice.

SUMMARY OF CONTENT

The purpose of this book is to assist oral health care professionals in understanding the key principles of macrophotography and the techniques and strategies necessary to successfully implement digital photography in everyday practice. Sheridan reminds us that "clinical photography is not just about pictures; it is an important part of best practice dentistry" (p. vi). The book commences with an overview of biomedical imaging, presenting the purpose and various uses of clinical photography as an essential instrument for accurate documentation and communication of findings. It highlights the need for photography to be fully integrated into everyday clinical practice. As the book progresses, the author reviews the key principles of photography and details the finer aspects of shutter speeds, ISO, aperture, and megapixels. Subsequent chapters explore different types of camera systems while comparing and contrasting their suitability for clinical photography. Specific digital camera recommendations and the necessary use of mirrors and retractors to achieve exceptional images are also addressed. A chapter on standard views discusses correct client positioning and ideal camera settings, and includes a step-by-step guide to achieving various intraoral and extraoral views. The author also explores clinical practice considerations such as infection control, ethical aspects of digital photography, cost, maintaining client integrity and privacy, and the dental hygienist's role in producing high-quality photographs. The final chapters of the book are dedicated to the management and postprocessing of digital files, and they highlight how digital images can improve communication with the client or other health care professionals about oral conditions and possible treatment plans. The author concludes with an argument for acceptance of photography as a legitimate record-keeping and communications tool in dentistry.

The 222-page book is divided into 9 chapters and includes numerous photographs taken by the author over the past 40 years in his dental practice. Four appendices offer additional information, including a full bibliography

of related articles and apps, a handy exposure review sheet, recommendations for camera systems, and tips for educators who are looking to present courses and lectures on digital photography.

ANALYSIS AND EVALUATION

Sheridan argues that photography in dentistry is undervalued and underutilized due to minimal exposure to the topic in our dental education and the paucity of postgraduate educational courses. His book encourages the reader to explore the use of photography as a means of augmenting clinical practice. The author asserts that clinical photography in dentistry should advance beyond esthetic dentistry and encompass a broader spectrum, including the documentation of initial assessments, diagnosis, treatment planning, case presentation, and before-and-after views. It may also be used effectively for professional collaboration, medicolegal matters, research, and forensics. Photographs throughout the book demonstrate these multiple uses. Indeed, clinical photography has the potential to assist the oral health professional in attaining a high level of best practice.

To support his arguments in favour of digital photography, Sheridan presents straightforward explanations that simplify complicated facets of digital photography. He provides the reader with detailed illustrations of camera settings and intraoral images, with efficient step-by step instructions for achieving various intraoral and extraoral views. A noted advantage to support the use of proper digital photography equipment is the ability for an occlusal image of a single tooth to be enlarged, creating a distinct new image without loss of resolution. Hence, one image can serve multiple purposes. Additionally, the author discusses the limitations of intraoral cameras and compact cameras, and provides a thorough explanation of the role of sensor size in achieving high-quality images. He emphasises the importance of investing in appropriate equipment and recommends suitable camera systems for office use.

Strengths of the book

The book is a comprehensive resource that examines the technical aspects of digital photography and provides the reader with guidance on how to consistently achieve high-quality images in clinical practice. The content is current, clearly articulated, easy to follow, and ideally suited to all dentists, dental hygienists, students, and educators with varying levels of experience in photography.

Throughout the book, the author engages the reader with extraordinary photographs, illustrative examples, comparisons, and informative tips and techniques for achieving consistent high-quality images. Sheridan's extensive experience as both a dentist and photographer is evident in the detailed photographs that inspire oral health care professionals to create exceptional images for record keeping. The photographs further compel the reader to reflect and re-examine their own approach to utilizing photographs in clinical practice. In addition, Sheridan discloses how the images in the book were uploaded and if any postprocessing was utilized. An accompanying footnote provides the author's contact details where he welcomes questions and comments from the reader. Overall, the book is effective at conveying the relevance and full scope of digital photography in dentistry.

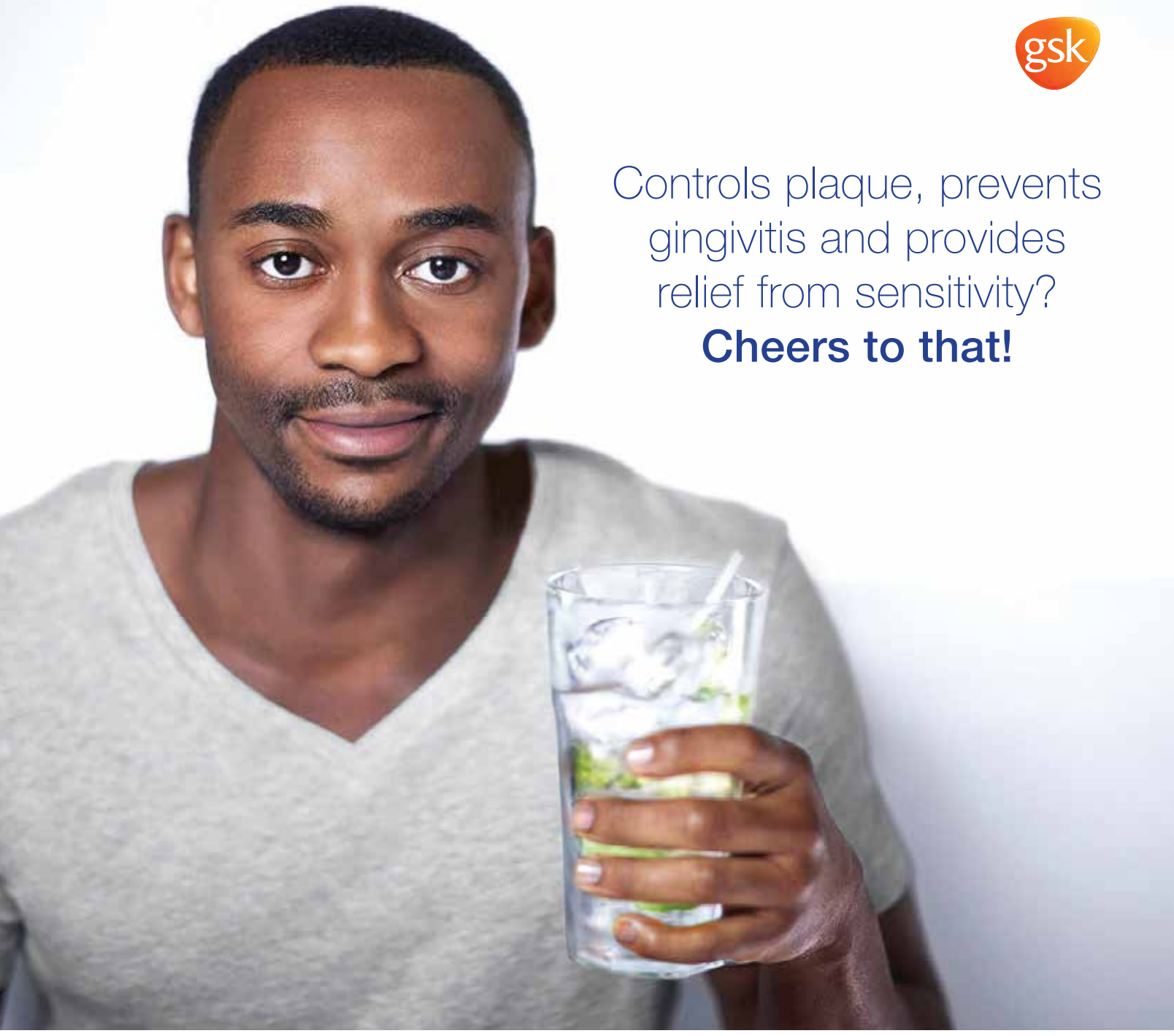
Weaknesses of the book

Although this book is comprehensive and clearly written, the content in Chapter 8 concerning digital asset management and postprocessing was harder to follow, but this could be due to the complexity of the topic. Additional information related to specific postproduction editing software programs and applications could have provided a better understanding. Another weakness is the choice to focus primarily on three camera manufacturers—Nikon, Canon, and Olympus—without mention of the suitability of other DSLR camera brands such as Sony and Pentax. Perhaps a future book will include a review of more cameras. Nevertheless, these minor weaknesses are clearly outweighed by the book's numerous strengths.

CONCLUSION

This book offers an insightful and informative perspective on the world of digital photography. It is filled with clear, crisp images that allow the reader to fully appreciate the tremendous impact of a single photograph. The author's enthusiasm for photography is evident, and he provides convincing evidence of digital photography as an essential tool for proper documentation and communication. He succeeded in shifting and expanding my understanding of digital photography; other readers may have the same experience. Overall, this book is a valuable educational resource that ignites an appreciation for the art of digital photography and redefines the scope and rationale for integrating clinical photography into everyday dental practice.

Teresa La Chimea, RDH, is pursuing a bachelor's degree in dental science at the University of British Columbia, Vancouver, British Columbia, Canada



Controls plaque, prevents gingivitis and provides relief from sensitivity?

Cheers to that!

When you recommend Sensodyne® Complete Protection to your patients, you'll take comfort knowing you're helping them with dentin hypersensitivity relief, while providing other gum health benefits, such as plaque removal and reduced gingivitis.

SENSODYNE®

GlaxoSmithKline Consumer Healthcare Inc.
Mississauga, Ontario L5N 6L4

ROUND FOR A REASON

Unique round CrossAction brush head

Unlike a rectangular head, the round, prophy-inspired ORAL-B® brush head provides three-side cleaning to all tooth surfaces.

Oral-B® GENIUS™ CrossAction Cleans Better than Sonicare DiamondClean*

Oral-B® Pro CrossAction
Oscillating/Rotating Pulsating Action

Sonicare DiamondClean
Side-to-side Action

Brush pressure monitoring system

Only Oral-B® has a Triple-Pressure Control System to detect over-aggressive brushing and provide the patient with a visual 360° SmartRing alert.

Innovative Position Detection

Smartphone app helps the patient improve their brushing technique by showing the areas they're missing.

Recommend Oral-B® GENIUS™ to your patients so they never miss a zone.

Bluetooth®

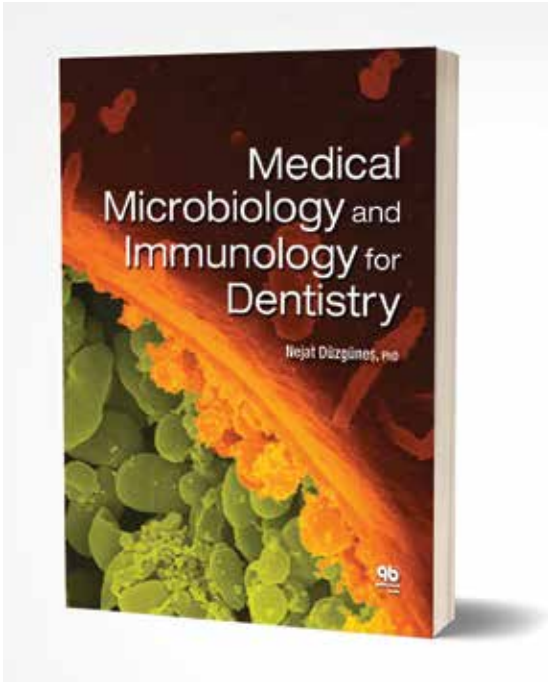
Oral-B GENIUS

* Based on multi-week clinical studies
Sonicare is a registered trademark of Koninklijke Philips N.V.

 ORAL-20485

Medical microbiology and immunology for dentistry

By Nejat Düzgüneş, PhD
Chicago: Quintessence Publishing Co, Inc; 2016. 290 pp. with index
ISBN: 978-0-86715-647-8; available from Quintessence Publishing (www.quintpub.com)



Medical microbiology and immunology are quintessential topics for doctors, dental hygienists, and dentists. Many of the operations in a dental professional's office, such as scaling and debridement or complex maxillofacial surgery, may be complicated by the presence of pathogenic organisms. Consequently, it is important for oral health practitioners to have, at the very least, a basic understanding of microbiology and immunology as they pertain to a client's health. The dental practitioner may be "ground zero" for observing and diagnosing potentially life-threatening illness and disease.

Dr. Nejat Düzgüneş, author of *Medical Microbiology and Immunology for Dentistry*, attempts to provide an in-depth, clear, and accessible medical microbiology textbook that highlights the relationship between disease and oral health for dental students. The author notes that students and other allied health professionals may also benefit from this textbook. The book is laid out in stepwise fashion, beginning with pertinent topics in immunology, and then leading into the predominant section on bacterial structure, genetics, and disease before touching on viral, fungal, prionic and parasitic disease.

Düzgüneş is a professor in the Department of Biomedical Sciences at the Arthur A. Dugoni School of Dentistry, University of the Pacific in San Francisco, California. He is a prolific publisher, with over 165 peer-reviewed scientific articles, more than 50 book chapters, and 10 edited collections. Additionally, he has reviewed manuscripts for over 100 journals. He is a fellow of the Japan Society for the Promotion of Science and a recipient of the International Association of Student Clinicians–American Dental Association Faculty Advisor Award.

SUMMARY AND ANALYSIS

This book is well laid out, with an esthetically pleasing design, and has an appropriate quantity of figures and images to support the text and bring even mundane information to life. Most chapters contain a detailed examination of a particular genus of organism. Major species of each genus are discussed with the following format:

1. Clinical syndromes and diagnosis
2. Pathogenesis and epidemiology
3. Treatment and prevention

Other chapters and sections provide less of an emphasis on particular species and more of a focus on relevant general background information.

Every chapter includes "discovery" panels, which provide a very useful and interesting historical look at the science behind the topic discussed. I found these panels to be very enlightening and a nice break from particularly information-dense sections. Additionally, there are "research" panels that are intended to 1) probe the reader's own knowledge on a topic and 2) facilitate deeper research into that topic. I often found these research panels to be onerous, as they require an immense amount of independent research to make sense of, thus I questioned their relevance given the textbook's aim to be a simplified microbiology reference book.

While this textbook does contain a wealth of data, complete with useful and interesting side panels and figures, I ultimately found myself surprised by the density of information and the lightning pace at which it was discussed. As a graduate student in immunology, I expected that I would find the introductory immunology section to be a light and easy read. I was wrong. I could scarcely believe the detail in which very important immunological concepts were discussed. Put another way, this was just not a simple read, even for an expert in the discipline. Putting myself in the shoes of a young dental or dental hygiene student, I don't believe that I would learn efficiently from many sections of this textbook, owing to its complexity and pace.

Very importantly, there were strikingly few pages

in the first section of the book explaining and linking immunological topics to oral health. For example, roughly a page's worth of information on "immunity in the oral cavity" (pp. 29–31) is not sufficient to properly illustrate the relationship between oral health and immunology. Additionally, I was surprised that the author devoted an entire chapter to vaccines. I do believe many individuals would benefit greatly from increased education on vaccines. However, I don't believe this chapter is well suited to this textbook, given its intended readership of dental students.

I enjoyed the largest section in the textbook, *Bacterial Structure, Metabolism, and Genetics*, as there seemed to have been an increased effort to relate the topics to oral health. In most sections, Düzgüneş successfully provided relevant information on a pathogenic genus and species as they related to oral health. In a supporting role, figures depicting the mechanism of action of different bacterial, viral or fungal species were very nicely presented, particularly in the section on human immunodeficiency virus (HIV). There were also a few chapters written specifically for dental students, such as "Oral Microflora and Caries" and "Periodontal and Endodontic Infections." These chapters succeeded in linking a significant portion of the material to oral health.

The final chapters on viruses, fungi, and prions followed the same structure, with comparable strengths and weaknesses. I was, however, disappointed that there were no full chapters in which the primary focus was a particular aspect of oral health. Perhaps a concise section illustrating the relative occurrence rates of common viral and fungal diseases would have been appropriate.

The textbook includes an appendix with 21 case studies designed to test the reader's skill in disease diagnosis but, puzzlingly, not as it relates to oral practice. While well thought out and appropriately challenging, this section seemed to be more of an exercise in pathology than anything else, and thus may not be well suited to dental students.

Lastly, I believe this textbook would have benefitted from a glossary. Given the breakneck pace of each chapter, it was difficult to identify and remember all the key terms as they related to important concepts.

CONCLUSION

This textbook aims to be an essential resource for dental students, illustrating how microbiology affects all aspects of dental practice. The highly respected author attempts to cover as many topics in microbiology as possible within roughly 300 pages. However, despite gorgeous diagrams and images, along with interesting scientific background and a very esthetically pleasing presentation, the book cannot be recommended for dental or dental hygiene students.

Medical Microbiology and Immunology for Dentistry suffers from an identity crisis. It attempts to be an accessible guide to important microbiological concepts as they relate to oral health, yet it reads more like an advanced-level microbiology textbook. I could not escape the feeling that the highlighted connections to oral health were added as an afterthought to sell this textbook, which seems better suited for microbiology and immunology students than for dental or dental hygiene students.

Rees Kelly, BSc (Biochemistry), is pursuing a Master of Science degree in immunology at the University of Alberta, Edmonton, Alberta, Canada

She knows that 30 minutes of yoga boosts short-term memory.

WHAT ELSE WOULD SHE WANT TO KNOW?

Young people today are staying informed to stay healthy.[1] But do they know that healthy foods including fruit, juices and sports drinks are highly acidic and can put their enamel at risk?[2-5] Exercise your influence as their trusted dental professional. Help educate every young patient about the effects of acid erosion.

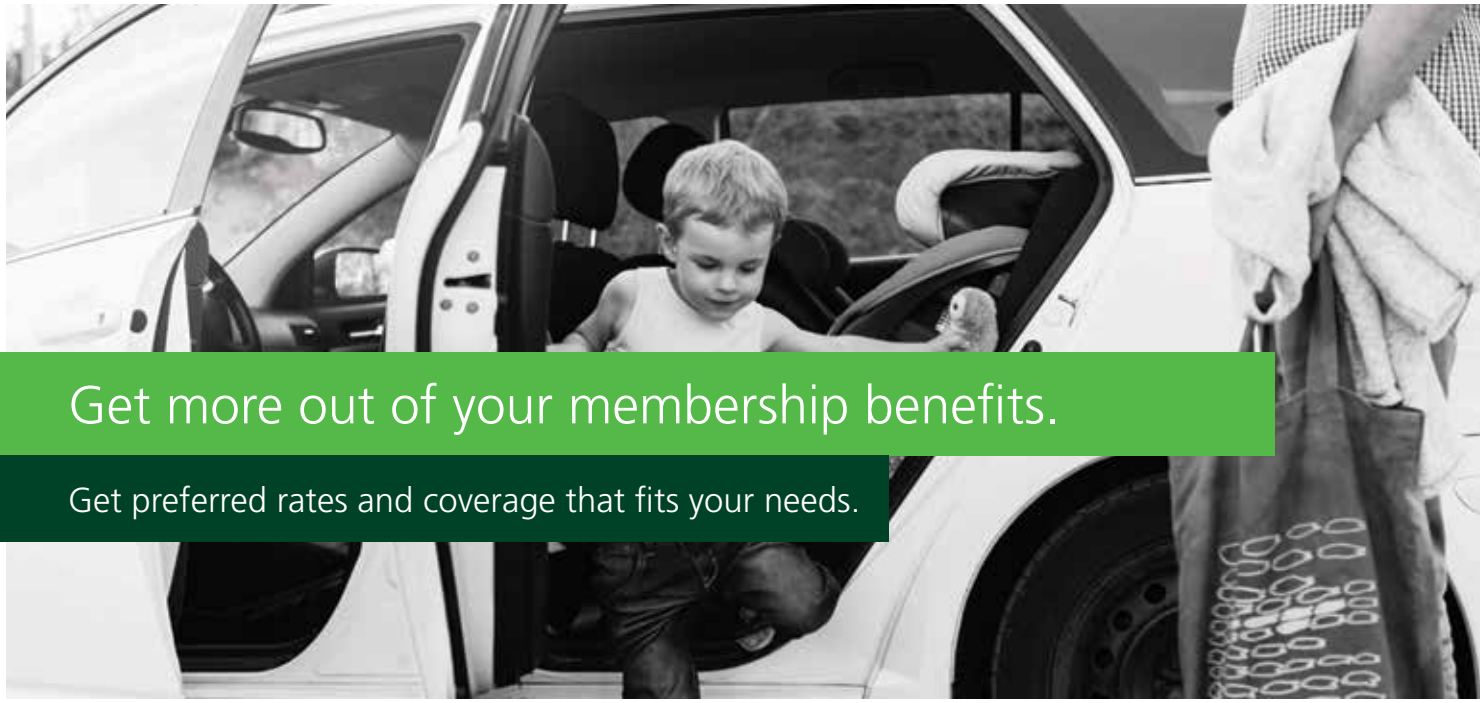
Because the investment in their enamel should start today.

For your acid erosion candidate.

1. GSK data on file, 2013. **2.** Lussi A. Erosive tooth wear – a multifactorial condition. In: Lussi A, editor. Dental Erosion – from Diagnosis to Therapy. Karger, Basel, 2006. **3.** Lussi A. *Eur J Oral Sci.* 1996;104:191–198. **4.** Hara AT, et al. *Caries Research.* 2009;43:57–63. **5.** Lussi A, et al. *Caries Research.* 2004;38(suppl 1):34–44.

GlaxoSmithKline Consumer Healthcare Inc.
Mississauga, Ontario L5N 6L4

TD Insurance
Meloche Monnex



Get more out of your membership benefits.

Get preferred rates and coverage that fits your needs.

You could **save big*** when you combine your member preferred rates and bundle your home and car insurance.

Take full advantage of your membership.

As a Canadian Dental Hygienists Association member, you have access to the TD Insurance Meloche Monnex program. This means you can get preferred insurance rates on a wide range of home and car coverage that can be customized for your needs.

For over 65 years, TD Insurance has been helping Canadians find quality home and car insurance solutions.

Feel confident your home and car coverage fits your needs. Get a quote now.

Home and auto insurance program recommended by:

CDHA ACHD
THE CANADIAN DENTAL HYGIENISTS ASSOCIATION
L'ASSOCIATION CANADIENNE DES HYGIÉNISTES DENTAIRES

HOME | CAR | TRAVEL

Get a quote and see how much you could save!
Call **1-866-269-1371**
Or, go to **tdinsurance.com/cdha**

We have the tools

Re: Lavigne S. The baby boomer takeover: Canada's changing demographics and its oral health care implications. *Can J Dent Hyg*. 2017;51(2):63–65.

Dr. Salme Lavigne's description of oral health challenges facing Canada's aging population in her June 2017 editorial ended with this recommendation: lobby government to develop new ways of providing access to dental care.

As an independent dental hygienist in Hamilton, Ontario, I think government has already given us this chance. In 2007, Ontario enabled dental hygienists to practise independently and, in 2013, we were allowed to use in-office prescription drugs such as Prevora. We have the ability to use interim stabilization therapy and now silver diamine fluoride. What more do we need? (Or perhaps just as importantly, what more can we expect when governments have no money and many other priorities?)

For more than 4 years, my practice has been developing a clinical and business case for managing the cause of poor oral health in older (and younger) Canadians. The cause is an imbalance in the bacterial composition of the plaque, which originates commonly at the gum line. Scientists call this imbalance "dysbiosis" (as opposed to symbiosis, when the plaque is balanced and thereby harmless to hard and soft tissues).

To manage oral dysbiosis, I have been treating my high-risk clients (average age of 72 years) with the Prevora sustained-release antiseptic coating (DIN 02046245). At the outset, I was cautious about introducing this new pharmaceutical product as there were good data from controlled studies, but long-term results in the setting of a dental hygiene practice were limited. I was also concerned that clients, particularly those with insurance, would balk at paying out of pocket for a Prevora treatment plan or would drift away from this preventive path over time.

Gradually, I found that clients indeed will pay for more preventive care, and that the clinical effects of Prevora are excellent past year 1, and now into year 4. I have also observed that these clients not only have an absence of caries, but their periodontal status has also improved significantly. And if clients are achieving good oral health, they become very loyal to the treatment plan. So, my clinical case for managing oral dysbiosis is well established.

The business case is too. The Prevora treatment plan has generated repeat visits from dedicated clients with improved oral health, regardless of price increases. I have also found that most high-risk clients will agree to invest in better oral health when it is introduced appropriately.

The Ontario government along with the Ontario Registrar have given us the Prevora opportunity to deliver better care at a manageable cost. In my view, now we must run with it. We need not wait for the lobbyists.

Julie DiNardo, RDH
Owner, Gleam Smile Centre
Hamilton, Ontario, Canada

The author responds

Dear Julie,

Thank you for your response to my June 2017 editorial entitled "The baby boomer takeover: Canada's changing demographics and its oral health care implications." I congratulate you on your contributions as a private dental hygiene practitioner to improving the oral health of Canadians, and seniors in particular, with your Prevora program. You are right in indicating that government has already given dental hygienists the chance to help improve the oral health of the public by passing legislation for independent practice in many provinces such as Ontario. However, the same situation does not exist in all Canadian provinces. I believe that the problem of access to care for this vulnerable group, which comprises a large portion of the Canadian population, cannot be solved with just one approach; it must be multifaceted. Legislation that has enabled independent dental hygiene practice is definitely one important part of the solution, yet over one-third of all seniors live in institutionalized settings and most are not receiving appropriate oral health care. As well, there are many seniors who, without adequate income and/or dental insurance, cannot afford to seek dental care regardless of whether it is from a dental or a dental hygiene practice.

These people are the ones I was talking about in my editorial. When suggesting both a community and institutional approach, I was referring to the need for government-supported interprofessional community health clinics that could be both a "medical home" as well as a "dental home" for individuals who cannot afford to pay for dental care. This concept has already been explored by medicine as well as by community oral

health groups. Additionally, placement of dental hygienists in all institutionalized settings would be a definite move towards eliminating this gap in dental hygiene services for these vulnerable groups. Both of these approaches require government support as someone needs to pay the salaries of the dental hygienists working in these types of facilities. I recognize that there are many dental hygienists who have established practices within long-term care settings. However, the families of the residents pay the bills. Not all residents have that type of family support. This is what my final statement about lobbying was intended to address.

Hopefully this clarifies the extent of this problem; obtaining independent practice is one of several steps that must be taken to address this critical issue. Thus, the lobbying must continue!

Thank you for being a part of the first step towards resolving this situation.

Sincerely,

Salme Lavigne, PhD, RDH
Scientific Editor, Canadian Journal of Dental Hygiene

The editorial board of the *Canadian Journal of Dental Hygiene* is delighted to announce the winners of the 2017 CJDH Research Awards.

Best Original Research Article

Examining changes in income-related oral health inequality in Canada: A population-level perspective. *Can J Dent Hyg*. 2016;50(2):65-71.

Authors: J Farmer, L McLeod, A Siddiqi, V Ravaghi, C Quiñonez

Best Literature Review

Exploring how the quality of the client–dental hygienist relationship affects client compliance. *Can J Dent Hyg*. 2016;50(1):15-22.

Authors: JE Morris and Z Kanji

CJDH JCHD

THE CANADIAN DENTAL HYGIENISTS ASSOCIATION
L'ASSOCIATION CANADIENNE DES HYGIÉNISTES DENTAIRES

Advertisers' Index

Exclusive Member Benefit

For medication-related oral implications the **CPS is a must-have** for Canadian dental hygienists!

CPS

The Canadian standard for drug monographs

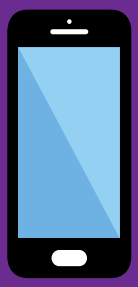
SEE WHAT YOUR COLLEAGUES HAVE TO SAY ABOUT CPS.

"The CPS is a great resource at your fingertips! Very easy to use and the constant updates on new drugs is the best way to keep current. I work with older clients on multiple medications that I need to look up. **I use this tool almost daily and without it I'd be at a loss.**"

— Eva Lissia, CDHA Member

"I love having it at hand for all my clients and I like that it has frequent updates so as to be sure **I'm getting the most accurate information**. I don't know how I got on without it!"

— Denise Mulligan, CDHA Member



WIN a brand new iPhone 7 or Samsung Galaxy S8!

Renew your CDHA membership and **activate your CPS** desktop and mobile accounts by **October 31, 2017** and your name will be entered into a draw for a chance to Win a Smartphone!

Visit www.cdha.ca/cps for details.

THE CANADIAN DENTAL HYGIENISTS ASSOCIATION
L'ASSOCIATION CANADIENNE DES HYGIÉNISTES DENTAIRES

CANADIAN PHARMACISTS ASSOCIATION
ASSOCIATION DES PHARMACIENS DU CANADA

Index to volume 51 (2017)

The *Canadian Journal of Dental Hygiene* is indexed according to the medical subject headings established by the National Library of Medicine, US National Institutes of Health, as well as by author name. The title of each article is followed by a code that designates the article's category. The categories used in this volume are listed below.

Book Review (BR); Editorial (E); Literature Review (LR); Letter to the Editor (L); Original Research (OR); Position Paper (PP); Short Communication (SC), Scoping Review (SR), Student Essay Award Winner (SEA)

SUBJECT INDEX

AUTHOR INDEX

MISCELLANEOUS

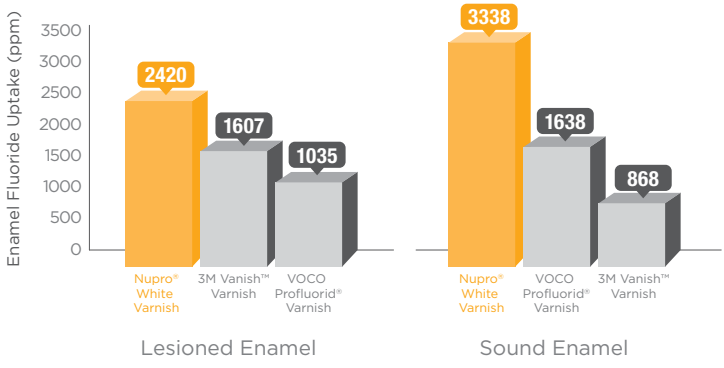
Now available in caramel flavor and easy application packaging.

Nupro® White Varnish

Delivers a new world of caries prevention.

- Uniquely formulated varnish for effective fluoride protection
- 2 hour wear time, so patients can quickly resume eating and drinking
- Releases more than 7 times the amount of fluoride than Vanish™ 5% Sodium Fluoride Varnish over a 2-hour period[1]
- Designed to be applied to wet tooth surface and formulated for no dripping or stringing to reduce potential mess
- White varnish is easy to see during application and sets to a clear finish
- Gluten, SLS, and dye free
- Now available in caramel, grape, raspberry, bubble gum, and mint flavors

Nupro® White Varnish fluoride uptake vs 3M Vanish™ Varnish and VOCO Profluorid® Varnish*



Available in 2 packaging options for easy handling and clinician convenience.
To request free samples or for more information, call 1.877.393.3687 or visit dentsplysirona.com.

*In an enamel fluoride uptake study, varnish was applied to sound, polished enamel specimens. These specimens were each paired with a specimen that had an artificial incipient lesion formed, and the lesioned enamel was not treated with varnish. The paired specimens were immersed into artificial saliva for 5 minutes, after which they were placed in fresh artificial saliva; this procedure was repeated at 15 minutes, 30 minutes, 1 hour, and 4 hours, and the specimens remained in artificial saliva for a total of 24 hours. After 24 hours, remaining surface varnish was removed. One layer of enamel was removed from each specimen and fluoride content was measured. Nupro® White Varnish had significantly more fluoride uptake into both sound and lesioned enamel than VOCO Profluorid® Varnish and 3M Vanish™ Varnish.

[1] Data on file, Dentsply Professional.
[2] Compared to competitive varnishes, data on file

NUP06-1115-2 Rev. 2

Imported & Distributed by:
DENTSPLY Canada
Woodbridge, Ontario
L4L 4A3

THE DENTAL SOLUTIONS COMPANY™

Dentsply Sirona

What reaction do you want?

Caramel, Bubble Gum, Mint, Cherry and Melon

VOCO Profluorid Varnish SingleDose

5% NaF

THE THIN TRANSPARENT 5% SODIUM FLUORIDE VARNISH IN A NON-MESSY SINGLEDOSE DELIVERY SYSTEM

- No yellow discoloration of teeth
- Five great tasting flavors without the unpleasant aftertaste of some other brands
- Adheres well to moist surface
- Sets quickly in seconds after contact with saliva
- Enhanced flow characteristics with a thin spreadable consistency allow Profluorid Varnish to reach areas traditional varnishes may miss
- High immediate fluoride release to relieve hypersensitivity
- Contains Xylitol
- Available in both adult and child doses

Learn more and order your FREE SAMPLE
www.vocoamerica.com

THE DENTAL ADVISOR ++++

MADE IN GERMANY 100%

- Does not contain tree nuts, peanuts, corn, shellfish, eggs, milk protein, soy, gluten, triclosan, petrolium, red dye/artificial coloring, saccharin or aspartame.
- CDT Insurance code D1206 for HIPAA dental claims
- CPT Insurance code 99188 for medical claims

Call 1-888-658-2584

VOCO THE DENTALISTS

VOCO Canada · toll-free 1-888-658-2584 · Fax 905-824-2788 · infousa@voco.com · www.voco.com