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

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Are We Future Ready?

The first ever *Surgeon General's Report on Oral Health* was published and disseminated in the millennial year 2000. Today, over twenty years later, we now have a follow up report, *Oral Health in America: Advances and Challenges 2021*. Nearly 800 pages in length, this report is full of information on the progress, or lack thereof, in oral health in the United States (US). We would like to take the opportunity to break the report down regarding what it can mean for the future of dental hygiene. The report is divided into six sections:

- Effect of Oral Health on the Community, Overall Well-Being, and the Economy
- Oral Health in Children and Adolescents
- Oral Health in Working-Age and Older Adults
- Oral Health Workforce, Education, Practice, and Integration
- Pain, Mental Illness, Substance use, and Oral Health
- Emerging Technologies and Promising Science to Transform Oral Health

Each section includes the current knowledge, practices, and perspectives; advances and challenges; promising new directions; and a summary. The discussions of the “Advances and Challenges” provide us with some benchmarks on what we have accomplished since the first report in 2000 and where there is still much room for growth. Here are some key takeaways to be proud of and some areas that miss the mark.



Cynthia C. Gadbury Amyot,
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Access to Care

+ The number of individuals receiving oral health services at FQHCs across the U.S. increased from 1.4 million in 2001 to nearly 5.2 million in 2020.

- More than half of dentists in the US do not participate in public insurance such as Medicaid.

Interprofessional Practice

- There is a need for both individual-based preventive programs and services as well as public health approaches to oral care. Both approaches could be aided by improved models of medical-dental integration; increased utilization of interprofessional education (IPE) and interprofessional practice (IPP); and innovative approaches to improve oral health literacy.

Preventive Approach to Oral Care

+ Paradigm shift in dental treatment over the past 20 years is moving from a restorative approach to a preventive approach with 12% services focused on restoring teeth with preventive care making up the remainder, as compared to 22% restorative services in 2000.

Oral Health Across the Lifespan

Children (2-11 years of age)

+ The most substantial decline in untreated dental caries was in preschoolers with 10% having untreated caries as compared to 19% in 2000. Improvements were seen across all racial and ethnic groups and income levels

Adolescents (12-15 years of age)

- Overall prevalence of dental caries was 48% as compared to 57% in 2000. The improvement in adolescent oral health has been inconsistent and not as good as in younger children.

Working-Age Adults (20-64 years of age)

- Overall prevalence of untreated caries is 29%, up from 28% in 2000, of those with untreated tooth decay, 52% live in poverty. The prevalence of periodontal disease has remained unchanged.

Older Adults (≥65)

+/- 65% of older adults have functional dentitions (more than 20 teeth) as compared to 46% in 2000. However, there were increased disparities across racial and ethnic groups and income levels.

Dental Insurance Coverage

+/- There was an overall increase in dental insurance benefits to 78% as compared to 55% in 2000. However, this expanded coverage was primarily for children and adolescents due to a 50% increase in Medicaid and CHIP programs. Nine out of ten children now have some type of dental insurance. Working age adults were the only group that did not benefit from increased dental insurance coverage.

Key points

As dental hygienists, each of the above points should resonate with our profession. The current oral health system in the US delivers predominantly office-based care that is convenient for providers but is not accessible for many patients, especially older adults, persons with disabilities, and others who are unable to travel for care or who work in jobs without leave during general working hours. Access to care has been an area where dental hygienists have significantly increased their participation over the past 20 years. Since 2001 there have been increased scopes of practice for dental hygienists across the country, with 42 states permitting some form of direct access. Today many more dental hygienists are working in settings where care is taken to the patient rather than the patient required to travel for care and the impact of these models can be seen in the new report.

Today, 19 states permit direct Medicaid reimbursement to dental hygienists. This needle needs to keep moving in

order to encourage dental hygienists embrace the concept bringing oral health care to people who cannot access care in the traditional settings. Another important aspect to consider is that more than half of dentists do not participate in public insurance, e.g., Medicaid. Considering the data, this is exactly where we need dental hygienists to help move the dial on patients who are eligible for these programs. It also should be noted that while the report referred to the concepts of oral health related quality of life (OHRQoL) and person centered care as relatively new concepts in dentistry 20 years ago, the report failed to mention that dental hygiene has had a published OHRQoL model of care for over 20 years, and person-centered care defines the practice of dental hygiene.

Where do we go from here? What is our role for the next 20 years and beyond? The dental hygiene profession was founded on the principles of preventing oral disease and promoting oral health. Our profession must be ready to work with other health care providers to bring policy changes for better and greater access to care. We must be ready to expand our practice settings to include more community based centers, schools, nursing homes, and medical centers. We must be focused on increasing our diversity and expanding our cultural education to reach the growing diverse populations we serve. ***Together we can move forward.***

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A Review of Oral Chronic Graft-Versus-Host Disease: Considerations for dental hygiene practice

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Abstract

Purpose: Allogeneic hematopoietic cell transplantation (alloHCT), also known as stem cell or bone marrow transplantation, is a cellular therapy performed to treat a variety of malignant and non-malignant hematologic diseases. Chronic graft-versus-host disease (cGVHD) is a common immune-mediated complication of alloHCT that can affect various organs of the body, with approximately 70% of affected patients presenting with oral features. Oral manifestations of cGVHD include lichenoid lesions (diagnostic feature), erythema, pseudomembranous ulcerations, superficial mucocoeles, salivary gland hypofunction, xerostomia, orofacial sclerosis, trismus, and increased sensitivity to spicy, acidic, hard, and crunchy foods. Patients with oral cGVHD are also at increased risk for developing secondary conditions, such as oral candidiasis, dental caries, and oral squamous cell carcinoma. Given these complex oral health challenges, the dental hygienist can play a key role in optimizing patients' oral health care from pre-stem cell transplantation through survivorship. Optimal care includes a comprehensive health history assessment, thorough extraoral and intraoral examinations, detailed hard and soft tissue evaluations, oral hygiene, and dietary assessment, along with the delivery of patient-centered, oral health instruction and preventive therapies. Appropriate monitoring and management of oral cGVHD require a collaborative care approach between dental, oncology, and oral medicine providers. As part of a multidisciplinary care team, dental hygienists play an important role in the management of patients with oral cGVHD. The purpose of this review is to provide an overview of alloHCT and its oral health considerations, with a focus on oral cGVHD etiology, signs and symptoms, and management considerations for the dental team.

Keywords: graft-versus-host disease, allogeneic hematopoietic stem cell transplantation, oral medicine, dental hygienist

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Introduction

Allogeneic hematopoietic cell transplantation (alloHCT), also referred to as “stem cell” or “bone marrow” transplantation, is a potentially life-saving procedure for individuals with malignant hematological (blood-related) diseases, such as leukemia and lymphoma, as well as non-malignant conditions, such as bone marrow failure syndromes and hemoglobinopathies.¹ According to the Center for International Blood and Marrow Transplant Research,² over 9,000 alloHCT procedures were performed in the United States in 2018, and this number has been steadily increasing.³ Recent developments in technology and supportive care practices have led to improved post-transplant survivorship.⁴⁻⁶ While this progress is highly encouraging, survivors are at risk for a range of post-transplant complications, including chronic graft-versus-host

disease (cGVHD), a relatively common and potentially serious condition affecting a range of organs, frequently including the oral cavity.^{7,8} Appropriate screening and management of post-transplant complications require a multidisciplinary team approach, in which oral health care providers play a central role.⁹ This review provides an overview of alloHCT with a focus on oral cGVHD and the role of the dental hygienist in the management of this complex condition.

Allogeneic Hematopoietic Cell Transplantation (alloHCT)

AlloHCT is a non-surgical therapeutic procedure, similar to a blood transfusion, in which a patient receives healthy hematopoietic cells from a related or unrelated donor via a central intravenous catheter.^{10,11} Prior to transplantation,

the patient undergoes a conditioning regimen, during which residual cancer cells (in the case of hematologic malignancies) are targeted for destruction and the patient is immunosuppressed via chemotherapy, total body irradiation, and/or immunotherapeutic agents.^{10,11} The conditioning regimen is essential for preventing graft rejection and for allowing the donor stem cells to establish hematopoiesis.^{10,11} The donor cells ultimately produce a new functional bone marrow capable of producing healthy red blood cells, white blood cells, and platelets.^{10,11} During this time, the patient's laboratory values are closely monitored, particularly the complete blood count (CBC) with differential. The patient is said to be "engrafted" when the absolute neutrophil count is greater than 500 cells/uL on three consecutive days, typically by day +30 after alloHCT.^{10,11} Following engraftment, patients continue to be monitored closely due to risk for disease relapse, infection, and other transplant-associated complications, such as graft-versus-host disease (GVHD).¹⁰ To reduce the risk of developing GVHD, all patients receive GVHD prophylaxis post-alloHCT, which typically consists of a short course of methotrexate and a longer course of a calcineurin inhibitor.¹²

There are many oral health considerations to assess immediately before, during, and following alloHCT. A comprehensive oral evaluation should be completed prior to transplantation and a dental clearance should be obtained as the recommended standard of care to reduce the risk of bacteremia and morbidity post-alloHCT.¹³ At this time, any urgent dental needs should be addressed, including any extractions, periodontal therapy, and the elimination of local trauma. Ideally this treatment should be completed two weeks before transplantation to allow sufficient post-operative healing of oral tissues.¹³ During and after alloHCT, patients have lower white blood cell counts, making them more susceptible to oral herpetic and opportunistic infections caused by *Candida*. Thus, patients who are seropositive for herpes simplex virus should receive acyclovir prophylaxis to prevent viral reactivation, and most medical centers use antifungal prophylaxis to prevent oral candidiasis.¹³ Furthermore, the conditioning and GVHD prophylaxis regimens are associated with the risk of oral mucositis, a painful ulcerative condition that can limit one's ability to eat, drink and speak.¹⁴ While mild oral mucosal pain may be addressed with topical anesthetics and analgesics, more debilitating pain may necessitate opioids, and total parenteral nutrition may be indicated if oral intake is severely limited.^{13,15}

The overall one- and five-year survival rates post-alloHCT are approximately 70% and 55%, respectively.¹⁶ The leading causes of mortality are cancer recurrence and complications

related to GVHD, including deaths due to infection and immunosuppressive treatment.⁶ Consequently, long-term follow-up care is critical for reducing the risk of complications related to the transplant.^{9,17}

Chronic Graft-Versus-Host-Disease (cGVHD)

Graft-Versus-Host-Disease is a complex immune-mediated disease resulting from an incompatibility between the donor (graft) and patient (host) cells. It is classified as either acute (aGVHD) or chronic (cGVHD) based on differentiating clinical and pathologic features. Acute GVHD typically occurs within the first 100 days following alloHCT and cGVHD usually develops after day +100; however, these time points are somewhat arbitrary.¹⁰ Acute GVHD most commonly affects the skin, liver, and gastrointestinal (GI) tract.¹⁸ Chronic GVHD most commonly affects the skin, oral cavity, eyes, GI tract, liver, and lungs.^{9,19} Acute and chronic features may overlap, yet cGVHD has distinct characteristics affecting the oral cavity. Signs and symptoms of cGVHD are similar to that of many autoimmune conditions and can profoundly affect systemic health and one's overall quality of life.^{9,20} Table I provides a summary of chronic GVHD clinical features.

Chronic GVHD affects up to 50% of alloHCT recipients and often follows aGVHD, but it can also develop de novo (without prior aGVHD) and may present upon tapering of GVHD prophylaxis (e.g., calcineurin inhibitors, such as cyclosporine or tacrolimus).¹⁸ Additional risk factors include the use of peripheral blood stem cells (versus bone marrow) as the graft source, unrelated donors (versus related donors, such as siblings), human leukocyte antigen (HLA) mismatching between donor and recipient, female donor to male recipient, older donor age, and history of donor lymphocyte infusion (a therapy used in patients with disease relapse).^{19,21} While the incidence of cGVHD is lower in pediatric alloHCT recipients (<18 years old), clinical manifestations observed in this population are similar to those seen in adults.²²

The pathophysiology of cGVHD is highly complex and involves multiple biological processes, including immune dysregulation, chronic inflammation, and fibrosis.²³ Histocompatibility differences between donor and recipient HLA gene products cause the donor T-cells to recognize the host HLA antigens as "foreign," which triggers an attack on the healthy host tissues.²⁴⁻²⁶ This inflammatory response can impact any organ system in the body and cause tissue fibrosis, varying degrees of tissue damage, and functional impairment.²⁷

Oral Manifestations of cGVHD

Following the skin, the oral cavity is the second most common site affected by cGVHD, with up to 70% of patients presenting with oral features.^{28,29} Oral cGVHD is typically

Table I. Clinical features of chronic graft-versus-host disease

Tissue/ affected organ	Signs	Symptoms
Skin	Pigmentation alterations (irregular color to skin) Erythematous rash Scleroderma/fibrosis Skin ulcerations and subsequent infections	Pruritis Skin tightness, restricted mobility Dryness, sensitivity, pain
Mouth/Oral Cavity	Lichen planus-like features Hyperkeratotic plaque, papule Salivary gland hypofunction Mucocoele Mucosal atrophy	Sensitivity and pain with speaking, mastication, and/or oral hygiene Xerostomia Alteration of taste, taste loss
Eyes	Keratoconjunctivitis sicca Punctate keratopathy	Burning, dryness, irritation, pain, blurred vision, sensitivity to light
Lungs	Bronchiolitis obliterans	Difficulty breathing
Liver	See symptoms	Elevated LFTs
Musculoskeletal	Myositis Fasciitis Joint stiffness and contractures	Weakness Limited mobility Difficulty with positioning (sitting to standing)
Genitalia/ Reproductive tract	Lichen planus-like features Ulcers, fissures, erosions Vaginal scarring or stenosis Dryness	Dyspareunia

diagnosed by an oncologist or oral medicine specialist based on a thorough health history assessment and clinical examination; in some cases, a biopsy may be required to support the diagnosis or rule out other conditions. Oral cGVHD can affect the lips, oral mucosa, and salivary glands. Clinical features may include lichen planus-like manifestations, salivary gland hypofunction, and orofacial fibrosis.^{30,31} Oral cGVHD can cause mucosal pain and sensitivity, xerostomia, and indirect effects, such as altered diet, compromised ability to maintain good oral hygiene, and, thus, increased risk for dental caries and gingival disease.¹³

Oral mucosal lesions

Mucosal lesions are characterized by three main signs: 1) lichenoid inflammation, 2) erythema, and 3) ulcerations.²⁰ Lichenoid inflammation appears as white reticular streaks or lacey lines that resemble Wickham striae observed in oral lichen planus and are considered to be a diagnostic feature of oral cGVHD^{7,30} (Figure 1a). While these lesions may occur anywhere in the oral cavity, they most frequently appear on the buccal mucosa and tongue.^{31,32} Lichenoid lesions may be accompanied by varying degrees of erythema and ulceration, which are features

often associated with more severe symptoms (Figure 1b-c). Ulcerations represent a breakdown in oral mucosa and can be particularly symptomatic, limiting functions such as oral nutrition, speech, and oral hygiene maintenance.³³

Figure 1a. Lichenoid inflammation



Figure 1b. Lichenoid erythema



Figure 1c. Lichenoid ulceration and erythema



Figure 1d. Oral mucocoeles



Pain at rest may be reported, however the hallmark symptom of mucosal inflammation is sensitivity to spicy, acidic, hard, and crunchy foods.^{31,34} Toothpaste containing sodium lauryl sulfate and strong flavoring agents (e.g., mint and cinnamon) may also be intolerable.³⁵ While symptoms are generally worse with more severe clinical features, it is possible for a patient with relatively

Figure 2a. Oral squamous cell carcinoma

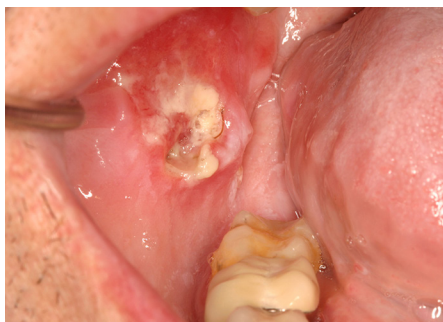


Figure 2b. Oral leukoplakia



Figure 2c. Hyposalivation and dental caries



Figure 2d. Oral candidiasis



mild lichenoid changes to experience symptoms similar to or worse than those of a patient presenting with erythema and ulcerations.³¹

Superficial recurrent mucoceles are also common in patients with oral cGVHD. They appear as transient, saliva-filled, raised lesions, secondary to inflammation of minor salivary glands, and are most commonly located on the hard and soft palate or labial mucosa³⁰ (Figure 1d). While these lesions are generally asymptomatic, they may be a nuisance or a source of concern to the patient. Treatment other than recognition and patient reassurance is rarely indicated.³⁶

Furthermore, patients with oral cGVHD are at increased risk for developing oral squamous cell carcinoma^{37,38} (Figure 2a). This may be due to prolonged mucosal inflammation, immune dysregulation, and iatrogenic immunosuppression.³⁹ Oral squamous cell carcinoma may arise from areas of oral leukoplakia, which generally presents distinctly from the white reticular features of mucosal cGVHD (Figure 2b).

Salivary gland dysfunction

Salivary gland dysfunction and xerostomia associated with cGVHD mimic the clinical features and symptoms of Sjögren syndrome. Hyposalivation impairs the protective activity of saliva, elevating the risk for dental caries and accelerating the progression of white spot lesions, and in some cases, to rampant dental caries and subsequent tooth loss^{31,40,41} (Figure 2c). Hyposalivation also reduces oral lubrication, which can lead to difficulty speaking, eating, and dysphagia.⁴² Furthermore, the reduction of

salivary proteins (e.g., histatin, lactoferrin, calprotectin) can diminish antimicrobial and antifungal activity, thereby increasing the risk for recurrent oral candidiasis.^{30,31,43} Oral candidiasis most frequently presents as white pseudomembranous patches but may also present with diffuse erythema (Figure 2d).

Orofacial sclerosis

Although relatively infrequent, sclerosis of the perioral skin and intraoral mucosal tissues may occur and can be associated with significant morbidity.^{30,44} Sclerodermatous cutaneous disease, a chronic hardening and tightening of the skin and connective tissues, can extend to the facial and perioral tissues, leading to impaired mouth opening and trismus.⁴⁵ In some cases, involvement of muscles can lead to transient painful myospasms, which can also contribute to trismus. These conditions can compromise the patient's ability to perform oral self-care and can complicate the provision of professional dental care.

Management of Oral cGVHD

Many patients with oral cGVHD will be managed with systemic medications due to cGVHD activity in other organ systems.³⁶ Systemic therapy may or may not adequately control oral cGVHD, as an oral response is highly variable. Furthermore, it is not uncommon for signs and symptoms of oral cGVHD to persist even after systemic therapy resolves cGVHD manifestations in other organ systems.^{30,36}

Dental hygienists, as part of a multidisciplinary care team, play an important role in the management of patients with oral cGVHD.⁴⁶ Patients will typically return to routine dental care approximately one year following alloHCT.⁹ At that time, the assessments should include a thorough review of medical history and medications, as well as a comprehensive extraoral and intraoral examination to identify clinical signs and symptoms of systemic and oral diseases.

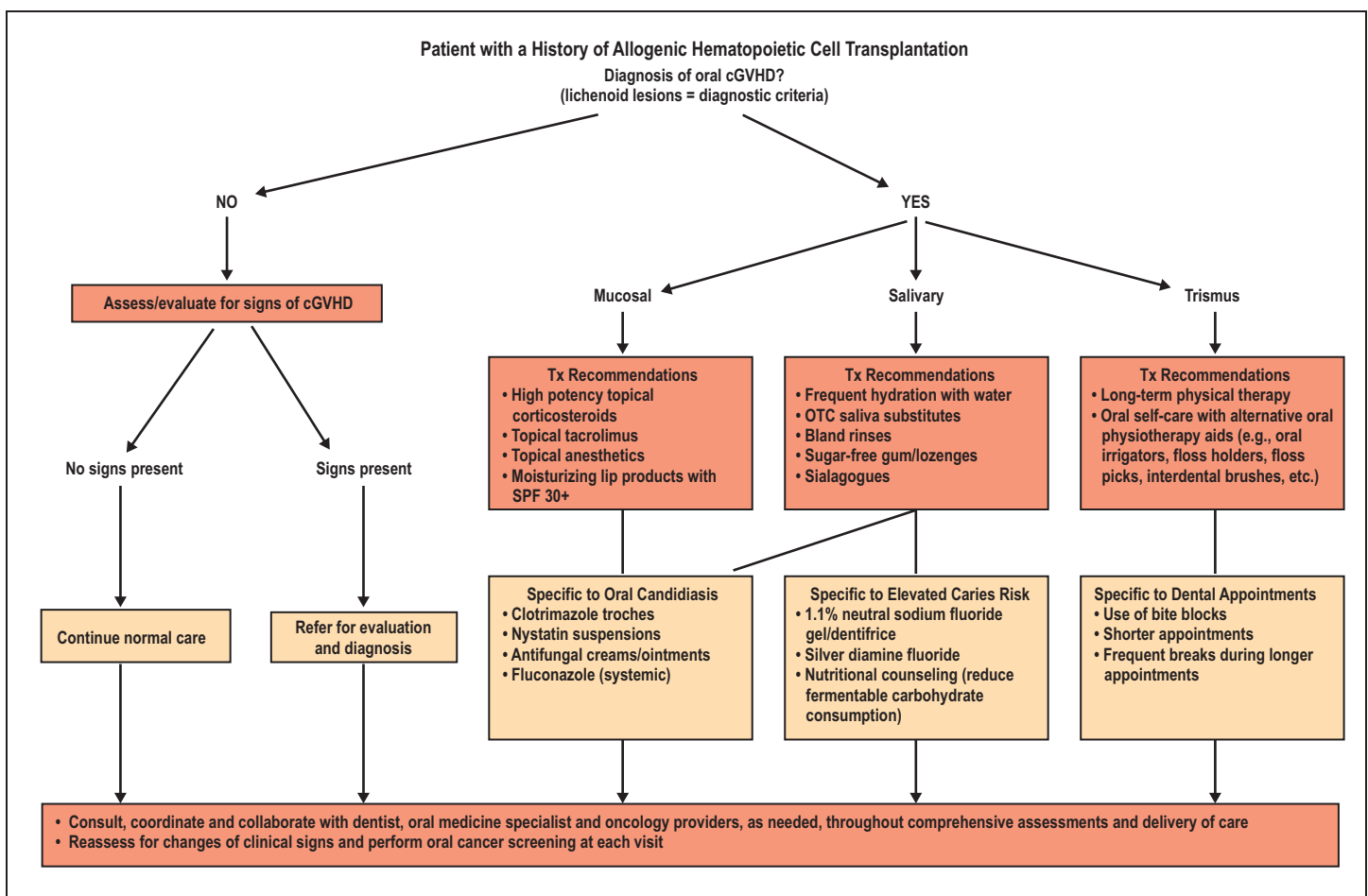
The extraoral examination includes a visual inspection of the skin and lips, careful palpation of the submandibular and

cervical lymph nodes, and assessment of temporomandibular mandibular joint (TMJ) function and mouth opening. The intraoral examination thoroughly evaluates all mucosal tissues, including the soft palate and tonsillar pillars. It can be challenging to distinguish between suspicious abnormalities and manifestations associated with oral cGVHD, but certain features that should be of particular concern as part of the oral cancer screening include atypical white plaques, focal masses, tissue induration, and non-healing and necrotic ulcers.³¹ Obtaining periodic intraoral photographs of mucosal findings is helpful for documentation and assessment of changes over time; suspicious abnormalities should be referred for biopsy.³¹ Risk factors for oral cancer, such as tobacco use, and excessive alcohol intake should be assessed, and patients should be counseled accordingly.⁴⁷ The dental hygiene care plan should address all symptoms of oral cGVHD, with a focus on preventing sequelae of disease, such as hyposalivation-induced dental caries and oral candidiasis. Figure 3 outlines the process of care for a patient with a history of alloHCT, and the oral health considerations and management recommendations are summarized in Table II.

Oral mucosal lesion management

When caring for patients with oral cGVHD, the overall goal is to manage symptoms rather than explicitly resolve or heal lesions.³¹ Oral mucosal symptoms are managed with high potency topical corticosteroids, generally in the form of a solution or gel.³⁴ Topical tacrolimus, a non-steroid immunomodulatory agent, can also help to manage symptoms and is commercially available in the form of a 0.1% ointment or can be compounded as a solution.⁴⁸ Solutions are swished for 4-6 minutes then expectorated, and are beneficial for treating extensively involved and hard-to-reach areas.⁴⁸ In addition to solution-based therapy, gels may be applied focally to symptomatic lesions where the disease is more localized or more intensive treatment is needed. Gels can be delivered via gauze or an occlusive custom tray (e.g., for gingival or palatal involvement) from one to four or more times daily, depending on the degree of symptoms and level of response.³¹ With improvement or resolution of symptoms, therapy is often tapered or discontinued but can be resumed or intensified if symptoms flare. Bland oral rinses (e.g., 0.9% saline) or “magic mouthwashes” containing a topical

Fig. 3. Oral cGVHD Process of Care



anesthetic and antihistamine can also be prescribed to help reduce oral mucosal pain.¹⁵ Topical tacrolimus is preferred when treating lesions of the lip vermillion due to the potential for irreversible atrophy and thinning of the tissue with topical steroid therapy.³¹ Topical anesthetics should be considered for in-office use during dental visits for pain control, as needed. In addition, lip care should include adequate moisturization and sun protection (i.e., SPF 30+) given the increased risk for skin cancers post-transplant.³⁶

Secondary candidiasis is a common complication associated with the use of topical steroids in the oral cavity.⁴⁹ Risk factors include systemic immunosuppression, topical corticosteroid therapy, and salivary gland dysfunction.³⁰ Diagnosis is usually based on clinical examination, although features may be difficult to distinguish from cGVHD.⁴⁹ Fluconazole is the most common systemic antifungal medication used to treat or prevent oral candidiasis but must be used with caution in patients on systemic therapy due to potential drug interactions.⁵⁰ Clotrimazole troches and nystatin suspensions are topical antifungal medications that should be used with caution due to their sugar content and cariogenic properties.¹⁵ Sugar-free versions of these drugs are available and can be requested when prescribed.

Angular cheilitis may also be present, for which antifungal creams or ointments can be prescribed.^{28,31} Patients wearing removable dentures and appliances should be advised to remove, soak, and brush their dentures/appliances daily with a commercial cleanser and denture brush to reduce their risk of oral yeast infections. Individuals with fungal infections should treat the denture/appliance with an anti-fungal remedy, such as chlorhexidine, nystatin, or dilute bleach solution (1:10) to avoid reinfection from the oral prosthesis. Those who experience recurrent infections may benefit from long-term antifungal prophylaxis.¹⁵

Salivary gland hypofunction and dental caries risk considerations

The symptoms of salivary hypofunction may be managed with over-the-counter products for dry mouth in the form of rinses, gels, sprays, and saliva substitutes.⁴⁸ In addition to ensuring good hydration with frequent water intake, the use of sugar-free gum and lozenges can stimulate salivary flow, and bland rinses (e.g., 0.9% normal saline or 0.5% sodium bicarbonate rinses) may ease the discomfort of xerostomia.³⁶ Salivary flow can also be improved with prescription sialagogue medications (e.g., pilocarpine and cevimeline).⁵¹⁻⁵³ Prior to prescribing sialagogue therapy, clinicians should ensure that there are no medical contraindications (e.g., narrow angle glaucoma) and possible side effects (e.g., sweating) should be reviewed with the patient and their oncology care provider(s).

When patients with alloHCT return to the dental office for routine follow-up care, their caries risk assessment and dental hygiene care plan should be updated based on their current health status. The three primary conditions associated with oral cGVHD (oral mucosal lesions, salivary hypofunction, and orofacial sclerosis) compound the risk for dental caries, potentially accelerating disease progression. Oral mucosal pain and sensitivity may lead to difficulty in performing oral self-care, as well as a shift to a softer diet that requires less mastication and often contains higher levels of fermentable carbohydrates.^{54,55} Additionally, reduced quantity and quality of saliva inhibit oral cleansing ability, antimicrobial activity, neutralization of acids, and tooth remineralization.⁵⁶ Patients with limited mouth opening may also encounter challenges with performing oral self-care, and patients experiencing other comorbidities may suffer from disease management fatigue, contributing to suboptimal homecare.⁵²

Dental hygienists can work with patients to help tailor their oral self-care routines. Brushing may be best tolerated with a non-mint flavored, fluoridated toothpaste and an extra soft bristle toothbrush.³⁶ Interdental cleaning can be made easier for patients with restricted mouth opening via the use of floss holders, floss picks, interdental brushes, and oral irrigators. For those presenting with moderate to extreme dental caries risk, a 5,000 ppm (1.1%) sodium fluoride toothpaste should be prescribed for twice-daily use.^{57,58} Patients presenting with high caries risk may also benefit from the application of prescription-strength fluoride gel via trays for 5 minutes daily. In-office fluoride varnish application every 3 or 6 months is recommended for patients with high or moderate risk for dental caries, respectively.^{57,59} Silver diamine fluoride is another caries-preventive and caries-arresting agent that can be applied in a site-specific manner to slow or arrest the dental caries process.⁶⁰

A dietary assessment should also be performed, and patients should receive nutritional counseling to help minimize their caries risk. Patients should be advised to avoid cariogenic foods and drinks, including sugar-sweetened beverages, gums, and lozenges while increasing their intake of non-cariogenic and cariostatic foods.^{61,62} The importance of twice-yearly or more frequent dental examinations and dental hygiene recare visits must be emphasized in coordination with the patient's primary medical team.³¹ Patients will benefit from individualized and detailed written instructions for all oral self-care recommendations.

Orofacial sclerosis considerations

Sclerodermatous oral cGVHD may be managed with long-term physical therapy to improve or at least maintain stable

Table II. Management of oral health in patients with oral chronic graft-versus-host disease.

Oral Manifestation (Sign or symptom)	Treatment	Dental Hygiene Care Considerations	Oral Hygiene Self-Care Recommendations
Mucosal sensitivity from lichenoid inflammation, erythema, or pseudomembranous ulceration	Referral to oral medicine specialist or patient's oncologist Rx: Topical corticosteroid gel (e.g., fluocinonide) or solution (e.g., dexamethasone) Rx: Topical tacrolimus Rx: Oral solutions with varying levels of local anesthetic (e.g., Magic Mouthwash with viscous lidocaine)	Assess patient for: <ul style="list-style-type: none"> • Difficulty performing oral hygiene • Difficulty eating, speaking, and swallowing • Increased dental caries risk • Recurrent oral candidiasis Use topical anesthetic or local anesthesia as needed during treatment Avoid products with strong flavorings (e.g., mint prophylaxis pastes and fluoride varnish) and acidulated products (e.g., acidulated fluoride gel or foam) Provide detailed, written oral hygiene instructions (e.g., toothbrush type, brushing method, and frequency, toothpaste selection) Perform motivational interviewing and support techniques	Avoid dentifrices with strong flavorings (e.g., mint, cinnamon) and sodium lauryl sulfate Use mild fluoridated children's toothpaste or no dentifrice (e.g., brush with water) Use bland rinses (e.g., 0.9% normal saline* or 0.5% sodium bicarbonate [§] rinses) to reduce mucosal irritation and discomfort Use an extra soft bristle toothbrush Avoid spicy, acidic, hard, and crunchy foods and drinks
Oral candidiasis/ Angular cheilitis	Rx: Antifungal medications Referral to oral medicine specialist or patient's oncologist	Consider dental caries risk if a patient is using antifungal rinse or troche with sucrose Professionally clean removable prostheses	Clean and disinfect removable prostheses daily Remove prosthesis overnight
Salivary gland hypofunction and xerostomia	Rx: Sialogogues (e.g., pilocarpine or cevimeline)	Perform dental caries risk assessment Assess for signs of oral candidiasis Assess for dysphagia and aspiration risk Provide nutritional counseling and oral hygiene instruction accordingly	Increase water/fluid intake for hydration Use over-the-counter moisturizing and lubricating rinses, gels, sprays, and/or saliva substitutes Stimulate saliva with sugar-free or xylitol-containing gum/lozenge Use bland rinses (e.g., 0.9% normal saline or 0.5% sodium bicarbonate rinses) to moisturize and cleanse the mouth
Superficial mucoceles	Treatment rarely indicated, referral to oral medicine specialist if sufficiently bothersome	Provide patient reassurance Assess for habits or local irritants that may cause or aggravate mucoceles (e.g., trauma prevention)	No treatment required; allow natural resolution

Oral Manifestation (Sign or symptom)	Treatment	Dental Hygiene Care Considerations	Oral Hygiene Self-Care Recommendations
Dental caries	In-office fluoride treatment Fluoride varnish or gel application at 3–6-month recare intervals Silver Diamine Fluoride (SDF) application to individual carious lesions Rx: 5000 ppm (1.1%) sodium fluoride toothpaste/gel	Perform caries risk assessment Adjust recare intervals and bitewing radiographic exposures based on caries risk Perform nutritional counseling as appropriate Apply fluoride varnish, gel, or SDF Provide detailed, written oral hygiene instructions (e.g., home fluoride use, method, and frequency)	Perform adequate biofilm removal with minimal twice-daily toothbrushing and once-daily interdental cleaning Brush with prescription 1.1% sodium fluoride toothpaste at least twice daily. For extreme caries risk: also wear trays with 1.1% NaF gel for five minutes daily Reduce frequency of sugar-sweetened food and beverage intake (e.g., refined fermentable carbohydrates, sports/energy drinks, sodas, juices, etc.) Increase consumption of non-cariogenic and cariostatic foods Rinse with water or bland rinse following consumption of carbohydrates if unable to brush
Orofacial sclerosis and trismus	Physical therapy	Schedule shorter appointments Provide patient with frequent breaks Use bite blocks for patient comfort Adapt oral physiotherapy aids for patient's limited mouth opening	Use floss holders, floss picks, interdental brushes, or oral irrigators/water flossers (with gentle pressure) for interdental cleaning Seek long-term orofacial physical therapy
Oral squamous cell carcinoma	Biopsy for diagnosis	Perform oral cancer screening Document suspicious lesions with intraoral photographs Perform motivational interviewing for tobacco cessation and/or limiting alcohol use, if applicable	Routinely apply lip care products with SPF 30+ Adhere to regular dental recare visits for routine extraoral/intraoral examinations and oral cancer screenings Avoid tobacco use and excessive alcohol consumption

* Normal saline: mix 1 to 2 teaspoons salt to one quart warm or cool water (patient preference; adjust to taste – not too salty). Can add 1 tablespoon baking soda (sodium bicarbonate).

§ sodium bicarbonate rinse: mix 1–2 tablespoons of baking soda to one quart of warm or cool water (patient preference and adjust to taste – not too strong)

mouth opening.^{31,63,64} Dental hygiene care appointments may be challenging for the patient and provider alike due to the patient's limited opening. Adaptations may be necessary to increase patient comfort and acceptance of care. These may include the use of bite blocks, shorter appointments, and frequent breaks during longer appointments.⁶⁴ When mouth opening is limited, dental hygienists may need to assist patients in identifying oral physiotherapy aids that improve access and effectiveness (e.g., an oral irrigator).⁶⁵

Conclusion

Patients with oral cGVHD present with unique challenges that require special attention during dental hygiene care. While this is a relatively small subset of the general population, the number of people surviving long-term after alloHCT is growing and is expected to continue to increase over time. Although major clinical features of oral cGVHD are not directly treated in the dental setting, the dental hygienist plays a central role in detecting, assessing, documenting, and educating the patient about the disease's signs and symptoms. Dental hygienists must take the time to inform patients with oral cGVHD of their elevated dental caries and oral cancer risks while educating them on risk reduction. Dental hygienists must counsel patients on the importance of regular oral mucosal exams and adherence to the recommended continuing care interval to monitor for signs and symptoms of disease. The dental team should work collaboratively with the patient's medical team to optimize care coordination and maximize oral health outcomes for these unique and complex patients.

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Effects of a Radiography Checklist on Reducing Retake Exposures

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Abstract

Purpose: Typically implemented as a safety measure, checklists can reduce risks and improve patient outcomes. Checklists have been widely used in medicine, but rarely applied to dentistry. The purpose of this replication study was to evaluate the effectiveness of a dental radiography checklist intervention for improving the diagnostic value of bitewing images and reducing retake exposures.

Methods: Two cohorts of dental hygiene students from programs in the same community college district participated in the mixed methods study; one as intervention group ($n=22$), the other as control group ($n=23$). The intervention group used a checklist each time bitewing images were acquired on manikins and live patients while the control group followed the usual protocol for image acquisition. Calibrated faculty evaluated all images and recorded whether images passed, failed, or required retakes. All participants completed a demographic survey at the study conclusion while the experimental group completed two additional surveys regarding perceived value of the checklist and intention to continue its use outside the educational setting. Descriptive and inferential statistics were used to analyze the data.

Results: Image failure and retake rates were significantly lower in the experimental group on both manikins and live patients ($p<0.001$). The control group experienced a lower failure rate on patients versus manikins; however, overall retake rates were higher than the experimental group. While the retake rate improved among both groups from manikin to human exposures, the magnitude of change across groups did not differ ($p=0.992$). Sensor placement was the most common cause for a failing image. Participants generally considered the checklist thorough and easy to use, however there was less agreement that it improved image quality or that they would continue its use outside the educational setting.

Conclusion: A radiography checklist used in an educational setting was successful in reducing bitewing image failure and retake rates, thus benefiting patient safety with reduced radiation exposure.

Keywords: checklists, dental hygiene education, dental radiography, evidence-based practice, dental radiation, patient safety

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Introduction

Checklists have a long history as a safety and standardization tool. First used in aviation in the 1930s, their use has expanded into a variety of professions including construction, finance, and medicine.¹ Checklists are not intended to be instructional devices but serve as reminders of what the user is expected to know and do in a given situation.² Particularly during a critical task or emergency procedure, checklists eliminate the need to rely on memory or intuition.³

One of the first and best-known examples of a checklist application in medicine was a study designed to reduce the incidence of catheter-related bloodstream infections among intensive care unit patients.⁴ When combined with additional measures including enhanced provider awareness and enforced

adherence to infection control practices, results demonstrated near elimination of catheter-related infections. The checklist movement gained further momentum when the World Health Organization (WHO) published the Surgical Safety Checklist in 2008.² Developed by a group of international experts with a goal of making surgery safer around the world, the resulting checklist has been lauded for its effectiveness.⁵⁻⁸

Checklist use in medicine expanded rapidly in the decade following the WHO initiative.⁹⁻¹¹ Its use in dentistry however, remains the exception rather than the rule. A review of the literature suggests that when dental checklists are used, they are frequently applied to higher risk procedures such as implant placement and oral surgery.¹²⁻¹⁴ However, other

procedures with less immediate risks may benefit from the procedural standardization that a checklist provides.

Dental radiographic imaging uses relatively low levels of ionizing radiation. Yet lack of a known “safe” threshold dose and the radiosensitivity of various tissues of the head and neck require that only essential images be exposed.¹⁵⁻¹⁷ Additionally, the need for ongoing radiographic exposures over a patients’ lifetime, challenges presented by intraoral image acquisition, and a goal of acquiring diagnostic images on the first attempt, mean that operator training and adherence to safety measures are essential. The range of checklist applications in medicine and similarities with dentistry suggest that additional exploration is warranted.

In a previous study evaluating the effectiveness of a dental radiography checklist on improving the diagnostic value of bitewing images and reducing retake exposures,¹⁸ the checklist intervention did not result in improved diagnostic value of images or a reduction in radiation exposure. However, in that study, only paralleling aiming devices were used, the majority (94%) of images were acquired using a photostimulable phosphor plate (PSP) system, and participants in the intervention group acquired mostly vertical bitewings (91%). Other limitations were the time frame (12-weeks) and the limited number of assessments (five sets of bitewings acquired on live patients per participant).¹⁸ Given the limitations of the original research and the potential impact of a checklist on patient safety, a replication study was warranted. The purpose of this study was to evaluate the effectiveness of a dental radiography checklist in improving the diagnostic value of bitewing images and reducing retake exposures on both manikin and live patients. User perception of the value of a radiography checklist and willingness to continue its use in clinical practice was also assessed.

Methods

The Institutional Review Board of the Maricopa County Community College District (2014-11-384) and A.T. Still University (2015-092) deemed this study exempt. A mixed-method design with quantitative and qualitative assessments was developed. Dental hygiene students from two programs within the Maricopa County Community College District in Arizona were solicited to participate. A sample size analysis was not conducted prior to study inception as the design called for participation of all students enrolled in each program, provided they agreed to participate. All participants shared a similar didactic foundation given that the programs utilized a shared admissions process and implemented the same district-mandated curriculum.

A nonrandomized control group design, using one program cohort as the control group (n=23) and the other as the experimental group (n=22) was implemented in fall of 2015 as the students matriculated into the four-semester program. The Principal Investigator (PI) met with each cohort during a regularly scheduled class period to introduce the study and obtain informed consent.

During semester one, both cohorts participated in a didactic radiology course and the associated laboratory course, in which only manikin images were exposed. From semester two through four, students made radiographic exposures on live patients during regularly scheduled clinic sessions. Both programs used their usual supplies and equipment throughout the study for the acquisition of radiographic images. All participants followed the same procedures when acquiring images: the oral cavity was inspected, the types and number of images needed were determined, necessary supplies and exposure aids were assembled, and the images were exposed with consideration for the patient’s specific oral conditions. Students elected to acquire either vertical or horizontal bitewings and whether to use a wired sensor or PSP system.

Didactic and image acquisition instructions remained the same for both the control and experimental groups with one exception. Participants in the experimental group were asked to reference an eight-step radiography checklist displayed in each radiography treatment room when acquiring bitewing images. The checklist highlighted the essential steps in the image acquisition process and was visible to the operator throughout the set-up and exposure procedures (Figure 1). The checklist was developed according to best practices identified in the literature and incorporated simple, minimal language, actionable steps, was sized and formatted for easy reference, and hung on the wall directly behind the patient chair for the duration of the study.^{1, 19-21} Participants were not expected to apply a physical checkmark to the document.

Faculty at each program randomly assigned an identification number to study participants; control group numbers ranged from 1-25 and intervention group numbers ranged from 26-50. This number was used by faculty when recording image data and by participants when completing study surveys. Participants were known to the PI by number only.

Faculty for both the control and experimental groups recorded the evaluative data on a collection form for all bitewing images acquired from semester one through semester four. All faculty who participated in evaluating and recording bitewing image data were calibrated by the PI in advance of the study. Faculty were asked to provide data from four-image bitewing series only. Any incomplete series or those consisting

Figure 1. Dental radiography checklist for bitewing images

Exposing Bitewing Images	
Prior to Receptor Placement	
Oral Inspection	Complete
Supplies	Assembled
Exposure Setting	Set
Tubehead	Set
After Receptor Placement	
Teeth of Interest	Covered
Contacts	Open
Occlusion	Verified
Tubehead	Positioned
Expose	

of fewer than four images were not evaluated for study purposes.

Evaluation criteria regarding diagnostic and nondiagnostic images was established as well as what constituted the need for a retake exposure. Faculty evaluated all exposures according to programmatic requirements but also indicated on the data collection form when and how images failed to meet minimum diagnostic criteria and whether a retake exposure was needed to visualize the targeted areas of interest. Failing images were noted with an “F” and the error causing the failure: sensor placement (SP), horizontal angle (HA), vertical angle (VA), and “other” (cone cut, reverse sensor, etc.). If an image needed to be retaken in order to visualize a specific area of interest, an “R” was also recorded. Not all failing images required a retake if the target information was visible on the adjacent image.

At the conclusion of the study, respondents in both the control and experimental groups completed a survey regarding individual demographics and previous radiography experience. Respondents in the experimental group completed two additional surveys: one that addressed perceived value of the checklist and a second survey that explored willingness to use the radiology checklist outside of the educational setting.

All instruments used in the study were created by the PI and based on the literature, with the exception of the Radiography Checklist Intentions

Survey.²² The instruments were evaluated for content validity and then pilot tested for reliability using a test/retest method with a third dental hygiene program cohort in the same community college district as the control and experimental groups. Suggestions for improvement and modification were incorporated into the instruments as deemed appropriate.

Statistical analysis

Descriptive statistics, including counts and percentages for categorical variables and means and standard deviations for continuous variables, are provided. A generalized estimating equations approach was used to accommodate the multiple images exposed by each participant. Logit models with auto-regressive correlation matrices were specified. Sequential Bonferroni adjustments were used to interpret significance. Spearman’s rho was used to estimate monotonic relationships between variables and Cronbach’s α was calculated to estimate the internal consistency of scale items. Analyses were performed using a statistical software program (SPSS Ver. 25, IBM Corp., Armonk, NY, USA). The criterion for statistical significance was $\alpha = 0.05$, two-tailed.

Results

A total of 45 dental hygiene students from the two programs consented to participate. All but one of the participants was female, and the mean participant age was 32 years (SD 7.34). Among all survey respondents ($n=36$), six participants from the control group and eight participants from the experimental group stated they had prior radiography experience. Most participants with prior radiography experience were trained through a formal, multi-session course as opposed to on-the-job training; sensor-based imaging was the most frequently identified radiographic acquisition system among participants with dental radiography experience. Sample demographic information collected in the post-intervention survey is shown in Table I.

A total of 4,400 bitewing images were evaluated in the study. Images acquired in semester one were exposed on manikins, and from semester two through four, on live patients. Primary analysis was based on exposure of 2,160 bitewing images in the control group ($n=23$, $M=94$), and 2,240 images in the experimental group ($n=22$, $M=102$). The number of images exposed per student was not evenly distributed, i.e., some exposed more than the mean number of images and some fewer. Retrospectively, assuming only 50 replications per student, and an autocorrelation (AR1) of 0.60, analysis achieved 80% power (two-tailed) to detect an odds ratio as small as 1.7 (e.g., 20% incorrect responses for the experimental group versus 30% incorrect responses for the control group, $\alpha = 0.05$).

Seventy percent of all images were horizontally oriented and 30% were vertically oriented while 72% of all images were acquired using a paralleling aiming device and 27% with tab holders. Thirty bitewing series were inadmissible as part of the data set ($n=11$ control group; $n=19$ experimental group). Reasons for rejection included missing data (participant number, type of holder, etc.), fewer than four images in the series, and students working together on image acquisition.

The failure rate was higher in the control group for both manikin

Table I. Post-intervention survey sample demographics (n=36)

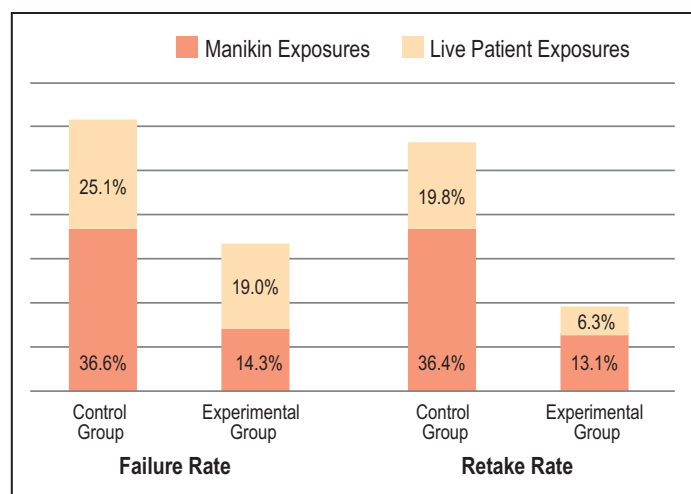
Characteristics	Control (n=18)	Experimental (n=18)
Gender		
Female	17	18
Male	1	0
Age (average yrs.)	30.61	32.44
Prior dental experience*		
Observation only	11	6
Front office	5	5
Back office	1	2
Dental hygiene assistant	1	1
Dental assistant	7	7
Prior radiography experience		
Yes	6	8
No	1	4
Prior radiography system experience*		
Traditional film	3	6
Phosphor plate	4	3
Sensor-based	5	7
Total years radiography experience		
1-3 yrs.	0	3
4-6 yrs.	1	1
7-9 yrs.	1	1
10+ yrs.	4	3
Prior radiography training		
On-the-job	1	2
Formal course	5	6

*Participants may have selected multiple options for these categories.

and live patient exposures ($p<0.001$) (Figure 2). On average, the failure rate was slightly lower on patients (22.2%) versus manikins (25.5%), $p<0.008$. When considering the failure rate, interactions between the control and intervention groups and manikins versus live patients were statistically significant (Wald Chi-Square=0.000). Likewise, the retake rate was higher in the control group for both manikin and live patient exposures ($p<0.001$) (Figure 2). The retake rate among both groups was significantly lower on patients (11.5%) than on manikins (22.8%), $p<0.001$. While both groups improved from manikin to human exposures, the magnitude of change across the two groups did not differ ($p=0.992$).

The most common error resulting in a failing image across both groups, all semesters, was sensor placement

Figure 2. Failure and retake rate by group and type



(16.9%), followed by horizontal angle (6.0%), and vertical angle (2.8%). A total of 27 images failed due to “other” causes. When considering only live patients, sensor placement remained the most common cause of failure for both the control and experimental groups ($p<0.001$). While the control group had a higher percentage of failures due to sensor placement ($p<0.001$) and horizontal angle ($p<0.001$), the experimental group experienced more vertical errors than the control group ($p<0.001$) (Figure 2). No significant differences in failure rate from all errors was identified across bitewing image views: right molar 22.4%, right premolar 22.5%, left premolar 23.7%, and left molar 22.2%.

Most participants (80%, n=36) completed the demographic survey at the completion of the study (4th semester). When asked about prior radiography experience, 61% indicated no experience, 8% had 1-3 years, 6% had 4-6 years, 6% had 7-9 years; 19% reported having 10 or more years of experience. Years of radiography experience were not correlated with either the number of failing ($rs=0.11$, $p=0.55$) or retake exposures ($rs=-0.08$, $p=0.67$). Participants with no experience and those with 10 or more years of experience demonstrated similar outcomes.

Experimental group participants (n=18) completed a survey designed to assess their perceived value of the checklist (Cronbach’s $\alpha=0.73$). Respondents indicated that the checklist was simple to incorporate and use as part of the radiographic exposure process, but fewer agreed that it improved the quality of images (Table II). Three survey items solicited qualitative comments. When asked what aspects of the checklist caused it to be effective, 12 comments were provided. The physical characteristics of the checklist and its ease of use were mentioned by half of the respondents who provided comments (n=6) while the remaining comments

Table II. Perceived value of the radiography checklist (n=18)

Question*	Mean (SD)**
The radiography checklist was easily adaptable to the bitewing acquisition process.	4.00 (0.686)
The radiography checklist was not disruptive to the radiographic acquisition process.	4.56 (0.784)
The radiography checklist required little or no additional time to incorporate into the radiographic acquisition process.	4.00 (0.767)
The radiography checklist was thorough and included all steps necessary for acquiring diagnostic images.	4.06 (0.725)
The radiography checklist was effective at improving the quality of my bitewing exposures.	2.78 (0.943)

* Response options: Strongly Disagree = 1, Disagree = 2, Neither Agree nor Disagree = 3, Agree = 4, Strongly Agree = 5.

**SD = Standard Deviation.

indicated that the student either forgot about the checklist or didn't use it at all. When asked to elaborate why the checklist was ineffective, participants stated that they forgot about the checklist or never used it (n=5); the location of the checklist hindered its use (n=2); the checklist didn't provide enough detail on how to correct one's errors (n=1). When asked if they would change something to make the checklist more useful, of the 15 comments provided, over half indicated that no changes were needed (n=8), while several felt the location of the checklist was a barrier (n=3), the remaining respondents were unsure (n=1) or felt the question was not applicable (n=3).

Participants in the experimental group also completed a 12-item Radiography Checklist Intentions Survey (Cronbach's $\alpha = 0.89$) regarding their intentions to continue use of the checklist. Despite being considered easy to use, few respondents planned to use the checklist, or expected their classmates to, in the future. A modest correlation between perceived value of the checklist and intention to continue its use was found ($r_s = 0.184$).

Discussion

High quality radiographs are an essential diagnostic tool for oral health care professionals. However, the dangers of ionizing radiation and radiosensitivity of head and neck tissues require the operator to be a skilled radiographer in order to minimize retakes. A radiography checklist designed

to highlight the critical aspects of image acquisition can serve as an aid to the clinician in acquiring diagnostic images and reducing technique error. In this study, an experimental group used a radiography checklist throughout a four-semester program resulting in lower image failure and retake rates as compared to the control group.

While the failure rate of manikin images was considerably higher in the control group as compared to the intervention group, the percentage of failures among this group declined on live patients. However, the experimental group, who used the radiography checklist for all exposures, saw a small increase in failing images on live patients. Although the failure rate in the experimental group remained lower than the control group, the increase may be attributable to the challenges encountered when working in the oral cavity on a live patient.

It is noteworthy that not all failing images require reexposure. While an image may not meet minimum diagnostic criteria, if the areas of interest are evident on an adjacent image a retake exposure may not be necessary. In this study, the retake rate for both the control and experimental groups on manikin exposures was very similar to each group's failure rate, suggesting that in the context of a four-image bitewing series, failing images were not "saved" by adjacent images in either group. The retake rate of live patient images decreased significantly for both groups, resulting in decreased radiation exposure to patients. A likely cause for the reduced retake rate could be due to gains in operator experience and learning.

When considering all errors that resulted in image failure, sensor placement occurred with the greatest frequency. While bitewing retakes frequently occur due to missing mesial or distal structures,²³ challenges presented by tori, arch shape, and other anomalies may also contribute. Horizontal angle errors were second most prevalent among both groups, although the experimental group had a higher percentage of vertical angle errors than horizontal errors on live patients. The same causative factors related to sensor placement errors could also result in vertical angulation errors.

An interesting outcome regarding prior radiography experience and image failure and retake rates was evident. Although no correlation was found among these variables, participants with no radiography experience and those with the most experience demonstrated similar outcomes. It is not unusual for students with significant prior experience to initially struggle to succeed with dental radiography, especially if they received on-the-job training. Individuals who acquire their experience on-the-job often lack didactic and clinical instruction in radiographic principles and need to "unlearn" bad habits and poor technique. Strict attention

to detail and familiarity with the grading criteria generally resolve this issue.

Even the best designed intervention will fail if it is not used as intended. In this study, participants generally agreed that the checklist was thorough and simple to use and was easy to incorporate without being disruptive. There was less agreement however, that the checklist improved the quality of the images. It is possible that participants in the experimental group, who were trained to use the checklist from the beginning of their radiography instruction, were not cognizant of the benefits it provided. A significantly lower image failure and retake rate as compared to the control group further supports this assumption.

The Radiography Checklist Intentions Survey indicated that although participants had a strong belief that they could use the checklist on their own, they did not intend to do so, nor did they believe that their classmates would. In this study, the radiography checklist was introduced into the academic setting as part of a research project designed to assess its effect on the diagnostic value of bitewing images. It is possible that students viewed the checklist as a temporary instructional tool rather than a permanent safety measure. Based on the significantly lower failure and retake rates attained by the experimental group as compared to the control group, it may be advantageous to promote the checklist as a standard component of the image acquisition process in the future.

Although this study saw significantly lower image failure and retake rates in the experimental group as compared to the control group, a previous study by Nenad et al.¹⁸ did not. In the earlier study, the intervention group experienced a higher failure and retake rate than the control group even though participants found it similarly helpful and easy to use. The larger number of images acquired on both manikins and live patients throughout the duration of the program improved confidence in trends observed in the current study.

Some important distinctions between the two studies should be noted. The current study was implemented over the course of a four-semester curriculum while the previous study took place during a 12-week period in the final semester of the program. It is possible that learning with the aid of the checklist for the duration of the program allowed its use to become a habit resulting in more successful images on the first attempt. Additionally, a greater percentage of images were horizontally oriented, exposed using a tab holder, and acquired with a digital sensor, than in the previous study. Each of these factors may have influenced the quality of the images thereby affecting the failure and retake rates.

This study had several limitations that may have influenced outcomes. Operator fatigue may have occurred as the study progressed resulting in participants no longer “seeing” the checklist. Participants were not asked to make a physical check mark on the document making it impossible to determine if each item was read and/or performed. If an image “failed”, was reexposed, and “failed” again, only data from the first “failed” image was recorded for purposes of the study. Suggestions for future research include adapting a radiography checklist to clinical dental hygiene practice outside the educational setting and further exploration of participant belief that although the checklist was readily adaptable to practice, it did not contribute to improved image quality.

Conclusion

Use of a radiography checklist in the educational setting can contribute to reduced radiographic image error and retake rates, thereby reducing patient exposure to ionizing radiation. Ease of implementation and participant acceptance of the checklist may further encourage dental and allied dental education programs as well as practitioners to consider adapting a radiography checklist to their image acquisition procedures.

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Color-Blind Racial Attitudes in Practicing Dental Hygienists

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Abstract

Purpose: Individuals who subscribe to a color-blind racial ideology may not be aware of differences or differential treatment based on race which may be related to racial inequality in the delivery of oral health care. The purpose of this study was to determine color-blind racial attitudes in a convenience sample of clinical dental hygienists.

Methods: A convenience sample of practicing dental hygienists recruited through social media via snowball sampling was invited to participate in this cross-sectional survey study. The Color-Blind Racial Attitudes Scale (CoBRAS), a valid and reliable measuring instrument, was used to determine unawareness of racial attitudes and stereotyping. Three subscales (Racial Privilege, Institutional Discrimination, and Blatant Racial Issues) were measured by the survey. Descriptive statistics and separate one-way between-subjects ANOVA were used to analyze the data.

Results: Two-hundred and thirty-three ($n = 233$) dental hygienists in clinical practice completed the survey. ANOVA revealed statistically significant differences in overall CoBRAS scores when comparing age groups and ethnicities. Participants aged 18-29 had significantly lower overall CoBRAS scores compared to participants aged 60 and over ($x = 49.41$, $x = 59.17$, respectively; $p = .019$). African American participants scored significantly lower on overall CoBRAS scores compared only to those in the Other ethnicity category ($x = 42.27$, $x = 62.08$, respectively; $p = .029$).

Conclusion: Participants possessed moderate levels of color-blindness, suggesting unawareness of racism and a need to understand the implications of racism as a means of promoting equity and improve oral health care delivery. Findings emphasize a need for more research examining color-blind ideology and how it affects oral health care delivery to diverse patient populations.

Keywords: color-blind racial attitudes, cultural competency, racial stereotyping, dental hygienist, racial privilege

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Introduction

Institutional racism, a form of racism embedded through laws and regulations within society; White Privilege, the societal privilege benefitting white people over non-white people in some societies; and unconscious or conscious biases have become increasingly important topics in the United States (US). The effects of these types of constructs contribute to racial inequality and can be seen in many different sectors including employment and health care.² In addition, the US population is experiencing a demographic shift towards increased diversity. Currently, the US Census Bureau estimates that of 328 million American inhabitants, approximately 13% are African American, 6% Asian, 0.2% Native Hawaiian or Other – Pacific Islander, 3% two or more races, and 19% Latino or Hispanic.³ While the population

diversifies, 64% of health care providers are predominately White.⁴ Moreover, research suggests, in the future, caregiver/patient interactions will be in cross racial/cultural dyads.⁵ These demographic shifts highlight a need for the delivery of ethnically and culturally competent health care, including oral health care, to meet the needs of a diversifying population.

The Institute of Medicine (IOM) publication, *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care*, investigated health care disparities and the role of bias and stereotyping at the patient, institutional, and health care system level.⁶ In this report, the IOM found minority groups were less likely to receive cardiac medications or be given proper treatment following a cardiac event,⁷ less likely to receive testing, screening, or pain medication for cancer,^{6,8}

less likely to receive kidney dialysis or transplant⁹, and less likely to receive antiviral HIV drugs,¹⁰ among other care issues. The report also identified differences in delivery of care to minority populations at a disproportionate rate.⁶ This has been a historical trend, with African American populations receiving lower quality of care compared to White counterparts.^{6,7,10-15} Research has also found that some of these disparities extend beyond treatment and care decisions such as minority groups receiving different communication from health care providers.^{11,13} Health care providers may spend less time during appointments with minority patients, infrequently ask patient opinions about treatment decisions, and use a more verbal dominant tone, all contributing to minority patients finding their care to be less patient-centered.^{11,13} Ultimately, the findings of this report support that implicit bias and discrimination were contributing factors affecting health care providers and their patient care decisions.⁶

Implicit biases may manifest in non-verbal behaviors such as eye contact and posture or proximity, and often represent a dissociation between what a person outwardly believes and what is deeply-seated in their thoughts/actions.^{16,17} Implicit biases are different than overt or explicit racism, they are often an automatic, unconscious, unknown negative thought or attitude toward a minority group and can profoundly affect clinical decision-making.^{18,19} The presence of these biases among health care providers and the effects on quality of care are concerning as a clinician may not recognize these deeply seeded thoughts or actions and how they affect their ability to deliver impartial care. Additionally, these biases may operate at a disadvantage to an already vulnerable patient population.¹⁸ Implicit biases have been researched extensively in health care, however, there is a lack of literature in the dental profession. For example, one study examined inherent biases related to race and the effects on dentists' decisions to restore teeth.²⁰ Dentists were given a clinical scenario along with photographs of a Black and White patient and a decayed tooth. Biases were measured through an explicit questionnaire related to how they would treat the patient as well as Implicit Associations Tests (IAT) to measure inherent biases. The study found that overall, dentists were significantly more likely to recommend root canal therapy (RCT) to White patients and significantly more likely to recommend extraction for Black patients instead of a restoration.²⁰ Additionally, 91% of participants scored high on the race preference IAT test and 79% scored high on the race dental cooperative IAT test demonstrating pro-White biases for both IAT tests, and indicating that racial biases might influence the quality of dental care received by Black patients.²⁰

A type of contemporary implicit bias, color-blind racial attitudes, may explain current research findings related to differing care and implicit biases. Color-blind racial ideology can be described as a set of beliefs used to make sense of social categories involving race that emphasizes sameness and does not implicate individuals who are White in racism.^{1,21,22} Moreover, a color-blind ideology focuses on the belief that racism is a concept of the past and all persons have equal opportunities in contemporary society.^{1,21} Those who subscribe to this ideology hold the belief that the color of a person's skin is not seen, everyone is equal, and further opposes the view that racism is an ongoing societal problem.²¹ This ideologic perspective is further explained as one that assumes class and culture, not institutional racism, are responsible for social inequities.²³ Research suggests when evaluated, health care providers with higher color-blind racial ideology scores may engage in racially insensitive behavior and exhibit an increase in negative emotions and a lack of ethnocultural empathy.^{21,24-27} Additionally, research suggests individuals subscribing to color-blind habits may show higher levels of biases on implicit and explicit measures of racism such as IATs.²⁵ All health care should be delivered objectively while taking into consideration the unique characteristics of each patient; however, it is possible some health care providers may exhibit high color-blindness that may be linked to a lack of impartial care.

Although color-blind racial attitudes have been researched in other disciplines, minimal data is available in the dental profession, with only one study in dental hygiene on a student population from one institution in Virginia.²⁸⁻³⁰ Ludwig et al. examined the prevalence of color-blind racial attitudes in dental hygiene students (n=70).³⁰ The results revealed over one-half (65%) of the study participants possessed moderate levels of color-blind racial attitudes, indicating a lack of awareness of White privilege and cultural competence.³⁰ The researchers recommended expanding the sample size to more fully conceptualize color-blind racial attitudes in dental hygienists. Awareness of color-blindness is an important first step in promoting equities in health care and combatting social injustices which may affect dental hygiene care delivery to diverse populations. Therefore, the purpose of this study was to investigate color-blind racial attitudes in a national sample of dental hygienists in the US.

Methods

This study was determined to be exempt (1673546-2) by the Old Dominion University Institutional Review Board (IRB). A convenience sample of dental hygienists who were recruited via social media sites and a non-probability sampling

technique was used for a cross-sectional survey. Snowballing was used to enlist participants in the study. The 24-item survey was administered online (Qualtrics; Provo, UT, USA). Administrators/moderators of dental hygiene Facebook groups were asked for approval to post the survey invitation. Upon approval, a link to the survey instrument was posted on an array of dental hygiene related social media sites. All responses were collected anonymously; voluntary informed consent was understood upon return of the survey. Data collection was performed over a six-week period.

Survey Instrument

The 20-item Color-Blind Racial Attitudes Scale (CoBRAS), a valid and reliable instrument developed by Neville et al.²², was used to measure color blind racial ideology in three subcategories. The first category, Racial Privilege, is comprised of seven items and assesses the blindness of persons to the existence of White Privilege. The seven-item second category, Institutional Discrimination, determines recognition of the implications of institutional forms of racial discrimination, and third category, Blatant Racial Issues, consists of the six questions designed to measure awareness of general pervasive racial discrimination. Participants used a 6-point Likert scale ranging from strongly disagree (1) to strongly agree (6), to determine level of agreement or disagreement with the 20 statements. Responses were added to obtain subscale and overall scores with total scores on CoBRAS ranging from 20-120 and subscale scores ranging from 7-42. Higher scores indicate higher levels of denial or unawareness of racism. Overall scores ranging from 20-53.3 indicate low unawareness, 53.4-83.7 moderate unawareness, and 83.3-120 high unawareness. Subscale scores ranging from 7-18.6 indicate low unawareness, 18.7-30.3 moderate unawareness, and 30.4-42 high unawareness. In addition to the CoBRAS, five demographic questions were also included (age, gender, ethnicity, geographic location, and education level) in the survey.

Statistical Analysis

A statistical power analysis and effect size (medium effect size; $=0.25$) was performed.³¹ The projected sample size needed for an alpha $=.05$, power $=.80$, and a medium effect size (G*Power 3.1), was approximately $n=231$. Descriptive statistics were used to evaluate the means between groups. Separate one-way between subject's ANOVA were used to determine statistically significant differences ($p<0.05$) among dental hygienist participants based on age, ethnicity, geographic location, and level of education. If Levene's statistic was significant and violated the assumption of homogeneity of variance, the F -statistic was adjusted and reported using Welch's F and Games-Howell post hoc tests were utilized to find significant differences between groups.

Results

Two hundred and seventy-two dental hygienists participated in the study; 39 surveys were not used due to incomplete data, yielding a participation rate of 86% ($n=233$). Most respondents (96%, $n=224$) were women, one-third of participants (36%, $n=85$) were between the ages of 30-44 and one-third (33%, $n=76$) were aged 45-59. Nearly half of participants (48%, $n=111$) had a four-year degree, 39% ($n=91$) held a two-year degree, and 11% ($n=26$) held a master's degree. Geographically, almost half of participants (46%, $n=106$) were from the

South and most participants were White (71%, $n=166$). Demographic characteristics are displayed in Table I.

Results revealed an overall average score of 54.04 on the CoBRAS questionnaire indicating overall moderate unawareness of racism among participants (Table II). When comparing overall CoBRAS means among the group demographics of geographic location and education, no statistically significant differences were found ($p's>0.05$). However, when comparing age groups, ANOVA revealed a statistically significant difference ($F(3, 99.844)=4.076, p=.009$).

Table I. Participant demographics (n = 233)

Gender	n (%)
Female	224 (96.14)
Male	3 (1.29)
Choose not to respond	6 (2.58)
Age	n (%)
18-29	37 (15.88)
30-44	85 (36.48)
45-59	76 (32.62)
60+	35 (15.02)
Education	n (%)
Two-year degree	91 (39.06)
Four-year degree	111 (47.64)
Master's degree	26 (11.16)
PhD or equivalent	5 (2.15)
Geographic Location	n (%)
Northeast	39 (16.74)
Midwest	54 (23.18)
South	106 (45.49)
West	34 (14.59)
Ethnicity	n (%)
White	166 (71.24)
Black or African American	11 (4.72)
American Indian or Alaska Native	3 (1.29)
Hispanic	16 (6.87)
Asian	12 (5.15)
Mixed	12 (5.15)
Other	13 (5.58)

Games-Howell post hoc test revealed participants aged 18-29 had significantly lower overall CoBRAS scores when compared to participants aged 60 and over ($x=49.41$, $x=59.17$, respectively; $p=.019$). Additionally, ANOVA revealed a statistically significant finding related to ethnicity ($F(6, 226)=2.561$, $p=.020$). Tukey post hoc tests revealed participants of African American ethnicity had significantly lower overall CoBRAS scores compared to those who identified in the Other ethnicity category ($x=42.27$, $x=62.08$, respectively; $p=.029$) (Figure 1).

CoBRAS subscales were also compared among group demographics of age, ethnicity, level of education, and geographic location. Participant average score on the racial privilege subscale was 16.80, indicating low unawareness of White racial privilege. When comparing means among group demographics of age, level of education, and geographic location on the racial privilege subscale, no statistically significant differences were found ($p's>0.05$). When comparing ethnicity groups, ANOVA revealed a statistically significant difference between ethnicity groups ($F(6, 226)=2.541$, $p=.021$), however Tukey post hoc tests showed that there was no significant difference between any ethnicity groups (Table III).

Table II. Overall and subscale scores for all groups (n=233)

Group	Score (x)	Racial Privilege (x)	Institutional Discrimination (x)	Blatant Racial Issues (x)
Overall CoBRAS				
	54.04	16.80	23.46	13.78
Age				
18-29	49.41	16.49	19.59	13.32
30-44	51.92	16.22	22.42	13.27
45-59	56.32	16.67	24.87	14.68
60+	59.17	18.63	27.03	13.51
Geographic Location				
Northeast	55.95	17.08	24.36	14.51
Midwest	53.22	16.93	23.24	13.06
South	53.61	16.24	23.45	13.92
West	54.50	18.06	22.82	13.62
Ethnicity				
White	54.78	17.09	23.84	13.85
Black/African American	42.27	13.82	17.64	10.82
American Indian or Alaska Native	61.33	19.67	28.00	13.67
Hispanic	46.81	16.13	19.69	11.00
Asian	54.58	19.17	21.75	13.67
Mixed	52.50	13.50	23.67	15.33
Other	62.08	17.08	27.83	17.17
Education				
2-year degree	55.71	17.16	24.15	14.40
4-year degree	52.99	16.92	22.68	13.39
Master's	52.35	15.73	23.58	13.04
PhD or equivalent	57.00	12.00	29.20	15.80

Figure 1. Overall CoBRAS score based on ethnicity

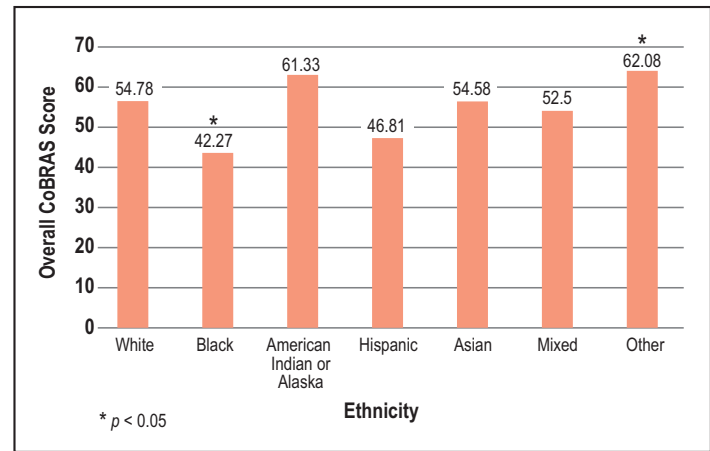
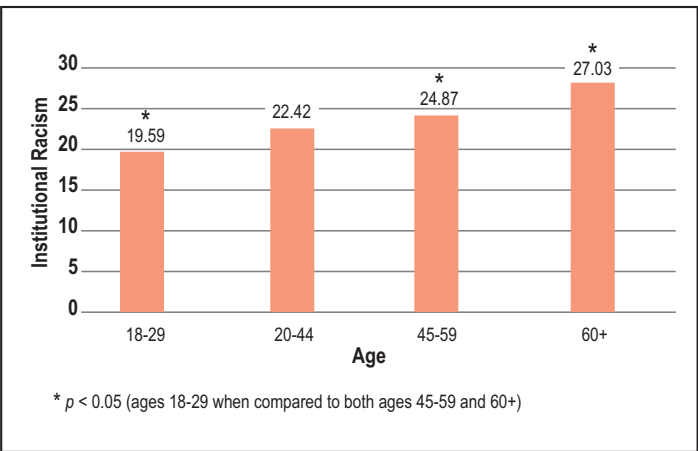


Figure 2. Institutional racism based on age



The overall average score on the institutional racism subscale was 23.56, indicating moderate unawareness of the implications of institutional types of racism (Table II). When comparing means among group demographics of level of education and geographic location, no statistically significant differences were found ($p > 0.05$). However, when comparing age groups, ANOVA revealed statistically significant differences ($F(3,100.849)=7.443, p < .001$). Games-Howell post hoc test revealed participants aged 18-29 had significantly lower scores on the institutional racism scale compared to participants aged 45-59 and 60 and older ($x=19.29, x=24.87, x=27.03$, respectively; $p=.004$ and $<.001$). Additionally, participants aged 30-44 had significantly lower institutional racism scores compared to those 60 and older ($x=22.42, x=27.03$, respectively; $p=.019$) (Figure 2). When comparing ethnicity groups, ANOVA revealed a statistically significant difference between ethnicity groups ($F(6, 226)=2.239, p=.041$), however, Tukey post hoc tests showed there was no significant difference between an individual group (Table III).

Finally, the overall average score on the blatant racial issues subscale was 13.87, indicating low unawareness of more overt, pervasive racism. When comparing group means among demographics of age, level of education, and geographic location, no statistically significant differences were found ($p > 0.05$). However, when comparing ethnicity groups on the blatant racial issues scales, ANOVA revealed a statistically significant difference ($F(6, 226)=2.234, p=.041$). Tukey post hoc test revealed participants of Hispanic ethnicity scored significantly lower on the blatant racial issues scale compared to those in the Other ethnicity category ($x=11.00, x=17.17$, respectively; $p=0.048$).

Discussion

Biases in health care providers may influence patient-provider relationships, hiring and promotion practices, decision making, treatment, and interpersonal communication thereby perpetuating health inequities.^{6-15,18,19} Striving to mitigate both explicit and implicit bias is important for all clinicians including oral health care providers and starts with awareness. Refusing to acknowledge differing values, traditions, and racial identities creates obstacles to acceptance and serves as a barrier when addressing the negative impact of racial discrimination and health care.³² This study investigated the prevalence of one form of implicit bias, color-blind racial attitudes in dental hygienists in the US. Overall participant CoBRAS questionnaire scores indicate moderate levels of denial/unawareness of racism. These findings were similar to previous studies among dental and dental hygiene students.²⁸⁻³⁰ Interestingly, average subscale scores

of participants indicated moderate unawareness in only one subcategory, institutional racism.

Participants scored in the low unawareness range for the subscales unawareness of racial privilege and awareness of blatant racial issues, meaning they were aware of White racial privilege and aware of more explicit forms of racism. These subscale findings were slightly different from previous studies of dental and dental hygiene students where participants were moderately unaware of both institutional racism and White racial privilege, which are considered to be more implicit types of color-blind ideology.²⁸⁻³⁰ Previous research of color blind racial attitudes in students who scored moderate in the White racial privilege scale could be a result of White students experiencing less racial discrimination and less interracial tensions and recognition of racial conflict.³³ Institutional racism exists in unfair policies and institutional culture resulting in differing access to goods and services, including health and dental care for minority groups.^{34,35} Institutional racism is difficult to detect and research suggests it is rarely visible by those privileged by it.^{1,35} Perhaps the practicing dental hygienists in this study, being older and having more life experience, have experienced or witnessed racial discrimination which resulted in their awareness of White racial privilege but unawareness of those negatively impacted by institutional racism, resulting in their moderate scores on this subscale.

The results also showed that older participants (60+) scored significantly higher on the overall CoBRAS questionnaire as well as the institutional discrimination subscale. Additionally, younger participants, aged 18-29, scored in the low unawareness range on the overall CoBRAS questionnaire, indicating they were more aware of the overall implications of racism. For the institutional discrimination subscale, older participants (45-49 and 60+) were significantly more unaware of institutional types of racism compared to those in the 18-29-year-old age group and the 30-44-year-old age group. These findings suggest older participants may be more unaware of the existence of racism as well as the racial inequalities that exist at a societal, political, and economic level.^{36,37} Perhaps these findings can be explained as a product of the culture in which these participants were raised. They could also be related to aging as research suggests the ability to suppress a thought or bias intentionally and unintentionally from consciousness, declines with age.³⁸⁻⁴⁰

There is also evidence suggesting that older adults show greater implicit prejudice than younger adults and the loss of inhibition that occurs with aging may play an important role in activation of those implicit prejudices.³⁸⁻⁴⁰ Additionally, the life experiences of younger individuals in this study along with recent media coverage of implicit and explicit bias

Table III. Statistical analyses on overall CoBRAS and all three subscales (n=233)

Group	Overall CoBRAS Mean (SD)	p-value	Racial Privilege Mean (SD)	p-value	Institutional Discrimination Mean (SD)	p-value	Blatant Racial Issues Mean (SD)	p-value
Age								
18-29	49.41 (14.69)	.009*	16.49 (4.57)	.075	19.59 (7.44)	<.001*	13.32 (5.70)	.366
30-44	51.92 (16.52)		16.22 (4.43)		22.42 (9.20)		13.27 (5.85)	
45-59	56.32 (14.34)		16.76 (4.91)		24.87 (7.67)		14.68 (5.23)	
60+	59.17 (12.89)		18.63 (4.47)		27.03 (6.97)		13.51 (4.77)	
Geographic Location								
Northeast	55.95 (15.48)	.833	17.08 (5.00)	.240	24.36 (7.95)	.880	14.51 (5.78)	.630
Midwest	53.22 (14.35)		16.93 (4.51)		23.24 (8.13)		13.06 (5.21)	
South	53.61 (16.23)		16.24 (4.82)		23.45 (8.86)		13.92 (5.67)	
West	54.50 (15.29)		18.06 (3.82)		22.82 (8.20)		13.62 (5.02)	
Ethnicity								
White	54.78 (14.96)	.020*	17.09 (4.62)	.021*	23.84 (8.20)	.041*	13.85 (5.31)	.041*
Black/African American	42.27 (18.77)		13.82 (5.14)		17.64 (9.62)		10.82 (6.66)	
American Indian or Alaska Native	61.33 (15.01)		19.67 (5.51)		28.00 (9.85)		13.67 (6.11)	
Hispanic	46.81 (15.60)		16.13 (5.01)		19.69 (8.85)		11.00 (4.69)	
Asian	55.77 (11.91)		18.62 (4.23)		22.92 (7.16)		14.23 (4.42)	
Mixed	52.50 (17.11)		13.50 (3.26)		23.67 (9.66)		15.33 (6.79)	
Other	62.08 (10.96)		17.08 (4.03)		27.83 (6.51)		17.17 (5.52)	
Education								
2-year degree	55.71 (15.15)	.540	17.16 (4.58)	.059	24.15 (8.56)	.254	14.40 (5.62)	.396
4-year degree	52.94 (15.76)		16.97 (4.71)		22.61 (8.31)		13.35 (5.45)	
Master's	52.35 (13.47)		15.73 (4.56)		23.58 (8.00)		13.04 (4.94)	
PhD or equivalent	57.00 (17.42)		16.80 (4.66)		29.20 (8.98)		15.80 (6.220)	

* $p < 0.05$

may have increased their awareness of racial inequalities.⁴¹ Importantly, institutional forms of racism may affect oral health care delivery and some dental hygienists may need to practice effortful inhibitory processes, as well as stereotype suppression, to replace implicit thoughts on institutional racism with more egalitarian thoughts.⁴² These efforts may produce a positive impact in reducing some barriers to care for diverse population groups. A greater understanding of the unconscious dynamics operating within a color-blind ideology may lead to challenges in understanding how these biases affect the unbiased delivery of dental hygiene care.⁴³

Participant's race played a significant role in overall CoBRAS scores as well as scores on the blatant racial issues subscale. African American participants scored significantly lower on overall CoBRAS scores compared to those in the Other ethnicity category. Moreover, African American participants' overall CoBRAS scores fell in the low unawareness range. Hispanic participants also scored significantly lower on the blatant racial issues subscale compared to participants in the Other ethnicity category. Hispanic participant average scores on this subscale also fell in the low unawareness range as compared to the moderate range for the Other ethnicity category. Race also played a significant role on the racial privilege subscale with American Indian or Alaska Native and Asian participants scoring the highest on this subscale, in the moderate unawareness range. Often, indigenous, Black, and other minority Americans have faced the most severe oppression and repression in everyday instances within these systems and in the past.^{44,45} Findings from this study were interesting because as minority ethnicities, American Indian and Alaska Native and Asian participants scored in the moderate range on the racial privilege subscale. Research suggests being able to ignore, dismiss, or truly believe privilege does not exist, stems from receipt of that privilege.¹ It is possible this subset of participants have not experienced biases based on their ethnicity which led to their unawareness related to White racial privilege.

In contrast, the African American and Hispanic participants in this study may have been subject to biases based on their ethnicity which led to more awareness and low scores on both the overall CoBRAS and blatant racial issues subscale. These findings were significant as research has indicated racially concordant health care interactions are associated with more positive health care interactions related to communication as well as utilization of health care services.⁴⁶⁻⁴⁸ Dental hygienists will encounter increasing diversity in their patient pool as the US population diversifies across the country. Hence, contemporary oral health care professionals need to increase personal awareness of biases

as an important step in providing impartial care to patients from all ethnicities.⁴⁹ Unless dental hygienists address biases such as color-blindness, oral health disparities may continue. Moreover, as in dentistry, greater diversity in the dental hygiene workforce is needed and, at the same time, increased understanding of the implications of racism by current practitioners may increase and improve access to high-quality oral health care.

Health care providers, including dental hygienists, may harbor color-blind racial attitudes in an effort to promote objectivity in oral health care delivery; however, research indicates these attitudes perpetuate barriers and is negatively associated with multicultural knowledge and empathy.^{21,26,27} Research suggests the attitudes of health care providers and their effect on health disparities are relevant and require further examination.⁶ As a part of diversity training in the education experience, dental hygiene programs might consider adding curriculum content and training programs related to increasing awareness of biases and stereotyping as well as information on gaining an understanding of how personal attitudes affect patient care. Instilling a lifelong commitment to evaluating how personal biases and assumptions may affect the oral health care they deliver to individuals of varying ethnicities and backgrounds is important. Continuing education courses that help participants recognize and evaluate colorblind ideologies is also suggested as an important strategy for mitigating bias in the delivery of oral health care by current clinicians. Equity training may make counterproductive color-blind language and attitudes more transparent and foster more equitable and inclusive oral health care.⁵⁰

Limitations

Several limitations could have influenced the results of this study. Upon viewing the survey invitation, dental hygienists familiar with color-blind ideologies may have been more likely to respond, which may have impacted the results. Other dental hygienists may have felt they did not understand the concept well enough or felt the topic was too controversial to respond. Future studies could include a brief synopsis of color-blind ideology in the invitation letter with a short explanation of the importance of participation. This could increase the response rate for future studies. Research focused on how dental hygienists' color-blind attitudes affect patient care is suggested as a starting point in addressing oral health inequities associated with bias. Future studies should also focus on education and intervention strategies specifically designed for oral health care professionals to assist with understanding and mitigating personal bias whether it is implicit or explicit.

Conclusion

Participants scores revealed moderate unawareness of the implications of a color-blind ideology on racism and older participants scored significantly higher on the institutional racism subscale compared to younger participants. African American and Hispanic participants were more aware of explicit forms of racism and American Indian or Native Alaskan and Asian participants were more unaware of White racial privilege. Findings underscore the need for more research to better understand how a color-blind ideology affects dental hygiene care. Awareness of color-blindness in oral health care professionals may be an important initial step in promoting more equitable delivery of care to increasingly diverse patient populations now and in the future.

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Experiences, Knowledge and Perceptions of Dental Hygienists, in the Treatment of Patients with Post-Traumatic Stress Disorder

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Abstract

Purpose: Post-traumatic stress disorder (PTSD) is a mental health condition that develops in individuals who have experienced a life-threatening event. Previous research has revealed patients diagnosed with PTSD are at increased risk for temporomandibular disorders and dental anxiety. However, the knowledge level of dental hygienists (DHs), regarding PTSD, and their treatment modifications for these patients is unknown. This study sought to evaluate DHs' knowledge of PTSD, and to understand their approach to treating patients with this condition.

Methods: Convenience and purposive sampling techniques were used to recruit actively practicing DHs via social media websites. Data was collected using a previously validated online survey, which assessed participants' knowledge of PTSD, and their approach to care for patients suffering from the condition. Descriptive statistics and a Spearman's Rho analysis were used to analyze the data.

Results: A total of 362 participants opened the survey for a 94% completion rate (n=342). Participants estimated that 15% of the adults they treated each week suffered from some form of PTSD. Overall, participants recognized that these patients were at moderate to high risk for dental anxiety (91.8%, n=313), and temporomandibular disorders (88.72%, n=33). However, most participants (58.4%, n=192) had not received any education regarding PTSD or how to care for patients with this condition.

Conclusion: Results suggest that education on PTSD and its impact on oral health should be incorporated into the dental hygiene curriculum to better prepare graduates to care for this patient population. Continuing education courses should be developed to focus on the special needs of patients suffering from PTSD, so oral health care providers are able to recognize risk factors for the condition and develop effective treatment approaches for these patients.

Keywords: PTSD, special needs patients, dental anxiety, temporomandibular disorder, dental hygienists, oral health care professionals

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Introduction

Post-traumatic stress disorder (PTSD) is a mental health condition which develops in individuals who have experienced a life-threatening event such as military combat, a natural disaster, car accidents, or sexual assault.¹ The National Institute of Mental Health (NIMH) has reported the prevalence of PTSD in adults in the United States (US) ranges from 6.8% to 8%.² In addition, PTSD is most commonly diagnosed in military personnel who have been deployed to a combat zone, with the percentage of veterans with PTSD reported at about 12%, greater than the general population.^{1,3} Despite the prevalence of PTSD in the US population, a

review of the literature revealed a paucity of research has been conducted regarding the knowledge level of oral health providers and the management of patients who present with this condition. Research conducted in the field of dentistry has been limited to investigations into the relationship of PTSD to temporomandibular disorder (TMD) and dental anxiety⁴⁻¹¹ but has not explored the preparation of oral health care providers in caring for patients suffering from PTSD.

Regardless of the event which may have initiated PTSD, research has revealed both children and adults diagnosed with the condition are more likely to present with poor oral health

(OH).⁴⁻⁶ They are also at increased risk for TMD, defined as any pain or dysfunction involving the muscles of mastication and the temporomandibular joint.^{7,8} In addition to the oral manifestations found to be associated with PTSD,^{4,7,8,9} a relationship between PTSD and dental anxiety has been identified.^{10,11} Researchers who have investigated the relationship between PTSD and dental anxiety have suggested oral health care providers need to develop a heightened awareness of the association between the two conditions, in order to appropriately alter their approach to caring for these patients.^{10,11}

Interventions to assist patients with PTSD, which might allow providers to more successfully deliver care to patients suffering from this condition include; use of nitrous oxide, relaxation therapy, cognitive behavioral therapy, group therapy, and computer-assisted relaxation learning (CARL), a desensitization program aimed at reducing dental fear.¹² Other techniques have been implemented to assist in delivering patient care; pre-treatment anxiety questionnaires, extended appointment time, distraction techniques, and psychotherapy techniques such as flooding and implosion which are approaches used to stimulate and focus on the patient's specific fear which can elicit repressed emotions.¹² Despite the success of these interventions, not all techniques are available to dental hygienists (DHs) in the clinical practice setting.^{11,12} Many clinicians may be unaware of the techniques and their benefit to patients with PTSD.^{11,12}

The purpose of this study was to assess the level of education DHs had received regarding caring for patients with PTSD, their understanding of the patients' increased risk for dental anxiety and TMD, and the approaches or treatment modifications taken when treating patients with PTSD.

Methods

This cross-sectional study was deemed exempt by the MCPHS University Institutional Review Board. Convenience and purposive sampling were used to recruit DHs currently practicing clinically in the US. Participants were recruited via invitations posted on multiple dental hygiene social media sites and directed to the electronic survey (Survey Monkey; San Mateo, CA, USA) by way of a link posted on the site. The social media sites used to recruit participants included Dental Hygiene Network, RDH, Dental Hygiene Life with Andy RDH, Dental Hygienist Talk, Boston Dental Peeps, RDH Network, and Dental Hygienists Network. Inclusion criteria for study participants were DHs who had been actively practicing for at least 6 months; retired or currently practicing DHs were excluded from participating.

Implied consent was secured through an informed consent statement at the beginning of the survey. Completion of the survey acknowledged consent to participate. A power analysis using a medium effect size $w=.3$, $\alpha=.05$, and 80% power was performed. Adjusting for a 30% attrition rate, the final recommended sample size was $n=229$.

A modified version of a dental anxiety survey developed by Drown et al.¹³ was selected because of the similar nature of the Drown et al.¹³ study to the current study design. The Drown et al.¹³ instrument was modified with permission and the term PTSD replaced the term dental anxiety. The 22-item instrument included 13 questions assessing participants' knowledge, practices for patients with PTSD and their risk for dental anxiety and TMD. Responses were a combination of two binary items, six 7-point Likert scale items, three multiple answer items, one single answer item, and one open-ended question. The nine demographic questions included gender, age, years of practice, education level, number of days and hours worked each week, total number of adult patients treated each week and number of patients identifying as having PTSD.

Prior to dissemination, the survey was piloted with DHs ($n=5$) who met the inclusion criteria. Feedback from the pilot study participants revealed there were no issues with accessing and completing the survey, and the participant recruitment was initiated. The survey remained open for three weeks, with data collected directly from the survey website. Descriptive statistics were used to report the findings using a statistical software program (SPSS 26; IBM, Armonk, NY, USA). Spearman's Rho test was used to analyze the ranked data to identify any correlations between the demographic data and participants' responses to each of the survey questions.

Results

A total of 362 participants opened the survey ($n=362$) for a 94% completion rate ($n=342$). The mean age of the respondents was 41.15 years ($SD=12.36$) and they had been in dental hygiene practice for 15.42 years ($SD=12.17$) and estimated that 15.07% ($SD=17.91$) of their patients suffered from some form of PTSD. Participant demographics are shown in Table I.

Most participants (58.2%, $n=192$) reported that they had not received any curricular content related to PTSD from lectures or textbooks during their dental hygiene education. In addition, nearly half (47.8%, $n=163$) reported they had not received any preparation for treating patients with

Table I. Sample demographics (n=342)

	Mean	Standard Deviation
Age	41.15	12.36
Practice experience in years	15.42	12.17
Work per week: days	3.99	0.99
Work per week: hours	31.48	8.61
What percentage of the patients you treat each week are adults/ over the age of 18?	80.26	20.90
What would you estimate is the percentage of adult patients you treat each week with this condition?	15.07	17.91
	Freq.	%
Level of education		
Associate's	163	47.66
Bachelor's	149	43.57
Master's	17	4.97
Doctorate	2	0.58
Other	11	3.22
Are you certified to administer local anesthesia?		
No	97	97
Yes	245	71.64

PTSD during their undergraduate education. A small number of participants (11.1%, n=38) indicated having completed continuing education or training regarding treatment of patients with PTSD since completing their dental hygiene education program (Table II).

Some participants (16.5%, n=56) reported having a question about PTSD in their patient health history while over one third (39.1%, n=132) were uncertain whether their dental practice treated patients with PTSD. Despite the lack of formal training in managing patients with PTSD, most participants (55.0%, n=188) felt confident in their ability to treat these patients. Responses were mixed regarding the disruptive nature of caring for a patient with PTSD with 44% (n=147) reporting that it was not disruptive and 39.8% (n=133) reporting that it was significantly disruptive. Most participants recognized dental patients with PTSD were at a significantly high risk for dental anxiety (77.3%, n=260) and for developing TMD symptoms (61.4%, n=207). Participant experiences and perceptions of patients with PTSD are shown in Table II.

Although the participants' responses reflected an understanding of the link between dental anxiety and TMD and PTSD, most (68.7%, n=235) did not employ any interventions to address the condition during oral health care appointments. Participants who did employ specific approaches most commonly used distraction

(38.9%, n=133) or added an additional appointment (37.4%, n=128). Flooding/implosion and CARL (0.29%, n=1) respectively, were reported approaches but used infrequently (0.29%, n=1). Treatment interventions for patients with PTSD are shown in Table III. The most frequently identified barrier to providing interventions was a lack of awareness of successful interventions (50.6%, n=173), followed by implementation of the interventions being too time consuming (15.5%, n=53) (Table IV).

A Spearman's Rho analysis of the ranked data revealed the level of PTSD education and training significantly impacted the mean frequency in modifying delivery of care during patient care sessions; those who received training were more likely to modify treatment ($\mu=3.89$) as compared to those who had not received training ($\mu=2.17$) (Figure 1). However, no statistically significant difference was found between the confidence level of participants who had received PTSD training ($\mu=5.74$) and those who had not received training ($\mu=4.35$) (Figure 2). Frequency in using interventions was positively correlated with receiving post-graduate training in PTSD and employing patient treatment modifications (Figure 3). Participants who reported receiving PTSD education were more likely to use interventions during treatment than those who had not received training. Distraction was the most frequently

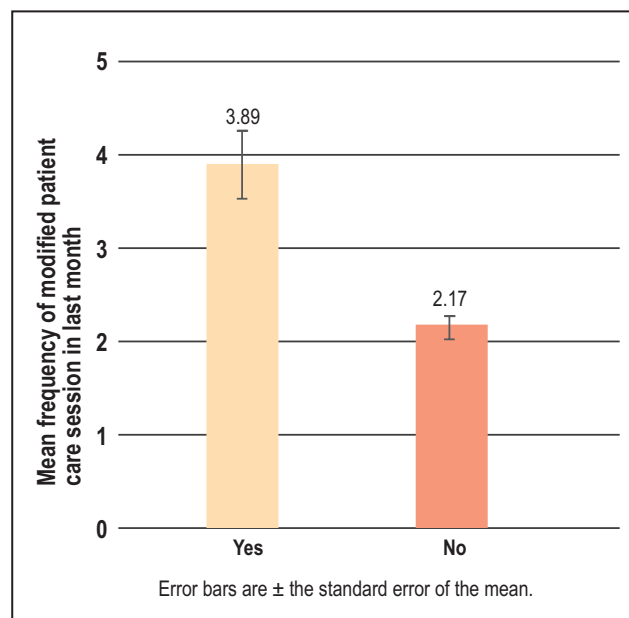
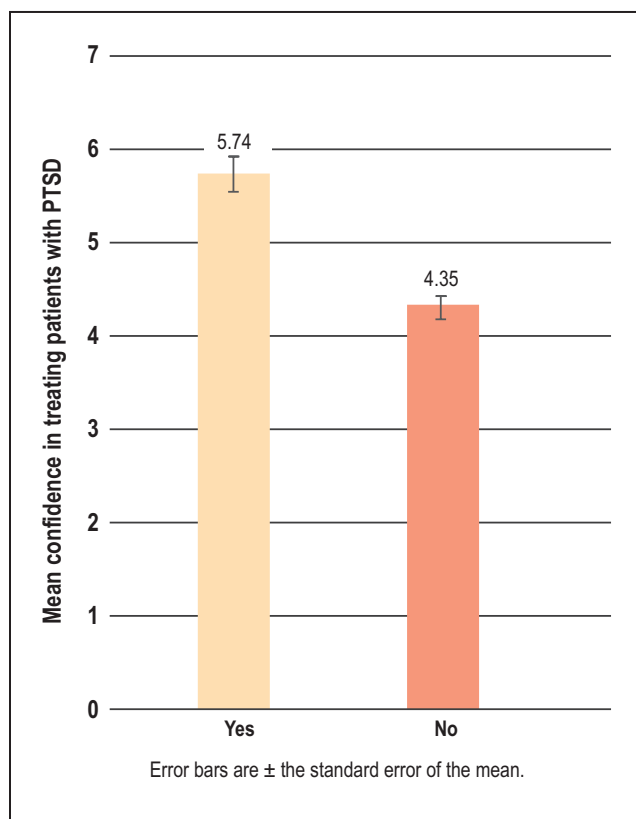
Figure 1. Patient care modifications between groups who had received post-graduate training and those who had no training

Figure 2. Confidence ratings between groups who had received post-graduate training and those who had no training

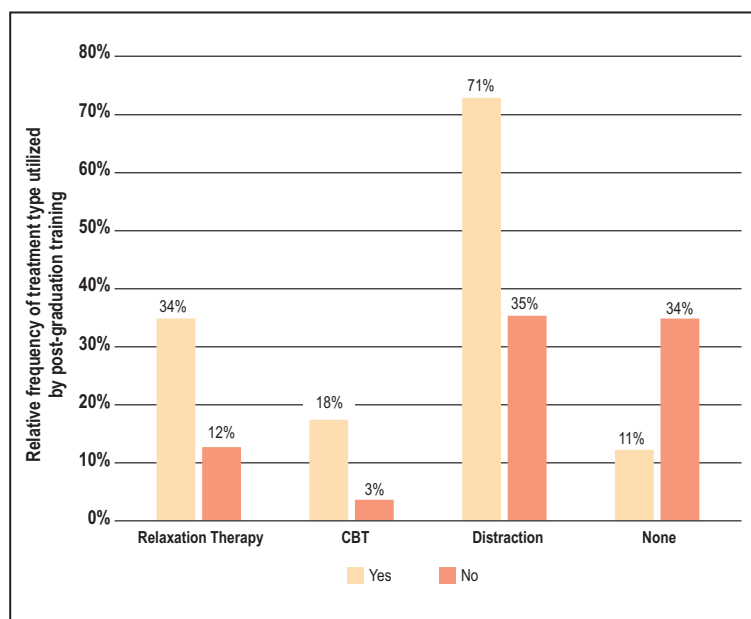


identified intervention used in treating patients with PTSD (38.9%, $n=133$), with participants who had received PTSD education ($\mu=5.74$) using this approach more frequently than participants who had not received training ($\mu=4.35$) (Figure 3).

Discussion

Although most of the DHs in this study had not received any PTSD education during their undergraduate education or post-graduation, most participants recognized that patients with PTSD were at moderate to high risk for dental anxiety and for developing TMD. This reported lack of PTSD education might have suggested that DHs had insufficient knowledge regarding the condition and its implications for oral health. However, the participants were provided a definition of PTSD at the beginning of the survey, and this may have given sufficient information to assist the participants in responding to the questions related to the risks associated with PTSD.

Figure 3. Frequency of type of treatment utilized based on post-graduate training (yes) or no training (no)



Despite the participants' ability to recognize the risk for dental anxiety and TMD in patients with PTSD, and a self-reported high level of confidence in treating patients with PTSD, the study results demonstrated DH's lack of knowledge on how to manage patients with PTSD. A significant finding in the study was the correlation found between the lack of PTSD education and training, and the frequency interventions were used in managing patients with PTSD. Participants with previous education related to caring for patients with PTSD were more likely to employ treatment strategies while providing dental hygiene care. Lack of knowledge regarding effective treatment methods was identified as the greatest barrier to employing specific care interventions. The minimal use of interventions and lack of PTSD education revealed in this research support the findings of Hoyvik et al. that suggested dental providers need to have greater awareness when assessing patients with PTSD and managing their patient care sessions.¹¹

Interventions most frequently employed by participants were distraction, and the extension of appointment time. These approaches may have been chosen due to the lack of advanced training required for these interventions. A self-directed computer-based series for coping strategies, CARL, was another intervention identified by participants that did not require specialized training. The use of CARL in dentistry has been investigated previously in research by Heaton et al., which found CARL effectively reduced patients' dental phobia and fear of dental injections.¹² Computer-based relaxation therapy and virtual reality systems have been

Table II. Practice experiences and perceptions of patients with PTSD* (n=342)

	n	%
What type of PTSD education was included in your dental hygiene curriculum?		
Not covered at all	192	58.36
Textbook mention	91	27.66
PTSD lecture	46	13.98
PTSD modules	0	0.00
To what degree did your dental hygiene education prepare you to treat patients with PTSD?		
Not at all	163	47.80
2	63	18.48
3	42	12.32
4	39	11.44
5	21	6.16
6	6	1.76
Well prepared	7	2.05
Since receiving your formal undergraduate education in dental hygiene, have you received any training designed to help patients who suffer from PTSD?		
No	304	88.89
Yes	38	11.11
In your opinion, and for your patients with PTSD, how much has the condition interrupted your ability to provide care to them?		
Not disruptive	102	30.54
2	12	3.59
3	33	9.88
4	54	16.17
5	59	17.66
6	68	20.36
Very disruptive	6	1.80

	n	%
To what degree are your dental patients with PTSD at risk to suffer from dental anxiety?		
No risk	7	2.08
2	8	2.38
3	15	4.46
4	46	13.69
5	72	21.43
6	44	13.10
High risk	144	42.86
To what degree are your dental patients with PTSD at risk to suffer from temporomandibular joint disorder (TMD) symptoms?		
No risk	8	2.37
2	13	3.86
3	17	5.04
4	92	27.30
5	64	18.99
6	52	15.43
High risk	91	27.00
Please rate your confidence level in treating patients with PTSD.		
Not confident	25	7.31
2	23	6.73
3	29	8.5
4	77	22.5
5	61	17.8
6	58	17.0
Extremely confident	69	20.2
Does your dental practice's health history form include any questions specific to a patient's history or diagnosis of PTSD?		
No	283	83.48
Yes	56	16.52
In the practice setting where you provide oral health care, do you treat any patients who suffer from PTSD?		
No	14	4.14
Yes	192	56.80
Unsure	132	39.05

*Each question used a seven-point Likert scale with the end points labeled.

Table III. Treatment types* (n=342)

		n	%
Nitrous oxide (N ₂ O) sedation	Do not use	265	77.49
	Use	77	22.51
Relaxation Therapy	Do not use	294	85.96
	Use	48	14.04
Cognitive Behavioral Therapy (CBT)	Do not use	326	95.32
	Use	16	4.68
Computer-Assisted Relaxation Learning (CARL)	Do not use	341	99.71
	Use	1	0.29
Group Therapy (GT)	Do not use	340	99.42
	Use	2	0.58
Distraction	Do not use	209	61.11
	Use	133	38.89
Pre-Treatment Anxiety Questionnaire	Do not use	331	96.78
	Use	11	3.22
Flooding (Implosion)	Do not use	341	99.71
	Use	1	0.29
Swallowing Relaxation	Do not use	336	98.25
	Use	6	1.75
Individual Systematic Desensitizing (ISD)	Do not use	333	97.37
	Use	9	2.63
Add an appointment time	Do not use	214	62.57
	Use	128	37.43
None	Do not use	235	68.71
	Use	107	31.29

*Respondents either endorsed they have used the treatment with PTSD treatment (use) or not (do not use).

adopted previously by the US military as an intervention for soldiers dealing with anxiety, stress and PTSD.¹⁴ Integrating this technology as a method of PTSD treatment has been found to be effective, and has allowed for delivery of therapy independent of direct care from a clinician.¹⁴ Using technology for delivery of behavior health treatment could be an option for DHs seeking interventions without need of specialized training. Its ease of use, and the patients' perception that treatment delivery is occurring in a more welcoming environment, may make this a viable option for DHs.¹⁴

Table IV. Barriers (n=342)

		n	%
Not aware	Not a barrier	169	49.42
	Barrier	173	50.58
Too time consuming	Not a barrier	289	84.50
	Barrier	53	15.50
Lack of interest	Not a barrier	334	97.66
	Barrier	8	2.34
No demand/unnecessary	Not a barrier	298	87.13
	Barrier	44	12.87
Not effective	Not a barrier	338	98.83
	Barrier	4	1.17
NA	Not a barrier	307	89.77
	Barrier	35	10.23

Although participants reported the successful use of PTSD treatment interventions which did not requiring specialized training, the development of community-based programs offering specialized training for health care providers has been recommended.¹⁵ Opportunities for health care providers to access training in the use of evidence-based treatment (EBT) interventions for patients with PTSD has been limited and offered primarily to mental health providers.¹⁵ Expanding access to EBT interventions to health care providers on a national level could expand the current toolkit available to DHs and other health care providers in the treatment of patients with PTSD.¹⁵

This study had limitations. The non-probability, social media sampling method and the small sample size limit the generalizability of the results. Participants with a higher level of interest or knowledge in PTSD may have self-selected to participate. Also, the survey relied on self-reported data and there may have been recall bias. Further research with a larger sample is warranted. Future studies should also investigate the level of education regarding PTSD being offered to dental hygiene students during undergraduate education.

Table V. Type of PTSD content during dental hygiene education by treatment type (n=342)

	What type of PTSD education was included in your dental hygiene curriculum?											
	Not covered at all				Mentioned in textbook				PTSD lecture			
	Not used		Used		Not used		Used		Not used		Used	
	n	%	n	%	n	%	n	%	n	%	n	%
Nitrous oxide (N ₂ O) sedation	158	82.29	34	17.71	62	68.13	29	31.87	35	76.09	11	23.91
Relaxation Therapy*	169	88.02	23	11.98	80	87.91	11	12.09	34	73.91	12	26.09
Cognitive Behavioral Therapy (CBT)	184	95.83	8	4.17	87	95.60	4	4.40	43	93.48	3	6.52
Computer-Assisted Relaxation Learning (CARL)	191	99.48	1	0.52	91	100.00	0	0.00	46	100.00	0	0.00
Group Therapy (GT)	190	98.96	2	1.04	91	100.00	0	0.00	46	100.00	0	0.00
Distraction	126	65.63	66	34.38	51	56.04	40	43.96	22	47.83	24	52.17
Pre-Treatment Anxiety Questionnaire	189	98.44	3	1.56	89	97.80	2	2.20	40	86.96	6	13.04
Flooding (Implosion)	191	99.48	1	0.52	91	100.00	0	0.00	46	100.00	0	0.00
Swallowing Relaxation	191	99.48	1	0.52	89	97.80	2	2.20	43	93.48	3	6.52
Individual Systematic Desensitizing (ISD)	189	98.44	3	1.56	88	96.70	3	3.30	43	93.48	3	6.52
Add an appointment time*	140	72.92	52	27.08	44	48.35	47	51.65	22	47.83	24	52.17
None*	117	60.94	75	39.06	66	72.53	25	27.47	43	93.48	3	6.52

*Indicates a statistically significant chi-square comparison.

Conclusion

Dental hygienists who had received education on caring for patients with PTSD were more likely to use interventions during the provision of dental hygiene care. Results suggest that education on PTSD and its impact on oral health should be incorporated into the dental hygiene curriculum to better prepare graduates to care for this patient population. Continuing education courses and training programs should be developed to focus on the special needs of patients suffering from PTSD, allowing oral health care providers to better recognize risk factors for the condition, develop effective protocols for treatment modifications, and improve oral health outcomes for these patients.

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Issues and Innovations in Dental Hygiene Education

The Effects of Self-Assessment on Clinical Competence in Dental Hygiene Education

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Abstract

Purpose: Accreditation standards require dental hygiene graduates to enter the profession with self-assessment skills and it is imperative for dental hygiene education to foster self-assessment skills throughout the curriculum. The purpose of this research was to evaluate the effect of self-assessment strategies on clinical competence in technical skill development and document student perspectives about the effects of participating in self-assessment activities.

Methods: All students enrolled in a pre-clinical course (n=50) attended a baseline lecture introducing self-assessment. Throughout the semester students performed self-assessment activities, which consisted of reviewing recordings of their hands while demonstrating instrumentation principles. Students used a self-assessment form to evaluate their performance and provide a plan to improve their self-identified deficiencies. Scores for all competency exams were analyzed using Chi-square tests to determine whether there was a significant relationship between self-assessment and clinical competency. Scores on the final competency evaluation were compared to those from the previous academic year (control group) using descriptive statistics. A qualitative survey including items about clinical performance, deficiencies, preparedness, ability to learn autonomously, self-confidence, critical thinking, and active engagement in learning, was distributed to students who successfully completed the course.

Results: Chi-square analysis determined no statistical significance ($p = 0.39$) in the technical skill development between student groups that were (n=50) and were not exposed (n=56) to self-assessment strategies. A total of 21 participants (44%) completed the survey at the end of the course. Results revealed heightened self-awareness and confidence, enhanced skill development, the significance of self-assessment, increased student engagement, and the desire for instructor feedback.

Conclusion: While self-assessment did not impact clinical competency, it may be useful in fostering self-correction of instrumentation errors. Students felt participation in self-assessment activities helped to effectively evaluate their performance, improve skillset, increase engagement, and strengthen self-awareness, confidence, and critical thinking.

Keywords: dental hygiene education, self-assessment, clinical education, clinical competency, critical thinking, active learning

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Introduction

Dental hygienists are expected to enter the profession possessing the necessary skills to evaluate their performance and implement changes that will improve their clinical practices and patient care delivery. This concept is supported by the Commission on Dental Accreditation's standard 2-21, "Graduates must be competent in the application of self-assessment skills to prepare them for life-long learning."¹ Dental hygiene education is responsible for meeting workforce demands, as well as accreditation standards. Implementing self-assessment activities in preclinical and clinical environments is proposed as a strategy to meet these requirements.

Self-assessment is defined as the process of developing an awareness of a personal learning experience. It is a best practice for actively engaging health science students in the learning process and develops the learner's abilities to critically evaluate their clinical performance.² The self-assessment learning process allows students to reflect on an experience and determine what actions should be taken to improve the outcome of the particular experience. The purpose of implementing this teaching strategy is to develop students' critical thinking and problem-solving skill, ultimately leading to improved clinical performance.

The implementation of self-assessment strategies aligns itself with the long-established paradigm shift of active learning, transitioning from teacher-centered to student-centered environments, with the end goal of developing independent learners. Faculty members must still provide foundational information to ensure students have a clear understanding of concepts and skill criteria. However, in order for effective formative feedback to occur, learners need a strong working knowledge of task compliance, quality and the criteria used for evaluation.³ Once this is established, it then becomes the student's responsibility to self-evaluate their performance, recognize whether or not they meet standards and criteria, and develop plans to address deficiencies.⁴⁻⁶ Learners are then engaged in the process of grasping the criteria for the clinical practices in their field and making effective decisions about their own skills.⁷

Literature suggests that higher-level thinking and complex learning must occur over time and be dialogic in nature.⁸ Students need to develop the ability to evaluate their own work and not be dependent on others.⁸ This can occur if higher education institutions foster students who have the ability to learn autonomously. Educators have been charged with developing and facilitating strategic plans to assist students in critically assessing their educational and life experiences.⁹

Dental hygiene educators are responsible for efficiently preparing students to possess self-assessment skills in order to maintain competency and quality assurance.¹ To meet these demands, self-assessment strategies should be integrated into the dental hygiene curriculum, beginning with the first series of clinical courses. Learning how to evaluate one's performance at an early stage is intended to assist students with identifying and improving weaknesses. Implementing self-assessment strategies in pre-clinical courses, followed by clinical courses, is logical given that learning is an evolving process. This methodology also provides learners with the opportunity to develop a realistic sense of their abilities.² Additionally, if used as recommended as a means of formative assessment, students can use feedback provided to prepare for summative assessments.² This is a crucial process, for students to become aware of their weaknesses. Additionally, learners will be able to enhance their familiarity with shortcomings and plans for improvement, thus applying theory to practice during clinic sessions. This awareness and practice can lead to improved performance.

Previous research has primarily focused on attitudes towards the self-assessment process, accuracy of self-assessment, the impact of self-assessment on ergonomics, and various methods of self-assessment.⁹⁻¹³ There is minimal

research in dental hygiene education focusing on the association between the use of self-assessment strategies and clinical skill development. Furthermore, there is little research regarding students' perspectives related to self-assessment activities. Investigating these correlations can be used to further develop teaching and learning opportunities in self-assessment. Placing greater emphasis on self-assessment activities within the education process can help develop future oral health care providers prepared to enter a workforce with the necessary skills to evaluate and improve their performance to ensure quality care. Understanding the impact self-assessment has on clinical skill development can assist dental hygiene educators incorporate or advance self-assessment strategies within the curriculum. Creating an educational environment that promotes critical thinking and problem-solving skills will position graduates for a positive transition from academia to the workforce. The purpose of this study was to evaluate the effectiveness of self-assessment strategies on clinical competence in technical skill development in a pre-clinical dental hygiene course and document student perspectives regarding the effects of participating in self-assessment activities.

Methods

The Institutional Review Board of Farmingdale State College approved this mixed methods study. Purposive and convenience sampling was used to select the study sample. The study population consisted of dental hygiene students enrolled in a pre-clinical course. This was the first course of a series of clinical courses required for graduation from the program as well as for certification to register and take the national board licensing examination. Students were invited to participate in the quantitative portion of the study by word of mouth on the first day of class during orientation and were provided with the research consent form, detailing the study. All students chose to participate in the study.

All students (n=50) attended a baseline lecture on self-assessment held during the course orientation and were required to participate in self-assessment sessions four times over the course of the semester. Self-assessment sessions consisted of videos, completion of a criteria-based rubric, and a faculty-student review and feedback. To ensure anonymity, only students' hands were videotaped during instrumentation practice sessions. These sessions took place prior to the three competency exams and the comprehensive clinical final exam. Using a self-assessment form consisting of skill descriptors, students self-assessed their performance as either satisfactory or needs improvement in the application of the principles of instrumentation demonstrated in the recorded videos. Students then described their skill

demonstration and plans for improvement to a faculty member to confirm accuracy.

Scores for the three competencies and final exam were analyzed using descriptive statistics. Chi-square tests were used to determine significant relationships between self-assessment and clinical competency. Scores on the clinical final exam were evaluated for successful learning outcomes as compared to percent distribution of scores from the control group (n=56), consisting of students from the previous academic year. Chi-square analysis on competency exams I, II, and III were also evaluated for successful learning outcomes between groups.

While the four self-assessments, three competency test scores, and the final exam were a required part of the course, participation in the research study was optional and did not have an impact on students' standing. The informed consent forms were collected in an envelope, which were not opened until after the final course grades had been submitted. Ensuring confidentiality, participant information was de-identified at the point of collection. This also satisfied any concerns regarding coercion.

A qualitative survey assessing student perceptions regarding self-assessment was developed and administered via an online software program (SurveyMethods; Capterra Inc, Arlington, VA, USA) following completion of the pre-clinical course. Students were invited to complete the survey by means of an electronic mail containing a recruitment cover letter and a customized link containing the research consent form and study details, followed by the survey.

No identifying information was collected to maintain the anonymity and confidentiality. After the initial launch of the survey, two follow up emails were sent to non-responders to increase the response rate.

Concepts and theories that were detailed throughout the literature guided the development of survey questions. The survey consisted of seven open-ended questions assessing how participation in self-assessment activities affected students' abilities to identify clinical strengths and weaknesses, improve deficiencies, evaluate their performance, prepare for competencies, and learn autonomously. Students' self-confidence, critical thinking, and active engagement in the learning process as a result of self-assessment were also analyzed. Data were analyzed and coded through organization into categories. The process of coding was used to develop themes and patterns. Data theme identification techniques were performed manually.

Results

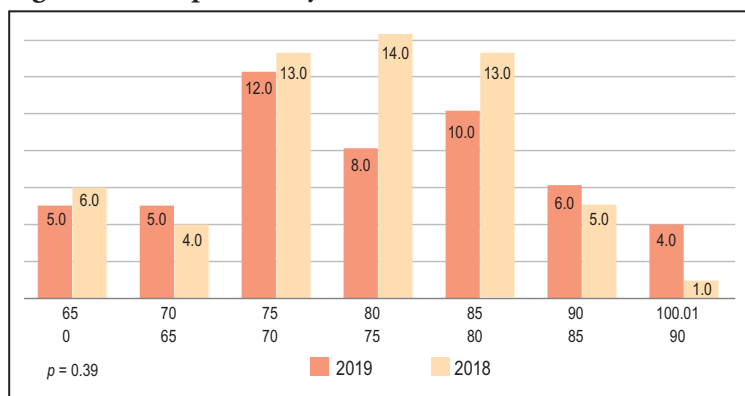
Quantitative Results

Fifty students performed self-assessment strategies four times throughout the semester prior to completing three pre-clinical instrumentation competencies and a final exam comprised the experimental group (n=50). Fifty-six students from the previous academic year, who had not been exposed to self-assessment strategies, comprised the control group (n=56).

Chi-square analysis determined no statistical significance ($p=0.39$) in the technical skill development on the comprehensive final exam outcome scores between the experimental (n=50) and the control (n=56) groups (Figure 1). Competency exam I assessed students' technical skill while performing the principles of instrumentation using a universal curette. Chi-square tests indicated a significant difference ($p=0.002$) between the experimental and control groups; the experimental group demonstrated higher successful learning outcomes on the use of the universal curette (Figure 2). Competency exams II and III assessed students' technical skill while performing the principles of instrumentation using the Gracey 15/16 and Gracey 17/18 curettes, respectively. Chi-square tests revealed a significant difference ($p=0.007$) between the two groups. The control group without self-assessment strategies demonstrated higher successful learning outcome on competency exam II (Figure 3), indicating that self-assessment did not have any impact on competency development on the use of the Gracey 15/16 curette. Findings on Chi-square test for competency exam III revealed no significant difference ($p=0.12$) in the technical skill development between the groups on the use of the Gracey 17/18 curette (Figure 4).

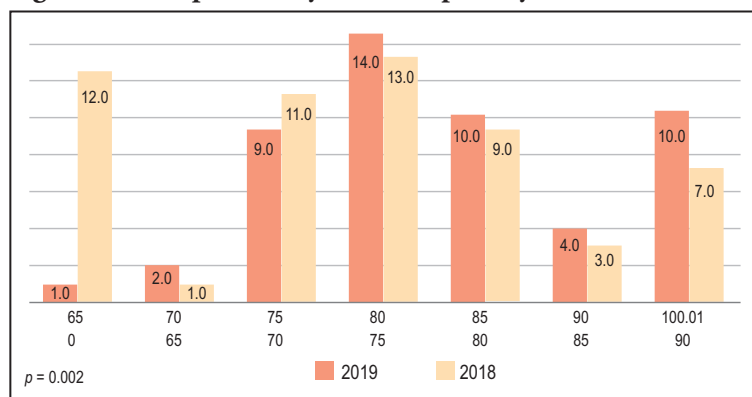
The final was a comprehensive clinic exam evaluating students' technical skill development in performing the principles of instrumentation using all the calculus removal instruments within their cassettes. A passing grade of C or better was used to determine

Figure 1. Chi square analysis of final exam results*



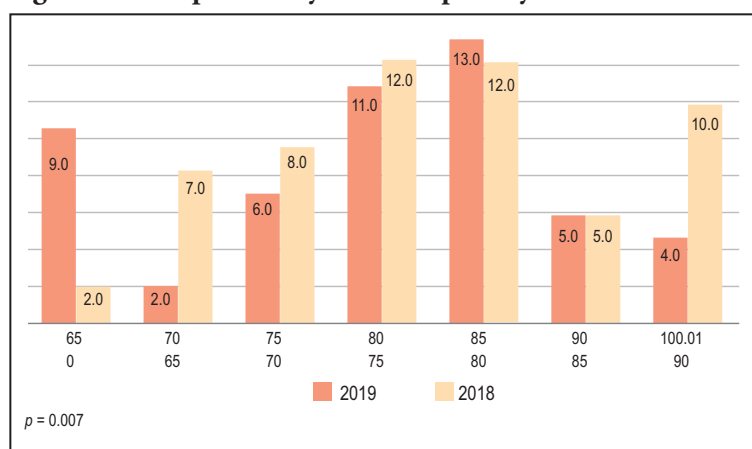
* Experimental group (n=50), Control group (n=56)

Figure 2. Chi square analysis of competency exam I*



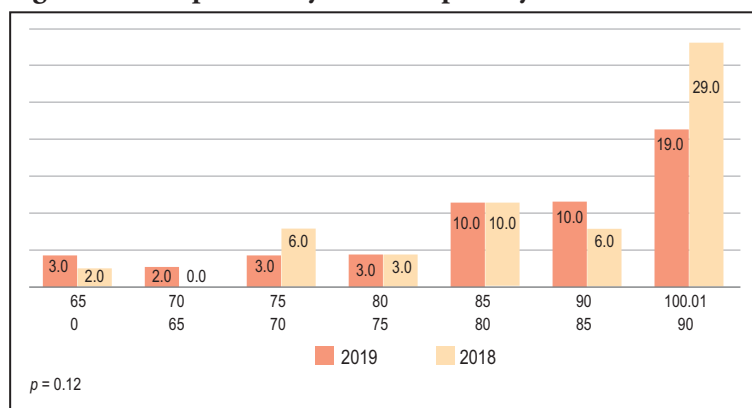
* Experimental group (n=50), Control group (n=56)

Figure 3. Chi square analysis of competency exam II*



* Experimental group (n=50), Control group (n=56)

Figure 4. Chi square analysis of competency exam III*



* Experimental group (n=50), Control group (n=56)

competency. Data indicated that there were no differences in skill levels between the groups. A majority (78%, n=50) of the experimental group were competent on the final exam, which was identical to the 78% of the control group (n=56).

Qualitative Results

All participants who successfully completed the course (n=48) were invited to take the survey with a response rate of 44% (n=21). Overall, respondents articulated sentiments of approval towards self-assessment. The following themes emerged from the qualitative data analysis: heightened self-awareness and confidence, enhanced skill development, the significance of self-assessment, increased student engagement, and the desire for instructor feedback. Participant perspectives for each theme are shown in Figure 5.

Discussion

Clinical competence in dental hygiene education can be enhanced by the early development of an awareness of personal learning while promoting student engagement in the learning process. This can be realized by implementing self-assessment skills to foster higher-order thinking and problem-solving skills. Review of the literature demonstrates that self-assessment is utilized in varying levels of preclinical and clinical dental and dental hygiene education.² Research findings also indicate that teaching self-assessment strategies, establishing consistent opportunities for students to self-assess, along with the addition of faculty feedback, provides students with multiple chances to improve their self-evaluation throughout the undergraduate curriculum.⁵ The addition of reflection within self-assessment seems to promote the development of critical self-reflective skills.⁵

In this study, self-assessment strategies in the pre-clinical dental hygiene course did not promote a significant difference in student learning outcomes in the technical skill development of the participants. However, it can be inferred from this investigation that student reflection and positive perceptions regarding the process were a beneficial outcome in providing a foundation for self-assessment measures to continue across the curriculum. In a national study of dental hygiene program directors, most (85%, n=125) most supported the utilization of self-assessment to evaluate clinical competence.¹⁴

Although the final competency exam scores in the current study did not demonstrate a significant difference between the experimental and the control groups, the participant voices on self-assessment days echoed their realization of a palpable “a-ha” moment in recognizing their errors when reviewing the videos. It was noticeable during these clinical sessions that students were receptive to the self-assessment strategies, and the visual aid of

Figure 5. Emergent themes linked to participant perspectives (n=21)

<p>Heightened Self-Awareness and Confidence</p> <p>After participating in self-assessment activities, students were able to better identify their clinical strengths and weaknesses. Students expressed a higher level of trusting their own judgment and abilities.</p> <p>Supporting comments</p> <ul style="list-style-type: none"> • “Watching the video records gave me a better view and understanding of my clinical performance. It made me aware of my strengths and weaknesses. This resulted in me critically evaluating my rights and wrong and know what I can do to develop my skills nicely.” • “It did make me feel more confident to work without an instructor.”
<p>Enhanced Skill Development</p> <p>The ability to demonstrate the principles of instrumentation was directly related to participation in self-assessment. After the activity, students were able to make corrections to improve identified deficiencies.</p> <p>Supporting comments</p> <ul style="list-style-type: none"> • “I believe that they helped me to think about what I needed to worker harder at which then improved those specific skills.” • “The videos that were recorded of my performance helped me to view my own technique and make the necessary improvements.”
<p>Significance of Self-Assessment</p> <p>Students expressed self-assessment activities met their learning style needs. It compelled them to think critically about their clinical performance. As a result, students understood how self-assessment can be of value as they continue their educational journey and enter the workforce.</p> <p>Supporting comments</p> <ul style="list-style-type: none"> • “I found the self assessment activities to be incredibly helpful. When I felt like I was struggling the most, watching back the videos of me working helped me see where I went wrong.” • “It is a great skill to take with me beyond dental hygiene school and throughout my career when my instructors will not be there to watch. There is always room for improvement and keeping that attitude in mind will hopefully grant me success.”
<p>Increased Student Engagement</p> <p>The majority of students felt the process of self-assessment enabled them to be more engaged in the learning process. It forced them to critically evaluate their skill set. As a result, their learning increased because they became aware of deficiencies and how to improve weaknesses.</p> <p>Supporting comments</p> <ul style="list-style-type: none"> • “I do believe that the self assessment activities helped me to actively engage in the learning process. When I thought about and wrote about what I was not good at in clinic it made me think more about how I could improve in those areas.” • “It allowed me to critically think about about my performance and reflect on it outside of the clinical setting. Evaluating my self as opposed to having one of my instructors do it was helpful because it was my self recognizing which were my strengths or weaknesses and coming up with the appropriate plans of action.”
<p>Desire for Instructor Feedback</p> <p>Students yearned for instructor feedback to confirm their assessments, as they felt they lacked experience. Many expressed that instructor feedback was needed since it contributed to their awareness. Students mostly looked to instructors when they were uncertain of how to improve weaknesses.</p> <p>Supporting comments</p> <ul style="list-style-type: none"> • “My instructors remarks were key to helping me understand where I needed improvement.” • “I valued my instructor to help guide me after I self-assessed. I don’t have the experience they do to be able to say with confidence if I did something exactly wrong or right.”

video recordings provided an opportunity to actually visualize their technique and see where improvement was needed. Students' positive attitude of the use of self-assessment videos in their clinical experience underscores findings from parallel research demonstrating that the addition of instructional videos enhances the acquisition of psychomotor skills.¹⁵

Limitations of this study included general time constraints and calibrating students on how to self-assess. Although all students in the experimental group were exposed to a baseline lecture detailing the accreditation standard on self-assessment, the study design did not allow for adequate time to teach students "how" to self-assess. Time did not allow for teaching students the dynamic intricacies of how to self-assess. A systematic review of the literature of self-assessment in dental education supports the concept that providing students with the appropriate training to critically evaluate and differentiate between correct and erroneous technique could increase students' potential in their ability to self-assess.² The recording of student instrumentation videos was restricted to the two principal investigators only and did not include all faculty members in the pre-clinical course. Expanding the ability to make recordings would have provided more access to demonstrations of student skills.

Future research could include studies with a focus on evaluating the differences between student self-assessments versus faculty assessments of principles of instrumentation. Additionally, implementing a baseline tutorial on what a student should be looking for in a self-assessment of instrumentation principles would be beneficial to investigate. Studying the effects of self-assessment with increased faculty helping students understand how to critically evaluate their performance may yield different findings because of more time spent on active, student-centered learning activities. A long-term evaluation could incorporate an annual survey on student perspectives of the self-assessment measures implemented throughout their clinical courses.

Conclusion

While self-assessment did not impact clinical competency in this study, it may have been useful in fostering participants' self-correction of instrumentation errors. Investigator observations of student attitudes during self-assessment included an increase in students' abilities to recognize the application of the principles of instrumentation. Participants perceived self-assessment as a method to effectively evaluate clinical performance, improve skillset, increase engagement, and enhance self-awareness, confidence, and critical thinking. Perspectives from this study demonstrate the value of exposing students to self-assessment strategies early on in the curriculum.

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Dental Hygiene Students' Perceptions Regarding the Importance of and Confidence with Using Brief Motivational Interviewing during HPV Patient Counseling

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Abstract

Purpose: Human papillomavirus (HPV), a sexually transmitted virus that has been identified in over two-thirds of all oropharyngeal cancers. Oral health care professionals play a key role in educating the public regarding HPV and the role of vaccinations. The purpose of this study was to examine dental hygiene and dental therapy students' perceptions of the importance of and their confidence with applying brief motivational interviewing (BMI) during patient counseling regarding the human papilloma virus (HPV).

Methods: A convenience sample of dental hygiene and dual degree dental hygiene/dental therapy students (n=32) participated in an enhanced BMI curriculum that included a 90-minute HPV BMI coaching and role-playing session on the use of eight MI strategies and the technique of elicit-provide-elicited. Questionnaires assessing participants' perceptions were disseminated at three time points; prior to the HPV BMI training (pre-test), immediately after the coaching and role-playing session (post-test 1) and after the participants had applied their HPV BMI skills during two patient interactions that included self-assessment and faculty feedback (post-test 2).

Results: All the students in the sample (n=32) completed the three questionnaires. While participants' perception of the importance of BMI increased for three of the eight strategies (pre-test to post-test 2), it was not statistically significant. Perceptions of confidence in applying of BMI increased for seven of the strategies (pre-test to post-test 1). Statistical significance was achieved for the "Use of the Importance Ruler" strategy ($p=0.003$) from pretest to posttest 1 and pre-test to post-test 2 ($p=0.003$).

Conclusion: Results indicate that an enhanced HPV BMI coaching curriculum in addition and two HPV BMI sessions with patients is not enough training to retain confidence overtime. Future research should investigate strategies, such as additional coaching and role-playing sessions, for retaining confidence with applying BMI for HPV discussions during patient care.

Keywords: motivational interviewing, brief motivational interviewing, dental hygiene students, dental therapy students, patient education, HPV education, oropharyngeal cancer

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Introduction

Oral health care professionals play a key role in the prevention and reduction of the incidence of oropharyngeal cancer (OPC).¹ Concurrently, the human papillomavirus (HPV) is the most common sexually transmitted infection (STI), and has been identified in 70% of all OPC.² Vaccines for the HPV first became available in 2006 and Healthy People 2020 set the HPV vaccine uptake goal in the United States (US) at 80%, yet vaccine acceptance is well below this threshold.³

However, HPV infection is a sensitive topic and oral health care professionals have reported ethical dilemmas on whether

HPV related topics should be addressed in the dental office or by a medical provider.⁴⁻⁶ Thompson et al. reported while dental hygienists view their role as prevention specialists in the reduction of HPV positive OPCs, they lack the training and resources for discussing HPV related topics.⁷ Additionally, prior research has shown that health care providers lack communication skills and confidence discussing HPV related topics during patient care.^{4,6,8-10} Despite these noted barriers, Stull et al. 2020 found that parents of adolescents are comfortable having HPV related discussions with their

dentists and dental hygienists and expect these oral health care professionals to provide HPV counseling.¹¹

Motivational Interviewing (MI) is evidence-based patient-centered counselling to support a positive behavior change.¹² Recent studies have explored MI as a communication intervention for HPV related topics during patient care.^{10,13} In a randomized clinical trial of medical professionals (n=188) a range of interventions including parent education on HPV, vaccine fact sheet, and MI communication training were studied.¹⁴ Dempsey et al. found the HPV fact sheet and MI were most frequently used among medical professionals with the majority (91%) of the participants reporting that they were most likely to use MI as the preferred communication for HPV-related topics.¹⁴

Motivational interviewing encompasses four components: 1) collaboration, 2) acceptance, 3) compassion, and 4) evocation, aimed at supporting patient autonomy, referred to as the “spirit of MI”^{12,15} Motivational interviewing allows providers to “roll with resistance” to avoid conflict during patient-provider communication.¹⁶ Additionally, MI supports self-efficacy to build patient’s confidence in the behavior change process.¹² Utilizing all four components or the “spirit of MI” has been shown to build trust and rapport between both the patient and the provider.^{12,16}

Guiding strategies are used within the MI process to support behavior change. These strategies include *open-ended* questions that allow the patient an opportunity to craft a response to provide insight on their perceptions; *affirmations* to encourage the patient’s strengths; *reflections* to allow the provider to demonstrate an understanding of the patient’s perceptions, ambivalence, and efforts; and *summaries* to close the MI session.^{12,16} In a study of health care providers’ communication regarding HPV vaccinations for adolescents, Reno et al. found the guiding strategies of affirmations and reflections were used more than 75% of the time.¹⁰ There are additional “RULEs” to follow to align with the spirit of MI. Resist the righting reflex (R), means providers do not “fix” or “change” the patient’s health behaviors.^{12,16} Understanding (U) is the demonstration of empathy for the patient’s motivations and perceptions of change.^{12,16} Listening (L) with empathy is the provider’s compassion for the patient.^{12,16} Empower (E) is to support patient autonomy and build the patient’s own self-efficacy for change.^{12,16}

Motivational interviewing as a communication strategy for positive oral health behavior change has been used in dental hygiene education for nearly a decade.^{17–20} An early study by Croffoot et al. identified the inclusion of MI in the dental hygiene curriculum improved students’ use of open questions

and reflections.¹⁷ In another study Curry et al. reported dental hygiene alumni valued their MI training during their education and identified MI as a superior communication approach.²¹ However, multiple studies have identified time constraints during a dental appointment as a barrier using MI.^{19–21} Therefore, brief motivational interviewing (BMI), a derivative of MI, is ideal for health care professionals with limited time (5-10 minutes) to support behavior change for improved health status.¹⁶

To apply BMI during patient discussions, as in those related to HPV, dental hygiene students need training in basic MI skills and the delivery of BMI. Motivational interviewing training including coaching, role-playing, and feedback have been found to increase retention of skills and provider confidence.^{19,20,22} Croffoot et al. reported dental hygiene students’ use of open-ended questions, affirmation, reflection and summaries improved with coaching and feedback,¹⁷ while Stull et al. found that students need continuous training to feel confident having HPV discussions during patient care.¹¹

Oral health care professionals have expressed an interest in communication training for HPV-related discussions during patient care.^{6,10,13,14} There is a gap in the literature regarding the most effective communication strategy for discussions regarding a sexually transmitted infection. It is also not known how to best prepare future oral health care providers, such as dental hygiene and dental therapy students, for discussions regarding HPV. The purpose of this study was to examine dental hygiene and dental therapy students’ perceptions of the importance of and their confidence with applying BMI strategies during patient counseling sessions regarding HPV.

Methods

This study was approved by the Institutional Review Boards of A. T. Still University (IRB #2019-106) and the University of Minnesota (STUDY00007617). A convenience sample of dental hygiene and dual degree dental hygiene/dental therapy students (n=32) from the University of Minnesota (UMN) participated in an enhanced HPV BMI curriculum over two semesters. Motivational interviewing is a thread within the UMN curriculum program that encompasses both dental hygiene and dental therapy students beginning during the second semester and has been detailed previously.¹¹

The BMI HPV communication training included a multimodal 40-minute online educational module on general HPV information, the role of HPV in OPC, and HPV vaccination fact sheet. Following the HPV online educational module, students participated in a 90-minute HPV BMI

coaching and role-playing session facilitated by an HPV faculty expert (CS) and an MI trained DH educator (MA). During the 90-minute session, students were coached on the utilization of eight MI strategies: 1) open-ended questions, 2) affirmation, 3) reflection, 4) summarize, 5) change talk, 6) use of the importance ruler, 7) ask for elaboration, and 8) enhance self-efficacy to apply during HPV discussions with patients. In addition, students were trained on the MI technique of elicit-provide-elicit (E-P-E). Students were paired into partners for role-plays as the patient and oral health care provider while practicing the eight MI strategies and E-P-E.

Students had four assignments spanning two semesters that included audio-recorded HPV BMI discussions (interactions) during clinical care with two patients followed by two self-assessment assignments. The two self-assessments were completed after listening to the audio recordings and grading their application of BMI for the HPV discussions using the UMN standardized HPV MI rubric. The audio recordings were also team graded by CS and MA using the same rubric. The standardized rubric focused on the four components of the spirit of MI and also included asking permission, and RULEs. The team grading served as an outcome measure of MI fidelity to ensure that the MI strategies were used during the HPV discussions.

Students' perceptions of the importance of and confidence with applying BMI during HPV patient counseling were measured by three evaluation instruments: pre-test, post-test 1, and post-test 2. The previously validated evaluation instruments were adapted with permission from the University of Missouri Kansas City and the University of Michigan and have been used for numerous studies measuring dental hygiene students' perceptions of importance and confidence in using MI strategies.¹⁷⁻²⁰ The three questionnaires were revised to have a focus on HPV related topics and were piloted tested by six faculty at the UMN School of Dentistry. Revisions were included to enhance the clarity of the evaluation instruments. All three evaluation instruments included Likert six-point scale questions; the post-tests also included open response items.

The pre-test was delivered prior to the 90-minute HPV BMI coaching and role-playing session. The pre-test addressed students' perception of the importance of and confidence with applying the eight MI strategies, students' perspective of using MI for HPV, OPC, and vaccine uptake discussions, and their confidence in applying the spirit of MI. The first post-test was delivered immediately following the 90-minute coaching and role-playing session and included the same questions from the pre-test along with additional items to determine the student's perspective of the enhanced

HPV BMI curriculum. Students then completed two audio-recorded patient interactions on HPV, followed by two self-assessments using the HPV MI rubric. After receiving faculty feedback via the team-graded HPV MI rubric, students then completed the second post-test. The post-test 2 included all the items from post-test 1 with additional items to evaluate the students' perspectives of their HPV patient interactions, self-assessment, and faculty team-graded feedback.

Responses were compared between the three testing time points using linear models. Pairwise comparisons between time points were adjusted for multiple comparisons using the Tukey method. The patient interaction team graded HPV MI rubrics were compared between interactions one and two using mixed effects linear models with a random effect for each student. Responses and grades were summarized using means, standard deviations, and confidence intervals. Data analysis was performed using an online statistical software program (R version 4.0.1). A two-sided *p*-value less than 0.05 was regarded as statistically significant.

Results

A total of 32 students (dental hygiene *n*=24, dental hygiene/dental therapy *n*=8) completed three evaluation instruments at different time points during their HPV BMI training (*n*=34). Participants' perception of the importance of BMI increased at post-test 1 and post-test 2, as compared to the pre-test, for the strategies: Listening Reflectively (pre-test, 5.69±0.69; post-test 1, 5.77±0.63; posttest 2, 5.72±0.55), Elicit Change Talk (pretest, 5.53±0.67; post-test 1, 5.60±0.77; post-test 2, 5.62±0.66), and for the Use of the Importance Ruler (pre-test, 5.35±0.80; post-test 1, 5.43±0.73; post-test 2, 5.38±0.75). However, no statistical significance was found for students' perceptions of the importance of the eight MI strategies over three time points (Table I).

Participants' perceptions of confidence with applying BMI strategies during HPV patient counseling increased over all three time points for the following strategies: Use of Open-Ended Questions (pre-test, 4.75±1.16; post-test 1, 5.00±1.03; and post-test 2, 5.00±0.98), Make Affirmations (pre-test, 4.94±0.98; post-test 1, 5.06±0.93; and post-test 2, 5.28±0.63), and Use of the Importance Ruler (pre-test, 3.97±0.96; post-test 1, 4.77±0.88; and post-test 2, 4.78±0.97). Perceptions of confidence with applying BMI strategies increased from pre-test to post-test 1, but decreased by post-test 2 for the strategies: Listen Reflectively (pre-test, 5.34±0.79; post-test 1, 5.42±0.72; post-test 2, 5.00±0.98), Elicit Change Talk (pre-test, 4.06±0.95; post-test 1, 4.52±1.09; and pre-test 2, 4.50±1.14), Ask for Elaboration (pre-test, 5.03±0.93; post-test 1, 5.16±0.97; post-test 2, 4.90±1.01), and Enhance Self-

Efficacy (pre-test, 4.56±0.88; post-test 1, 5.03±0.84; post-test 2, 4.88±0.91). Statistical significance was found for the Use of the Importance Ruler (0.003) from pre-test to post-test 1 and pre-test to post-test 2 (0.003). Participants' perception- of the importance of and confidence with applying the eight MI strategies over three time points is shown in Table I.

Participants' perceptions of confidence with demonstrating collaboration (pre-test, 4.00±0.95; post-test 1, 4.16±0.82; and post-test 2, 4.22±0.61) increased over all three time points but was not statistically significant. Perceptions of confidence with demonstrating acceptance (pre-test, 4.59±0.72; post-test 1, 4.65±0.68; and post-test 2, 4.62±0.51), showing empathy (pre-test, 4.59±0.80; post-test 1, 4.65±0.61; and post-test 2, 4.62±0.61) and "supporting autonomy (pre-test, 4.31±0.86; post-test 1, 4.65±0.66; and post-test 2, 4.62±0.55) increased from pre-test to post-test 1, but decreased from post-test 1 to post-test 2 and was not statistically significant. Participants'

confidence with demonstrating the "Spirit of MI" is illustrated in Figure I.

Perceptions that "BMI will be a valuable strategy that can be used during clinical care to educate patients about HPV" slightly decreased over three time points (pre-test, 5.69±0.59; post-test 1, 5.58±0.76; and post-test 2, 5.31±0.82). Respondents reporting that "using MI will help my patients understand the HPV- oropharyngeal cancer relationship, risk factors, and prevention, including vaccination" increased from pre-test (5.56±0.76) to post-test 1 (5.58±0.62) and decreased from post-test 1 to post-test 2 (5.25±0.80). Respondents' perceptions increased from pre-test (4.09±1.17) to post-test 1 (4.83±1.02) and decreased by post-test 2 (4.62±1.01) for the statement, "I have enough time in clinic to incorporate MI strategies for HPV patient education and vaccine advocacy" and statistical significance was found from pre-test to post-test 1 ($p=0.02$). Perceptions increased for the statement, "I

Table I. Perceptions of the importance of and confidence with applying the eight MI strategies during HPV patient counseling* (n=32)

MI Strategy	Pre-test M±SD	Post-test 1 M±SD	Post-test 2 M±SD	Unpaired T-Test T ₁ , T ₂ , T ₃
Importance				
Use of Open-Ended Questions	5.84±0.45	5.77±0.57	5.78±0.55	0.83, 0.88, 0.99
Listen Reflectively	5.69±0.69	5.77±0.63	5.72±0.58	0.88, 0.98, 0.95
Make Affirmations	5.72±0.52	5.60±0.67	5.50±0.80	0.77, 0.40, 0.83
Summarize	5.55±0.77	5.53±0.78	5.22±1.07	1.0, 0.31, 0.35
Elicit Change Talk	5.53±0.67	5.60±0.77	5.62±0.66	0.92, 0.85, 0.99
Use of Importance Ruler	5.35±0.80	5.43±0.73	5.38±0.75	0.91, 0.99, 0.95
Ask for elaboration ("What else?")	5.75±0.51	5.63±0.72	5.38±0.79	0.78, 0.08, 0.30
Enhance self-efficacy	5.78±0.49	5.67±0.66	5.62±0.66	0.74, 0.56, 0.96
Confidence				
Use of Open-Ended Questions	4.75±1.16	5.00±1.03	5.00±0.98	0.62, 0.62, 1.0
Listen Reflectively	5.34±0.79	5.42±0.72	5.00±0.98	0.90, 0.64, 0.89
Make Affirmations	4.94±0.98	5.06±0.93	5.28±0.63	0.82, 0.25, 0.58
Summarize	5.12±0.91	5.06±0.89	4.69±1.00	0.96, 0.15, 0.25
Elicit Change Talk	4.06±0.95	4.52±1.09	4.50±1.14	0.21, 0.23, 1.0
Use of Importance Ruler	3.97±0.96	4.77±0.88	4.78±0.97	0.003**, 0.003**, 1.0
Ask for elaboration ("What else?")	5.03±0.93	5.16±0.97	4.90±1.01	0.86, 0.86, 0.55
Enhance self-efficacy	4.56±0.88	5.03±0.84	4.88±0.91	0.08, 0.33, 0.76

*Importance response options: 0=unable to answer, 1=not very important, 2=of little importance, 3=neutral, 4=somewhat important, 5=very important.

Confidence response options: 0=unable to answer, 1=not at all confident, 2=little confidence, 3=neutral, 4=somewhat confident, and 5=very confident.

M= Mean, SD= Standard Deviation

T1 =pre-test to post-test 1; T2 =pre-test to post-test 2; T3 =post-test 1 to post-test 2

** $p<0.05$

have the skills I need to use MI strategies in the clinic for HPV patient education and vaccine advocacy” (pre-test 4.50 ± 0.92 ; post-test 1, 4.74 ± 0.82 ; and post-test 2, 4.88 ± 0.83) but were not statistically significant. Students’ perceptions of BMI during HPV patient discussions are provided in Table II.

Figure I. Confidence demonstrating the spirit of MI* (n=32)

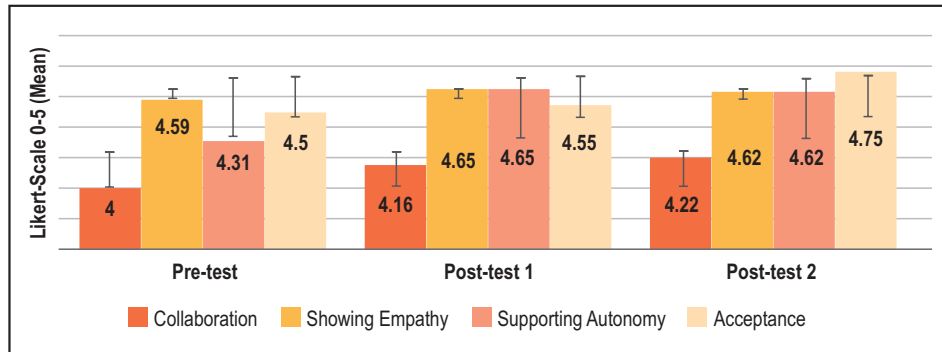


Table II. Perceptions of MI during HPV patient counseling* (n=32)

	Pre-test M±SD	Post-test 1 M±SD	Post-test 2 M±SD	Unpaired T-test T1, T2, T3
MI will be a valuable strategy that can be used during clinical care to educate patients about HPV.	5.69±0.59	5.58±0.76	5.31±0.82	0.83, 0.11, 0.32
Using MI will help my patients understand the HPV-oro-pharyngeal cancer relationship, risk factors, and prevention, including vaccination.	5.56±0.76	5.58±0.62	5.25±0.80	1.0, 0.21, 0.18
I have enough time in clinic to incorporate MI strategies for HPV patient education and vaccine advocacy.	4.09±1.17	4.83±1.02	4.62±1.01	0.02,** 0.12, 0.73
I have the skills I need to use MI strategies in the clinic for HPV patient education and vaccine advocacy.	4.50±0.92	4.74±0.82	4.88±0.83	0.50, 0.19, 0.81

* Response options: 0=unable to answer, 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree.

M= Mean, SD= Standard Deviation, T1 =pretest to posttest 1; T2 =pre-test to post-test 2; T3 =post-test 1 to post-test 2

** $p < 0.05$

Participants’ perceptions of the HPV and the BMI content were evaluated from post-test 1 and post-test 2. Perceptions of the HPV and BMI content decreased from post-test 1 to post-test 2. Statistical significance was found for the statement, “The material covered in DH 3123 was sufficient in detail for me to understand the application of MI to HPV discussions” ($p=0.02$) and “The HPV and MI activities were an effective way for me to demonstrate my MI skills” ($p=0.01$). Post-test 2 provided an opportunity for students to report challenges they experienced during HPV patient interactions (Table IV). Frequently reported themes of challenge included difficulty with MI strategies, patient resistance, and uncomfortable being recorded.

Faculty evaluation and students’ self-assessment scores from the standardized HPV MI rubric are shown in Table V. The faculty evaluation mean score for the first patient interaction was 20.9/30 (95% confidence interval (CI) 18.9-22.9) and the second interaction was 24.8/30 (95% CI 22.7-26.8); the difference between the two interactions was 3.8 (95% CI 1.3-6.4, $p=0.004$), demonstrating a statistically significant improvement in BMI skills over time. The self-assessment score for the first patient Interaction was 20.1/30 (95% CI 18.6-21.7) and the second Interaction was 22.9/30 (95% CI 21.1-24.7); and the difference between the two interactions was 2.9 (95% CI 0.8-5.5, $p=0.008$), demonstrating a statistically significant improvement.

Discussion

This study examined students’ perceptions of the importance of and confidence with applying eight MI strategies and practicing the “Spirit of MI” during HPV related BMI discussions. While not statistically significant at all three time points,

Table III. Perceptions of HPV and MI content* (n=32)

	Post-test 1 M±SD	Post-test 2 M±SD	Unpaired T-test
The material covered in DH 3123 was sufficient in detail for me to understand the application of MI to HPV discussions.	5.26±0.77	4.72±0.96	0.02**
The HPV and MI activities were an effective way for me to demonstrate my MI skills.	5.19±0.79	4.62±0.98	0.01**
The HPV and MI activities improved my confidence in discussing HPV with future patients.	5.10±0.75	4.81±1.00	0.21
I will be more confident in discussing the HPV vaccination with my patients.	5.13±0.76	4.78±1.16	0.16

* Response options: 0=unable to answer, 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree.

M= Mean, SD= Standard Deviation

** $p < 0.05$

most of the participants in this study reported their perception of the importance of applying the eight strategies as “high” during HPV BMI patient counseling, aligning with previous research findings of Croffoot et al.¹⁷ Research by Mills et al. also reported findings of students’ perceptions of the importance of the MI strategies of open questions, making affirmations, summarizing, and enhance self-efficacy during preventive education.²⁰ However, unique to the current study, was the incorporation of discussing a sexually transmitted infection as part of the BMI interaction with a patient, which may have impacted exact comparisons to previous MI and BMI studies. Stull et al. reported students’ lack of HPV knowledge and inexperience using BMI techniques impacted confidence when discussing HPV related topics during patient care.¹¹ However, in a study of health care providers use of MI techniques in adolescent HPV vaccination conversations with parents, open-ended questions, reflections and affirmations were used most frequently and were associated with increased perceptions of vaccination acceptance rates.¹⁰

Perception of confidence with applying the eight MI strategies during patient care was slightly lower as compared to the ratings of importance of the strategies at all three time points, similar to the findings of Mills et al.²⁰ While students may be supportive of the strategies and view them as important communication tools, due to inexperience they may be less confident in applying them in practice. Participants in this study rated the MI strategies “high,” which over time, may lead to improved confidence during HPV discussions with patients. This lack of confidence is not limited to students. Arnett et al. reported dental hygiene faculty had lower levels of confidence in applying the MI strategies as compared to the importance of supporting students’ delivery of the strategies Elicit Change Talk, Ask for Elaboration, and Enhance Self-Efficacy.¹⁹ Using a variety of faculty development activities with appropriate follow-up is needed for ensuring long-term effects and maintaining confidence.

In this study, confidence with the “Use of Importance Ruler” was the only MI strategy to achieve statistical significance, whereas Mills et al. reported significance of students’ confidence with seven of the eight MI strategies over time.²⁰ Previous studies have investigated the use of MI knowledge during HPV discussions, but have not explored levels of provider confidence with the application of the strategies.^{10,13,14} As this is a novel study assessing perceptions of confidence with applying BMI during HPV discussion, it is difficult to identify why the Use of Importance Ruler was statistically significant as compared to the other MI strategies. Participants may have been confident with this strategy because it was taught during the role-playing session as a way to assess patients’ interest and readiness to discuss the HPV vaccine with their primary care physician. The Use of the Importance Ruler is a scale similar to the Visual Analog Pain Scale, a familiar tool in their professional student role and an easy way to assess HPV vaccine interest. It has been well documented in the literature that oral health care providers report limited confidence and communication skills for discussing HPV-related topics with patients^{4,6,8–11} and this may be even more of an issue with oral health care students. Furthermore, the gap in time from the HPV BMI coaching and role-playing session to clinical application during the two patient interactions may have been too long to maintain perceptions of confidence with applying MI strategies to HPV discussions. These findings align with the literature that to be effective using MI, it requires training, coaching, and feedback to retain confidence and long-term skills.^{19,20,22}

Open responses from students indicate patient resistance as a challenge. This may be related to students in this study not applying the MI RULES, to mitigate patient resistance. Students lost points on the UMN standardized HPV MI rubric in the categories of collaboration and evocation for lecturing the patient and not supporting patient autonomy. Patient selection may have also impacted students’ perceptions

Table IV. Challenges during HPV patient counseling (n=32)

Theme	Response
Difficult with MI strategies (n=8, 25%)	<p>“The actual conversation itself wasn’t difficult for me; however, the implementation of MI is still a learning process for me”</p> <p>“Patients not answering the open-ended questions with answers other than yes or no”</p> <p>“Using MI when discussing HPV with my patients”</p> <p>“Trying to elicit change talk from patients and using enough reflections in a real conversation”</p> <p>“Difficult to keep the conversation going when you start to stammer or forget what you are trying to say, since I wasn’t very confident with the information anyway”</p> <p>“Reflect on what the patient just said to encourage them to give more information”</p> <p>“Remembering to use open ended questions, opening the discussion with the patient”</p> <p>“Reflecting every time”</p>
Patient resistance (n=6, 19%)	<p>“They seemed to not want to talk a whole lot about the subject. It might’ve been the way I worded my questions as well”</p> <p>“When they disagreed with wanting to know more information”</p> <p>“Patients showing resistance to the conversation”</p> <p>“Patient compliance”</p> <p>“One of the patients had very closed responses to open ended questions and were unwilling to expand”</p> <p>“A lot of patients were just unaware about HPV at all. It was difficult to balance the conversation.”</p>
Initiating the HPV conversation (n=3, 0.09%)	<p>“Bringing up the topic”</p> <p>“Bringing up the subject in general”</p> <p>“Bringing the conversation up”</p>
Patient criteria for assignment (n=1, 0.03%)	<p>“Finding patients in the age range who hadn’t received the vaccination”</p>
Uncomfortable being recorded (n=2, 0.06%)	<p>“It was hard knowing I was being recorded and graded”</p> <p>“The transition into doing the recording was awkward at times. Also, something about knowing I’m being recorded just makes me nervous and I don’t think the conversations was as good as they could have been due to my nerves.”</p>
Lack of HPV knowledge (n=5, 16%)	<p>“Lack of knowledge or of expectations for what to discuss with patients”</p> <p>“Being completely knowledgeable about the topic rather than reading off the information sheets”</p> <p>“Not being prepared for all the questions patients had, or their lack of interest in the topic”</p> <p>“When they asked a question that I do not know the answer to.”</p> <p>“Not knowing what to ask”</p>

of challenges reported in this study. The patient criteria for the audio recordings were men and women between the ages of 18 and 45. The UMN SOD has a large geriatric population, making it difficult for students to complete the two HPV assignments with patients meeting the age criteria. Therefore, students may have sought patients meeting the age criteria only without considering patient-provider trust and rapport, the foundation of the “Spirit of MI.” Building patient-

provider trust and rapport takes time and is not achieved with one interaction. As a potential explanation, students with unestablished trust and rapport may have enhanced patient resistance, especially because HPV, HPV vaccine uptake, and HPV as it relates to OPCs are sensitive topics to discuss with patients. Patients may not have understood the connection between HPV and oral health or the reason their student providers initiated the discussion, leading to resistance. Further,

Table V. HPV MI rubric scores* (n=32)

	Average Score	95% CI	p-value
Faculty evaluation			
Patient Interaction one	20.9/30	18.9-22.9	
Patient Interaction two	24.8/30	22.7-26.8	
Difference of Patient Interactions	3.8	1.3-6.4	0.004**
Student self-assessment			
Patient Interaction one	20.1/30	18.6-21.7	
Patient Interaction two	22.9/30	21.1-24.7	
Difference of Patient Interactions	2.9	0.8-5.0	0.008**

95% Confidence Interval (CI); 30 Maximum points possible on the UMN standardized HPV MI rubric;

** $p < 0.05$

students' perceptions of "confidence" with showing empathy was less over time compared to collaboration, acceptance, and supporting autonomy. The decrease in "confidence" with demonstrating the ability in showing empathy may be a result of patient resistance.

While perceptions of the importance of and confidence with applying the majority of the eight MI strategies, was not statistically significant in this study, the self-assessment scores from the first to second patient interaction increased with statistical significance. Similarly, faculty evaluation of students' patient interactions also improved overtime with statistical significance. The patient interactions and self-assessments were low stake assignments for students and earning a high score on the standardized HPV MI rubric had little to no impact on their overall course grade. Despite limited performance incentives, similar scores were reached between the faculty evaluations and the students' self-assessment. Perceptions of the importance of and confidence in applying the MI strategies coupled with the students' self-assessment scores supports prior research demonstrating the efficacy of MI strategies and the spirit of MI for discussions related to HPV vaccination strategies.

This study had limitations. The sample was from one institution at a Midwestern dental school with no control or comparison group and the results cannot be generalized. The validated pre-test and post-tests 1 and 2 were revised to include HPV specific content. While the revised instruments were pilot tested, they were not revalidated. Confounding factors such as confidence with and comfort discussing HPV topics with patients may have influenced students' perceptions regarding the importance of and confidence with applying MI strategies and the use of unpaired data to maintain anonymity may have impacted the ability to achieve statistical significance.

Conclusion

Findings from this study indicate a 90-minute BMI coaching and role-playing session and self-assessments along with faculty feedback from two patient interactions, is not enough training to retain long-term confidence

with applying MI strategies during HPV discussions. Refresher training in BMI for HPV conversations as part of patient care should be implemented prior to clinical application. Perceptions of confidence and comfort discussing HPV topics may have impacted student confidence in applying MI strategies. Additional MI experiences using objective structured clinical examinations (OSCE) with standardized patients to practice BMI HPV discussions and faculty evaluation should be explored.

Disclosure

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Issues and Innovations in Dental Hygiene Education

Facilitating Advanced Research Skills Beyond the Undergraduate Dental Hygiene Curricula

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Abstract

Purpose: Dental hygiene educators play a key role in assisting students to make connections between research and clinical practice. A core course in research was redesigned with the goal of motivating and encouraging dental hygiene students to advance research skills beyond the undergraduate dental hygiene curricula. The purpose of this pilot study was to evaluate the redesigned course and the student outcomes as they relate to perceived barriers and motivation for future research in dental hygiene.

Methods: A 25-item, electronic survey composed of 3 sets of Likert scaled questions was sent to a convenience sample of Bachelor of Science dental hygiene students (n=18) enrolled in the Introduction to Research Methods course at New York University. The survey explored students' perceptions of satisfaction with the learning strategies used as well as motivations and barriers toward future research. In addition to the survey, the final project, overall course grade and university end-of-course evaluations were examined to gain a comprehensive understanding of course effectiveness. Descriptive statistics were used to analyze data.

Results: Of the 18 students invited to participate, 12 completed the course evaluation survey (n=12) for a 67% response rate. Results indicated that all respondents learned about the research process and an Institutional Review Board (IRB) proposal. Most respondents indicated interest in taking additional research courses and in conducting future research. While students indicated lack of time as a barrier toward pursuing research (41.7%), they valued the need for research in clinical care. The IRB proposal project mean score was 88.3 % and the overall mean grade was 89.5%. On a Likert scale range of 1 (low) - 5 (high), the university end-of-course evaluation indicated a 4.9 overall course satisfaction.

Conclusion: Results from this pilot study reflected positive students' attitudes towards the redesigned learning modalities and indicated future plans for conducting research upon course completion.

Key words: dental hygiene students, dental hygiene research, dental hygiene curriculum, online learning

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Introduction

Advocating the role of dental hygiene research

Research plays a key role in dental hygiene education and the advancement of the dental hygiene (DH) profession.¹⁻⁴ The American Dental Hygienists' Association (ADHA) has had policy since 1970 advocating the role of dental hygienists in research, including their contributions to interdisciplinary studies and practice.⁵ In addition to ADHA policy, the National Dental Hygiene Research Agenda (NDHRA) acknowledges the importance of a body of knowledge unique to DH when defining it as a profession and developing it into a discipline.⁶⁻⁷

As a discipline, dental hygiene must continue to generate a knowledge base that is unique to the profession. As future professionals begin the education process, dental hygiene educators play a key role in assisting students in making the connection between research and clinical practice. Learning about the research process and understanding its impact on clinical practice can also serve to inspire students to conduct their own research and contribute to the growth of the profession.

Current curricula in associate and baccalaureate programs

Research has been broadly defined in dental hygiene education standards. While the American Dental Association

Commission on Dental Accreditation (CODA) Standard 2-22 states that dental hygiene graduates must be competent in the evaluation of current scientific literature, specific courses in research methodology or original research projects are not required in meeting the standards. Research is included in CODA Standard 1-1 which states “programs must demonstrate its effectiveness using a formal and ongoing planning and assessment process that is systematically documented by developing a plan addressing teaching, patient care, research and service.”⁸ Key to this standard is the ability of the institution to integrate research into the curriculum that is appropriate for their education setting.

An integrated research curriculum must be provided during professional education to promote future research, in addition to promoting skills to advance the profession. According to Fried et al. instruction in research lays the foundation for evidence-based decision making and the skillsets required for a dental hygiene workforce that is integrated into multidisciplinary teams.⁹ In spite of what is known about the benefits of incorporating research into the curriculum, there are challenges at the undergraduate level. In a study of the motivations and challenges towards research, Partido and Colón found the most frequently cited barriers were lack of time, lack of funds to conduct research projects, lack of formal research courses in curriculum and an overall lack of interest in research.¹⁰ However, participants also cited the benefits of research to patient care, understanding research terminology, and the development of transferable skills and competencies for a clinical career. Significant positive relationships were shown between participation in formal research activities and research courses.

Partido and Colón concluded that there is a need for more support of students in research activities to overcome perceived barriers to performing research.¹⁰

Undergraduate research course redesign

Accreditation standards and competencies can be met through a variety of educational degrees and curriculum plans. In the Department of Dental Hygiene and Dental Assisting at New York University (NYU), CODA Standard 1-1 requirements regarding research are met from a myriad of activities dispersed in courses throughout the Associate in Applied Science (AAS) curriculum. Students learn to create Problem, Intervention, Comparison, and Outcome (PICO) questions, search and review literature, create abstracts, and present research posters in the AAS curriculum. The Introduction to Research Methods (IRM) was designed to build upon the CODA standard and skills for the entry-level learner and provide additional research opportunities

to meet diverse student needs. This NYU Bachelor of Science (BS) research course had always been an in-person, required core course offered in the third year of the four-year curriculum. The NYU Department of Dental Hygiene and Dental Assisting offers numerous curriculum tracks to meet the needs of a diverse student body. In addition to the 78-credit Associate in Applied Science degree program, there are three BS tracks with an advanced set of required courses for the BS degree. The BS program can be completed as a four-year integrated program from freshman to senior years, a 3-year accelerated track for transfer students, or as degree-completion track (DHP) after the associate degree is completed. Students enrolling in the IRM course would have completed the prerequisite statistics course along with the entry-level AAS/AS curriculum.

Historically, the IRM course has been co-sponsored by the Department of Nursing and was taught to cohorts of dental hygiene and nursing students in a face-to-face classroom setting. The nursing sponsored course, although positive for interprofessional learning, created numerous scheduling conflicts resulting in delays in registering for this required course. The research content was focused more towards nursing practitioners; therefore the decision was made to create a research methodology course exclusively for dental hygiene students enrolled in the BS degree program. The course was redesigned for delivery by the Department of Dental Hygiene and Dental Assisting through the NYU learning management system, an online Sakai based platform with the full range of tools for discussion forums, testing, Zoom links, and access to university resources, such as the library. The redesigned IRM class was delivered asynchronously, similar to other courses in the DH BS program.

As a newly revised course, the course directors were able to establish course goals and learning activities at a level higher than the required CODA standards and to address the ADHA NDHRA priority areas. These learning activities allowed students to practice skills in critical thinking and research methodology. The activities included responding to forum questions and discussions, answering knowledge checks, completing internet-based assignments, creating PICO questions, developing research designs and creating a research final project as part of an institutional review board (IRB) application to demonstrate the culmination of skills and competencies. The course goals are presented in Figure 1. Given the newly designed course goals and learning experiences, the program faculty wanted to evaluate the course for advancing student research skills and meeting the course goals. The purpose of this study was to evaluate a redesigned introduction to research methods course and

the student outcomes as they relate to perceived barriers and motivation for future research in dental hygiene.

Figure 1. Introduction to Research Methods Course Goals

Use scientific research in problem solving and critical decision making for all professional activities.
Identify the process for developing clinically relevant questions and selecting a research topic.
Define research; explain and apply research terms; describe the research process, designs, and the principle activities, skills and ethics associated with the research process.
Develop information literacy skills for locating the best available evidence.
Identify and explain the difference between quantitative, qualitative, and mixed methods.
Read, interpret, and critically evaluate health research.
Describe how evidence-based practice shapes the health care professional's role in the private practice setting and community.
Construct a coherent research proposal that includes an abstract, introduction, literature review, research questions, ethical considerations, and methodology.

Methods

This course effectiveness study began following completion of the spring 2020 IRM course. This study was given the status of exempt by the Institutional Review Board of NYU (IRB-FY2020-4310). While the demographics and previous educational backgrounds of the 18 registered students were known to the researchers, no identifying characteristics were matched the survey responses regarding the demographics. All students previously had a course in statistics as a prerequisite to registering for the IRM course. The sample population was all 18 students registered for the IRM course in Spring 2020. Students were in their third year of the baccalaureate program or in the third year of the accelerated BS track for transfer students, or in the degree completion track. The IRM course evaluation for this study was composed of two aspects; that of the faculty created survey of the course learning strategies and the student attitudes of motivation and barriers, and the end-of-course university survey.

Survey instruments

The first instrument was a 25-item electronic survey named Introduction to Research Methods course evaluation (IRMCE) and was delivered using an online survey software program (Qualtrics version 2020; Provo, UT, USA). Two

external lay readers and two dental computer experts reviewed the survey for face validity of readability, question style, and clarity. Minor changes were made based on the feedback and the survey was distributed after the close of the semester. The survey was organized into four sections. The first section assessed general aspects of research including number of taken research courses, course helping with learning the research process and course helping construct a mock IRB proposal. The other sections assessed satisfaction with learning strategies including forums, discussions, and the final course project, (nine items), motivations (five items) and potential barriers in conducting future research (7 items). Satisfaction with the learning strategies was assessed using a five-point Likert scale from extremely satisfied to extremely dissatisfied and motivations toward research was assessed with a five-point Likert scale of definitely yes to definitely no. Barriers toward research were assessed with a five-point Likert scale of strongly agree to strongly disagree.

Each section was analyzed for internal consistency and the learning strategies section was reliable with standardized Cronbach's Alpha of 0.621. The perceived motivation section had a higher standardized Cronbach's Alpha of 0.890 and the perceived barriers about research had the highest standardized Cronbach's Alpha of 0.91. The internal consistency results indicated that the survey met the requirements of reliability and validity.

All students enrolled in the course were encouraged to respond and there were no exclusions to participating. Informed consent was provided through the unique IRMCE login.

In addition to the IRMCE survey, the investigators assessed the NYU end-of-course evaluation. These 12 questions provide the formal, ongoing modality to assess courses across the university. The survey questions were available to all 18 registered students at the end of the term but were not visible to faculty until the posting of grades. Items relevant to the IRM course are shown in Table V; the Likert scales ranged from 1-5, with 5 indicating strongly agree. Descriptive frequencies were used to evaluate the results of the IRM course evaluation survey items and assessed the means of the end-of-course evaluation. Descriptive statistics were used to analyze the investigator designed IRM survey and the NYU end-of-course evaluation.

Results

Participant demographics indicated that all were females registered in the baccalaureate program (n=18); either in the third or fourth year of the BS program (n=13) or in the BS degree completion program (DHP) (n=5). Participants' ages

ranged from 20 to 59 years, with a mean age of 29.8 years and a median of 26 years (Table I). Of the students invited to complete the IRMCE survey at the course conclusion (n=18), 14 responded; but only 12 completed the survey for a 66.7% response rate (n=12). The IRM course was the first research course taken by most respondents (n=10). All respondents strongly agreed that the course helped them learn the research process. Respondents also strongly agreed that the course helped them learn about constructing a research proposal. Most respondents felt the IRM course changed their view of research “a great deal” (n=9). The course project mean score was 88.3 % and overall course mean grade was 89.49%. Grades in the course ranged from C to A, with one remediated C/F. Grade distribution matched the normal curve of student achievement, with only one in the lower achievement grade categories (Table I).

Learning activities, motivations, and barriers to future research were assessed with descriptive statistics. The nine learning activities items indicated that knowledge checks, textbook readings, assignments using a dental learning website, and final project were rated more highly than the other learning activities. The students were more divided on responses for the forum activities and final examination (Table II). At least half the respondents indicated that they would consider future activities in research and would either definitely (n=4) or probably (n=8) take another research course. Respondents were also open to conducting future research and possibly publishing work in a peer reviewed journal. Respondents were divided about pursuing a research focused career. Responses to future interests and motivation towards research are shown in Table III. Respondents were asked to rate barriers towards conducting research with seven

Table I. Demographics (n=18)

Age							
18-23	18-23	24-29	30-34	35-39	40-44	45-49	50+
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
	6(33)	5(28)	4(22)	1(5)	—	—	2(11)
Year in BS Program	1st	2nd	3rd	4th	Degree completion		
	—	—	7(39)	6(33)	5(28)		
Grades	A	A-	B+	B	B-	C+	C
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Course grade	5(28)	5(28)	4(22)	3(17)	—	—	1(5)
Course project	5(28)	2(11)	2(11)	7(39)	—	2(11)	—

Table II. Satisfaction with learning activities (n=12)

	Extremely satisfied	Somewhat satisfied	Neither satisfied nor dissatisfied	Somewhat dissatisfied	Extremely dissatisfied
	n (%)	n (%)	n (%)	n (%)	n (%)
Knowledge checks	9(75)	3(25)	—	—	—
Discussion with others	9(75)	2(16.67)	1(8.33)	—	—
Forum activities	9(75)	2(16.67)	—	1(8.33)	—
Assignments	11(91.67)	1(8.33)	—	—	—
Research project draft	9(75)	3(25)	—	—	—
Final version research project	12(100)	—	—	—	—
Final examination	8(66.67)	3(25)	1(8.33)	—	—
Self-evaluation	9(75)	3(25)	—	—	—
Textbook and readings	10(83.33)	1(8.33)	1(8.33)	—	—

items ranging from lack of interest and time to disliking the complexity of research. Over half (66.7%, n=8) of the respondents did not feel that a lack of interest in research was a barrier, however lack of time and lack of support were identified as issues (Table IV).

Seven of the registered students (n=7) completed the 12 item NYU end-of-course evaluation, for a 39% response rate. A Likert scale of 1-5 indicated a 4.9 overall course satisfaction. The standard questions included the overall evaluation of the course, whether course objectives were clearly stated and if the course was well organized, intellectually stimulating with content that was valuable and worth learning (Table V).

Table III. Motivation toward research (n=12)

	Definitely yes	Probably yes	Might or might not	Probably not	Definitely not
	n (%)	n (%)	n (%)	n (%)	n (%)
Taking more classes in research	4(33.33)	8(66.67)	—	—	—
Conducting research	3(25)	8(66.67)	1(8.33)	—	—
Presenting a poster at a research conference	4(33.33)	5(41.67)	3(25)	—	—
Publishing articles in peer reviewed journals	3(25)	4(33.33)	4(33.33)	1(8.33)	—
Commencing a research-focused career	4(33.33)	2(16.67)	4(33.33)	2(16.67)	—

Table IV. Barriers towards research (n=12)

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
	n (%)	n (%)	n (%)	n (%)	n (%)
Lack of interest in research	1(8.33)	2(16.67)	1(8.33)	6(50)	2(16.67)
Lack of time	2(16.67)	4(33.33)	2(16.67)	3(25)	1(8.33)
Lack of support	2(16.67)	3(25)	1(8.33)	4(33.33)	2(16.67)
Research is not important for clinical careers	1(8.33)	1(8.33)	1(8.33)	1(8.33)	8(66.67)
I dislike the scientific complexity of research	1(8.33)	0(0)	3(25)	4(33.33)	4(33.33)
Lack of current knowledge (need more courses)	2(16.67)	12(16.67)	3(25)	3(25)	2(16.67)
Poor writing skills	1(8.33)	3(25)	1(8.33)	5(41.67)	2(16.67)

Discussion

The research methods course in the NYU BS degree program was redesigned from an in-person class delivered by the School of Nursing to an online class within the Department of Dental Hygiene and Dental Assisting and included objectives specific to dental hygiene. Results from this pilot study provided insight on the redesigned course and student outcomes as they relate to perceived barriers and motivation for conducting future research in dental hygiene. The redesigned IRM course was delivered asynchronously online. Methods for online courses vary extensively given the institutional platform, administrative support, and faculty expertise; these considerations have been discussed in previous studies.¹¹⁻¹⁵

Transitioning a course to an online platform was not a simple pedagogical process; specific learning strategies were developed to ensure success in the application of research skills. Effort was made to maintain student contact in an asynchronous delivery format. Online courses also require learning activities that address the course goals yet individualize and monitor learners' competencies. The IRM faculty established feedback and contacts to each student through the forums, draft project consults, and direct email. Students who were falling behind were contacted and the department student advisor was notified for further follow-up.

One key result of the pilot study was the highlighted effectiveness of the personalized contact from faculty. The required one-on-one meeting to review the IRB proposal project was noted

Table V. End-of-course evaluation: Introduction to Research Methods (n=7)

End-of course evaluation: Spring 2020	Mean score range 1-5
Overall evaluation of the course	4.9
Course objectives clearly stated	4.7
Course well organized	4.9
Course was intellectually stimulating	4.9
Topics organized in coherent manner	4.7
Content is valuable and worth learning	4.9
Assignments emphasized understanding	4.9
Rate course materials	4.7
Examinations emphasized material covered in course	4.7
Course uses fair grading procedures	4.9
Amount of course work is heavier than other courses	4.1
Overall rate quality of course content	4.6

as extremely successful by the respondents. This session provided a greater understanding of the project requirements and provided faculty with the opportunity to give direct feedback and additional support in guiding the research proposal. These strategies also served to motivate the students and overcome their personal fears for the projects. The use of online activities from corporate sponsored educational programs, exercises from the research textbook,¹⁶ and online videos for reviews of statistics and research methodology, proved useful in delivering content. Planning for future learning experiences should take into account access to the internet, faculty time for virtual conferences, effective use of virtual meeting platforms, and built-in structures for small group interactions or meet-ups. These concepts were previously assessed in a NYU study¹⁷ which helped guide the IRM course designers.

Textbook chapters¹⁶ were assigned for weekly readings and students were required to complete knowledge checks by the end of the week. Most of the respondents indicated that they were satisfied with the textbook and the knowledge checks, and it appears that these regularly scheduled activities had a positive effect on student learning, especially for a fully online course. Forum topics modeled the readings and were designed to apply the material prior to completing the knowledge check and most respondents were either extremely satisfied (75%) or somewhat satisfied (16.7%) with the concept of

discussions with others. Some students held back on posting discussion comments until many other students had posted and it appeared that there was some confusion regarding the assignment or the basis for the discussion. It was noted that students expressed pleasure when a faculty member responded to their posts or posted additional information for the class. For future planning, the faculty might present clearer instructions regarding the discussion topic and the required process for the activity.

The IRB proposal project was designed for students to apply their knowledge in defining a research problem, study purpose, design, methods, analysis, and ethical concerns to a research proposal. Students were required to frame a research question that was at a higher level than previous course work and required a more extensive search of the literature. The greatest challenge most students faced was clarifying a research question and determining the appropriate study design to test the hypothesis. Faculty was available to advise and redirect students in the online forum postings. This finding is similar to Partido and Cohen who identified the need for faculty support to help overcome barriers faced by student researchers.¹⁰ Faculty feedback throughout the IRM course helped to solidify student learning prior to the final project allowing for students to explore research methods as undergraduate students, while also establishing skills for future research as graduate students.

Motivation to pursue future research was included in the course evaluation and results indicated that the respondents had acquired enough information to consider conducting research in the future. While the respondents may not have perceived publishing future research, they were more inclined to consider making a presentation at a research conference. Additionally, the respondents overwhelmingly valued the need for research in clinical care, similar to the findings of Partido and Colón that conducting research contributes to patient care and a motivation for future research among students.¹⁰ The course goal to describe how evidence-based practice shapes the role of the health care professional was indicated positively in the findings.

Across all of the BS degree program selections, respondents seemed to indicate that they needed more courses in research and only a minority (8.3%) stated that they disliked the scientific complexity of research. Given the responses indicating that research is important in clinical careers, dental hygiene programs could consider adding additional course material to with this research focus or internships to apply the learned skills.

The university end-of-course evaluations are routinely used by the program curriculum committee as part of a bi-annual review. The low number of respondents restricts interpretation and application of the end-of-course results to this pilot study. Based on the 4.9 score, it may be inferred that the redesigned course was successful for the respondents. The DH department and IRM course faculty did not have access to previous end-of-course reviews from the previous course delivered by the nursing department for comparison. Overall, the course grades indicated that the students successfully navigated the course. The grade range of A to C aligned with other baccalaureate courses in the dental hygiene program.

As oral health care providers, all dental hygienists need fundamental research skills and the IRM course provided avenues to advance those skills. For most students this was their first formal research course.

Hopefully students will continue in a dental hygiene focused research path, apply the skills to evaluating the literature and thereby enhancing evidence-based decision making, and ultimately enriching our professional role in research. Current clinicians can consider these avenues for continuing education to enhance their research skills for the same goals of critical thinking and decision making.

Limitations

This study had limitations. The non-probability and small convenience sample size limits the generalizability of the findings. Social desirability bias may have influenced the survey responses. While the course had been completed and grades posted, students may have inflated their opinions towards the faculty and for the course. The survey also lacked a qualitative aspect. Participants may have been inclined to add comments or explanations if given the opportunity. Future cohorts should be evaluated and compared. Combined study results may yield further information for institutions planning research courses. Future studies should investigate whether students take additional methodology courses, conduct original research studies, and submit manuscripts for publication, indicating further success of the goals for the course.

Conclusion

Results from this pilot study showed that an innovative online research course for baccalaureate degree dental hygiene students was effective in developing advanced research skills. The active learning strategies provided practical knowledge and experiences that may inspire students to perform research that will expand the dental hygiene body of knowledge.

This course can serve as a model for developing higher level research skills and ultimately advance the profession.

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